# 3.0 Affected Environment and Environmental Consequences

This chapter describes the environment that would be affected by the implementation of the Proposed Action and the No Action alternatives analyzed in this EIS. The baseline information summarized in the Affected Environment sections was obtained from published and unpublished materials from private and government sources in the region. The affected environment for individual resources was delineated based on the area of potential direct and indirect environmental impacts that are likely to result from the potential future development of surface coal or lignite mine expansion areas or satellite mines and the implementation of USACE Fort Worth District's regulatory framework.

In general, the descriptions of the affected environment focus on the land within the study areas shown in **Figure 1-1**. For resources such as soils and vegetation, the affected area was determined to be the physical location and immediate vicinity of the study areas. For other resources such as water, air quality, and social and economic values, the description of the affected environment is more extensive (e.g., watersheds, regional geology, counties, etc.).

The specific aspects of each resource that are described in each section were selected because they have the potential to be affected by the Proposed Action or to affect the construction, operations, and reclamation of potential future mine expansion areas or satellite mines and the proposed regulatory framework.

The Environmental Consequences sections for each resource follow the description of the affected environment and present the analysis of potential impacts for each resource that would be affected by the implementation of the Proposed Action or the No Action alternatives.

Each resource section describes the analysis of projected impacts for each alternative in as much detail as possible. Resources were evaluated according to the available data, so some discussions are based on qualitative information and some on more detailed quantitative data that was acquired from a variety of sources. It is important to understand the terminology used in the impact analyses.

- Direct effects are caused by the action and occur at the same time and place. For example, this may include vegetation removal and soil mixing resulting from clearing and grubbing for mine site preparation and excavation during mining.

- Indirect effects are caused by the action and are later in time or farther removed in distance, but still reasonably foreseeable. Indirect effects may include effects related to induced changes in the pattern of land use, population density or growth rate, and related effects on air, water, and other natural systems.

Impact analysis assumes that the environmental protection measures listed in Section 2.2.5 would be successfully implemented by potential future surface coal or lignite mine expansion areas or satellite mines. It also is assumes that the mining companies responsible for future mine expansion areas or satellite mines would comply with applicable state and federal regulations. If impacts identified in the resource sections can be further reduced, the section identifies mitigation measures being considered by the USACE, where appropriate. Residual impacts are those that would remain after environmental protection measures, mitigation measures, and compliance with laws and regulations are completed.

Toward the end of each resource section is a discussion of cumulative impacts. In its “Regulations for Implementing NEPA” (40 CFR Parts 1500-1508), the CEQ defines a cumulative impact as follows in Section 1508.7:

> *“Cumulative impact” is the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.*

Cumulative impacts are the combination of the individual effects of multiple actions over time in the context of other development in a project or action area or the region. The individual effects may be minor when considered separately, but may be major or significant when considered in combination with all others in the region. A CEQ memorandum issued in 2005 (CEQ 2005) provides additional guidance on the consideration of past actions in cumulative effects analysis. This memorandum stresses the “forward-looking” nature of NEPA analysis. It states that the effects of past actions are only required to be analyzed if they are relevant and useful to determine whether a proposed project or action “may have a continuing, additive and significant relationship” to projected future impacts in the region.

Past and present actions within the cumulative effects study areas (CESAs) were identified in Section 2.4.1. In addition to past and present coal or lignite mining operations, past and present actions for this REIS include incorporated cities and towns, roads, oil and gas development, reservoirs, and energy generation facilities (e.g., power plants). RFFAs that would be developed within the REIS CESAs within the timeframe of the REIS also were identified. RFFAs include potential future surface coal or lignite mine or expansion areas or satellite mines, as well as other potential future actions (e.g., new reservoirs, energy-related development, highway construction, oil and gas development).

## 3.1 Geology, Mineral, and Paleontological Resources

### 3.1.1 Affected Environment

The regional discussion presented below for geology, mineral, and paleontological resources covers a broad area in order to describe the geologic setting; however, the focus is on the Texas Region of the Gulf Coal Province that begins at the U.S./Mexico border and stretches from the Rio Grande eastward to the Texas/Louisiana border (**Figure 3.1-1**) (RCT 2014c). The study area descriptions are based on the sub-regions defined by Kaiser et al. (1980): Northeast Texas, Sabine Uplift, East-Central Texas, and South Texas.

#### 3.1.1.1 Regional Summary

Physiography and Climate

The analysis area is located in the West Gulf Interior Coastal Plains section of the Coastal Plain physiographic province (**Figure 3.1-2**) (Fenneman 1928; Wermund 1996). The Interior Coastal Plains subdivision is characterized by parallel, northeast to southwest trending ridges (cuestas) and major river valleys that trend generally to the southeast. The parallel ridges correspond to more resistant geologic formations (sandstone and siltstone) that are interbedded with easily erodible material (clay and shale). In the northeast, hardwood and pine forests are the primary vegetation communities. To the southwest, the forests thin, and the pines largely disappear or are restricted to small areas (e.g., the Lost Pines of Bastrop). Farther to the southwest, grass and brush are dominant. Annual precipitation in the analysis ranges from 50 inches in northeast Texas to less than 24 inches in Maverick County, Texas (Texas Water Development Board [TWDB] 2011). Elevations in the Interior Coastal Plains range from 300 to 800 feet above mean sea level (amsl), with the overall topographic gradient from northwest to southeast towards the Gulf of Mexico (Wermund 1996).

Geology

*Stratigraphy*

The geologic units of interest for this analysis are the lignite-bearing formations of the lower Tertiary of the Texas Coastal Plain and the bituminous coals of the upper Cretaceous Olmos Formation (**Figure 3.1-3**). These units were deposited in the Gulf of Mexico Basin which began as a rift basin in late Triassic time during the breakup of the supercontinent of Pangea, 210 to 163 million years ago (Hudec et al. 2013). The initial clastic deposition in this area was superseded by deposition of the Louann Salt that underlies most of the Gulf Coast Basin. As the Gulf Coast Basin continued to rift and subside over time, tens of thousands of feet of clastic and carbonate sediments ranging in age from Triassic to Holocene (Recent) were deposited. These sediments were deposited on a basement composed of older sedimentary rock and oceanic crust. The major tectonic elements of the northwest Gulf of Mexico Basin are shown in **Figure 3.1-4**.

The Olmos Formation occupies the lowest position of the Navarro Group (**Figure 3.1-3**). It consists of sandstones, mudstones, carbonaceous shale, and coals that were deposited in deltaic environments in a sub-basin called the Maverick Basin (Hook et al. 2011a) (**Figure 3.1-4**). The sediment sources were located to the north or northwest and may have coincided with the Laramide uplift of the Rocky Mountains. The deposition of the Olmos Formation marks a change from largely carbonate to clastic sedimentation during late Cretaceous time (Condon and Dyman 2006).

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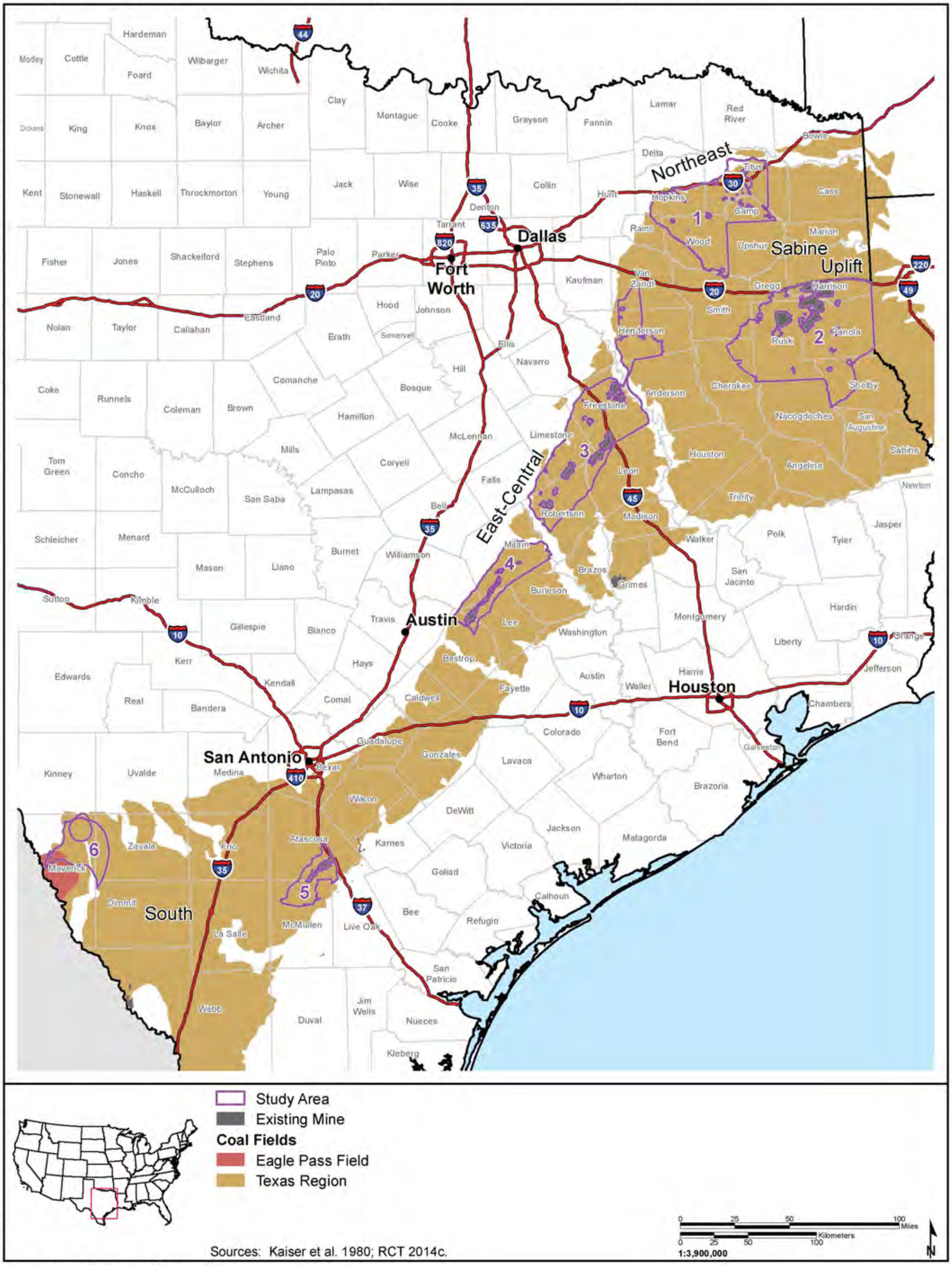


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Figure 3.1-1 Gulf Coal Province in Texas

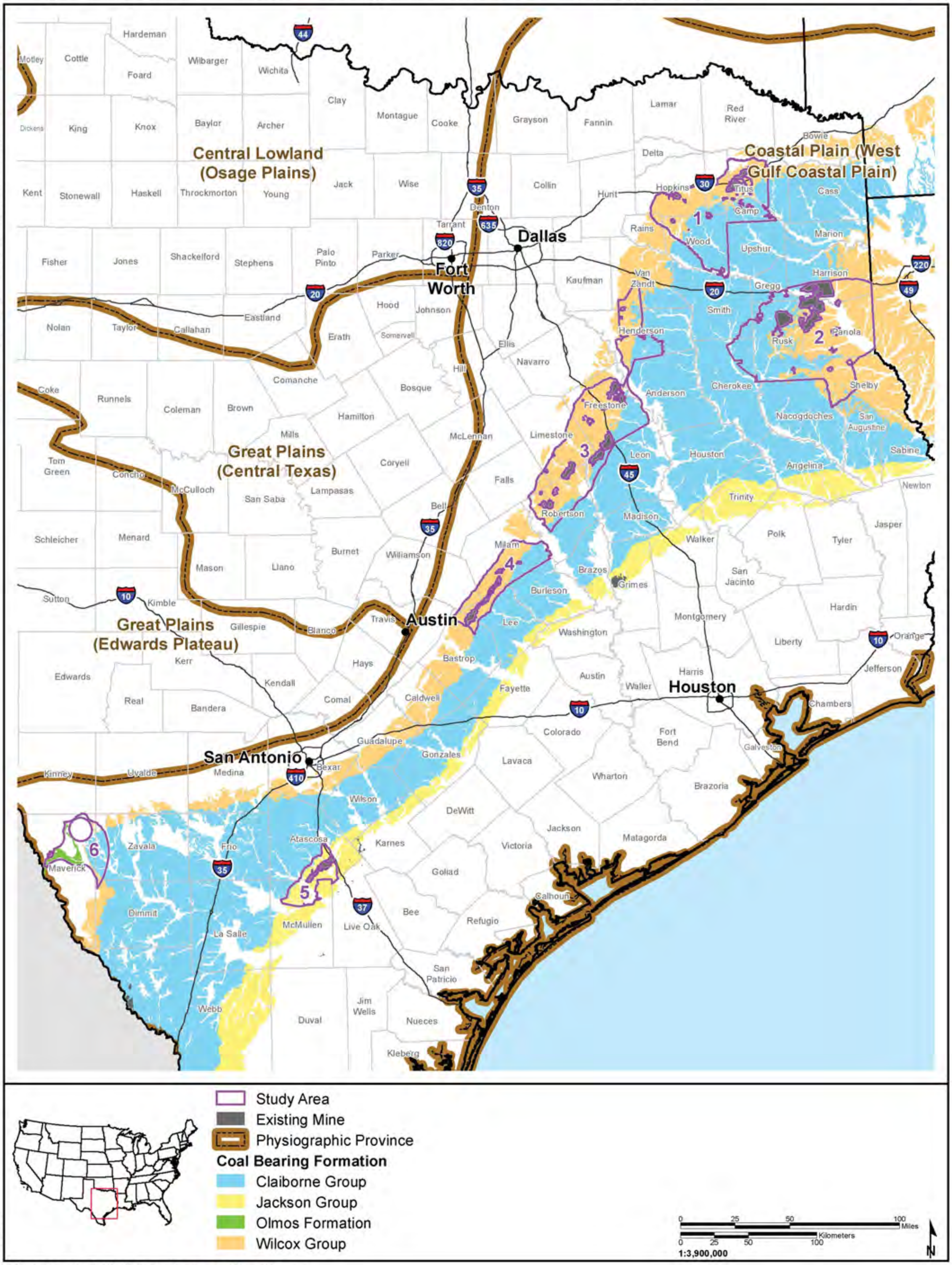


**Figure 3.1-2 Physiographic Areas**

<table>
<tr><th>Period</th><th>Epoch</th><th>Group</th><th>Formation</th></tr>
<tr><td rowspan="16">Lower Tertiary</td><td rowspan="13">Eocene</td><td rowspan="4">Jackson Group</td><td>Whitset</td></tr>
<tr><td>Manning</td></tr>
<tr><td>Wellborn</td></tr>
<tr><td>Caddell</td></tr>
<tr><td rowspan="8">Claiborne Group</td><td>Yegua</td></tr>
<tr><td>Cook Mountain</td></tr>
<tr><td>Sparta Sand</td></tr>
<tr><td>Yegua</td></tr>
<tr><td>Weches</td></tr>
<tr><td>Queen City</td></tr>
<tr><td>Reklaw</td></tr>
<tr><td>Carrizo Sand</td></tr>
<tr><td rowspan="3">Wilcox Group</td><td>Upper Wilcox</td></tr>
<tr><td rowspan="3">Paleocene</td><td>Middle Wilcox</td></tr>
<tr><td>Lower Wilcox</td></tr>
<tr><td colspan="2">Midway Group</td></tr>
<tr><td colspan="2" rowspan="2">Upper Cretaceous</td><td rowspan="2">Navarro Group</td><td>Escondido Formation</td></tr>
<tr><td>Olmos Formation</td></tr>
</table>

Sources: Hook et al. 2011a; Warwick 2011.

**Figure 3.1-3 General Stratigraphic Chart of the Gulf Coal Province**

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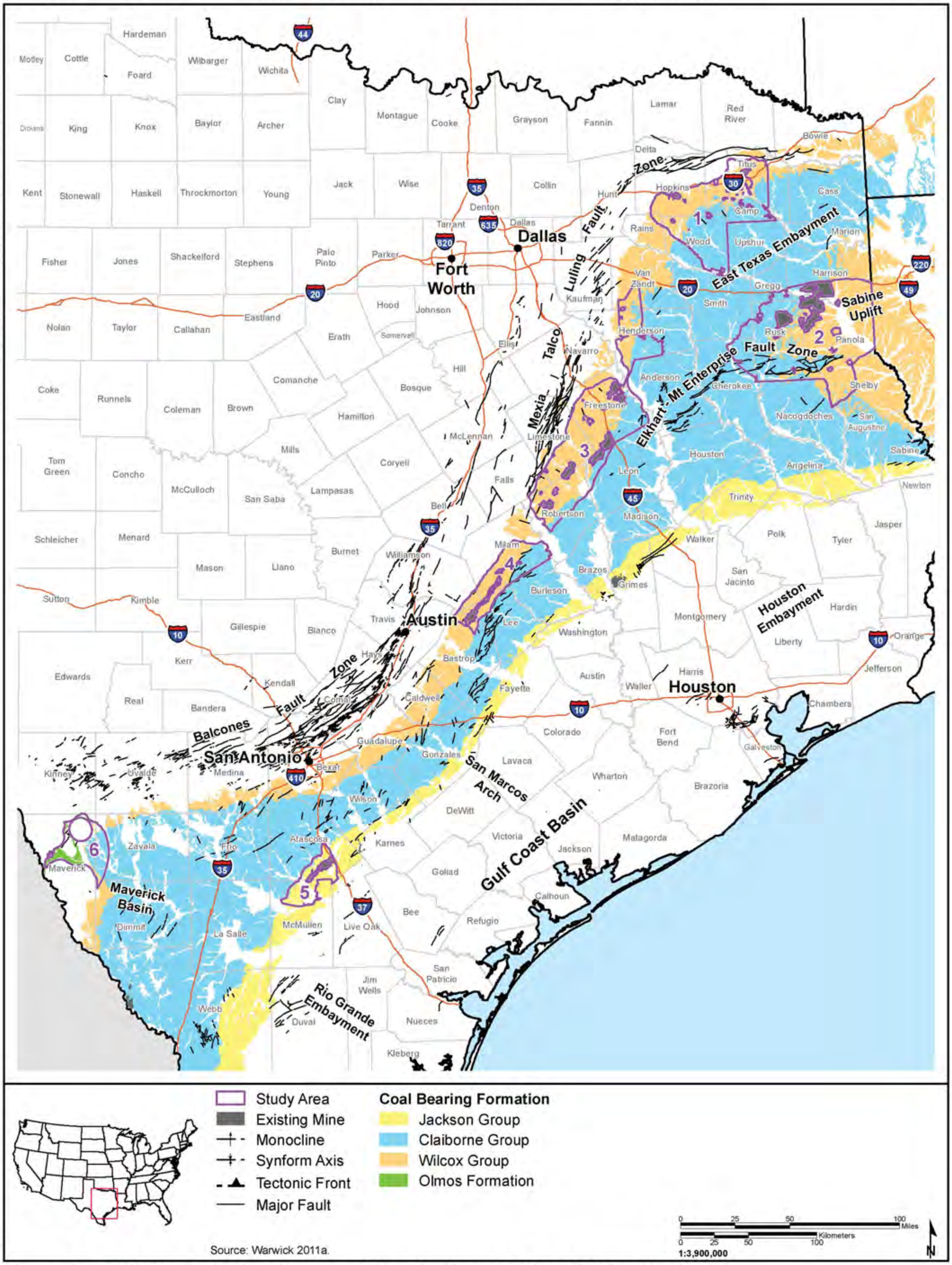


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**Figure 3.1-4 Major Tectonic Elements of the Northwest Gulf of Mexico Basin**

Clastic sedimentation continued into the Tertiary in response to continued uplift and sediment sources to the northwest in the Rocky Mountains. As a result, a wedge of sediments began to accrete (accumulate) in the Gulf Coast Basin, a process that has continued to the present. The important lignite-bearing sediments were deposited during lower Tertiary (Paleocene and Eocene) and consist of the Wilcox, Claiborne, and Jackson Group. These groups contain formations composed of fluvial, deltaic, and marginal marine deposits. Within these rocks are coals which have been mined for over a century (Ayers 1989; Warwick 2011). The lower Tertiary outcrop extends from the Rio Grande to northeast Texas; however, the section is highly variable as shown in **Figure 3.1-5**.

*Structure*

The major structural features in the region are shown on **Figure 3.1-4**. The Sabine Uplift is a large dome-like feature that covers approximately 5,000 square miles in northeast Texas and northwest Louisiana (Hosman 1996). Other features where the underlying basement has been deformed include the East Texas Embayment, Houston Embayment, Rio Grande Embayment, and the San Marcos Arch. The Mexia-Talco-Luling Fault Zone generally parallels the up-dip limit of the Tertiary deposits. This major fault zone is the surface manifestation of the buried Ouachita Fold Belt that represents the continental margin prior to the rifting that created the Gulf of Mexico Basin. Further east in the basin are growth faults that parallel the coastline and originate from a variety of causes. Down-to-the-basin movement in these faults has resulted in thickened sedimentary sections on the downthrown sides of the faults (Chowdhury and Turco 2006). Another important fault zone is the Enterprise Fault Zone that occurs on the south side of the East Texas Embayment.

*Geological Hazards*

Except where noted, the discussion of geological hazards is regional in scope, and due to the lack of these hazards in general within the region, geological hazards are not discussed below for the individual study areas.

<u>Seismicity</u>

There are numerous fault zones in the region. Although the eastern and southern areas of Texas currently are not seismically active (U.S. Geological Survey [USGS] 2014a), strong earthquakes historically have been felt in the area. In 1891, there was a strong earthquake in the vicinity of Rusk, Texas, in Study Area 2. Reports indicated that the intensity of the earthquake may have been equivalent to a 5.0 to 5.9 magnitude (USGS 2014a). This earthquake is thought to have originated from the Mount Enterprise Fault Zone (Davis et al. 1989). While there is some evidence of historical movement on the fault zone, which would indicate that it is active (Ferguson 1984), the USGS (2014a) currently does not classify it as active. The cause of the historical movement is uncertain; however, it may have been related to movement of the Louann Salt that comprises the basement of the East Texas Basin. No active faults were identified in the analysis area based on current information (USGS 2014a).

Seismic hazard mapping by the USGS indicates that a strong earthquake in the region is not likely to produce damaging ground motion. Ground motion in the event of a maximum credible earthquake in the region is expected to be less than 10 percent of the acceleration of gravity, with a 2 percent probability of exceedance in 50 years (Petersen et al. 2008).

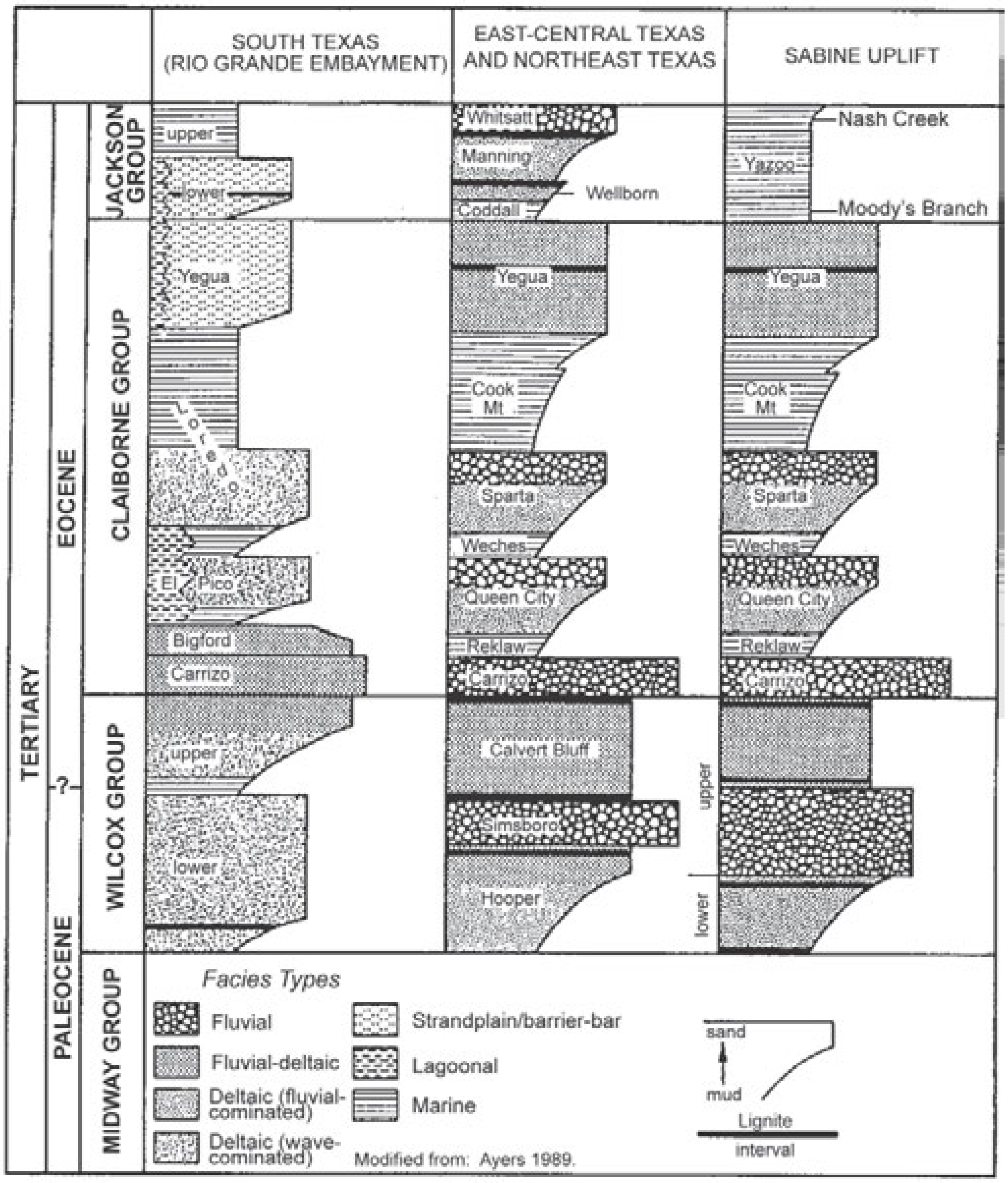


**Figure 3.1-5 Texas Coastal Plain Lower Tertiary Outcrop**

Landslides and Subsidence

There is a low susceptibility and low potential for landslides in the analysis area based on recent information (National Atlas 2014). Pseudokarst features have been identified in East Texas and occur primarily in the Claiborne Group sediments (Stafford et al. 2013). Pseudokarst occurs when karst features (e.g., sinkholes, caves, collapsed areas) occur as a result of processes other than the dissolution of water-soluble rocks. The pseudokarst features in east Texas occur as sinkholes and caves through the process of suffusion, or the erosion of material due to the flow of groundwater, and is associated with the Carrizo, Queen City, and Sparta sandstones.

Minerals

*Coal*

The coal resources in Texas have been grouped into four geographic subdivisions: Northeast Texas, Sabine Uplift, East-Central Texas, and South Texas (**Figure 3.1-1**). Coal resources in the region largely consist of lignite, a low heat-value coal found in lower Tertiary sediments of the Wilcox, Claiborne, and Jackson groups. The upper Cretaceous Olmos Formation contains bituminous coal that has a higher heating value than lignite. The near surface (20 to 200 feet) lignite resource in Texas was estimated to be approximately 23 billion tons by Kaiser et al. (1980). (Note: Short tons are used throughout this EIS; a short ton equals 2,000 pounds). A more recent USGS coal resource assessment estimated the resource to a depth of 500 feet to be approximately 96 billion tons (Warwick 2011). The bituminous coal resource in the Olmos Formation is estimated to be 525 million tons from seams ranging in thickness from 2 to 6 feet (Mapel 1967). Although more recent publically available resource information for Olmos Formation coals is not available, exploratory drilling for coal bed natural gas (CBNG) indicates that the coal resource could be much higher (Warwick 2011). The 2012 lignite production in Texas was 43.5 million tons (Energy Information Agency [EIA] 2014).

Accreting wedges of sediments created depositional environments conducive to the development of lignite deposits during the early Tertiary (**Figure 3.1-6**). The fluvial-deltaic environment at the outcrop and shallow areas resulted in thick sections of sand-dominated sediment that interfinger and eventually grade into fine-grained marine deposits in the deeper, down-dip direction (Berg 1980). The wedges of sediment accreted from west to east throughout the Tertiary, with the axes of deposition moving in the same direction. The surface mineable lignites are present in the shallow and outcrop areas dominated by fluvial-deltaic sediments. The lignite seams developed in two general depositional environments, resulting in delta plain lignites and coastal plain lignites. The lignites were derived from organic-rich material that accumulated in low-energy environments such as swamps, marshes, peat bogs, and lagoons between coarser-grained channel, distributary, and barrier bar sediments (Ayers 1989; Berg 1980). The early Tertiary lignites can be up to 25 feet thick, but are commonly less than 15 feet thick. Surface mining commonly involves the extraction of multiple thinner seams. Due to the complex of environments where organic matter was likely to accumulate, lignite seams may have continuity in a local setting, but are not laterally extensive over large areas or distances. For instance, while coal occurs in similar settings and stratigraphic levels in the Wilcox Group, the lignite seams in northeast Texas do not correlate with the lignite seams in East-Central Texas (**Figure 3.1-5**). Even in a local setting within a mine area, seams can be cut out by a sandstone channel or a single seam can split into several smaller seams that either pinch-out or merge together again.

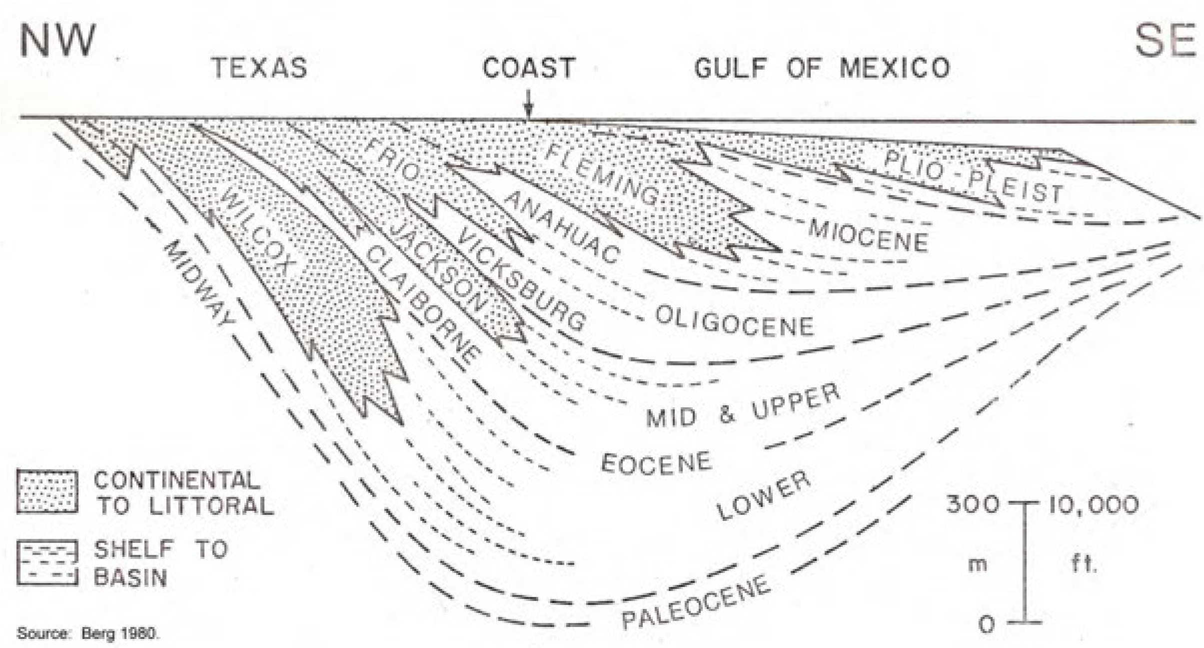


**Figure 3.1-6 Sedimentary Deposits during the Tertiary**

During the late Cretaceous, the sediments of the Olmos Formation were deposited in fluvial-deltaic environments similar to the lower Tertiary deposits. Coals were derived from organic-rich sediments in low-energy environments between channels and distributaries. The higher rank and heating value of the Olmos Formation coal may be due to latent heat due to late Cretaceous intrusive activity in adjacent areas in Mexico and in northern Maverick County, Texas (Hook et al. 2011d).

Pyrite is known to be associated with lignite sediments because the conditions that were favorable to the formation of lignite or coal were also favorable to the formation of pyrite (Horbaczewski 2007). Pyrite is composed of iron and sulfur and occurs in sedimentary rocks when sulfate is reduced to sulfide. The sulfate is derived from seawater in the environments in which the sediments were deposited. Because the coal-bearing strata in each of the study areas were deposited in similar environments associated with marginal marine conditions and conditions favorable to the reduction of sulfate into sulfide, it is expected that the Wilcox Group, Jackson-Yegua, and the Olmos Formation have pyrite mineralization.

*Coal Bed Natural Gas*

CBNG occurs as a result of microbial activity in organic material and the gas becomes adsorbed on to the surface of the coal. The adsorption occurs as a result of molecular attraction between the coal and the gas (McCune 2002). The gas can be released and produced from the coal by pumping water out of the coal and lowering the hydrostatic pressure. The USGS estimated that the undiscovered CBNG resource in the Wilcox Group in Texas, Louisiana, Arkansas, Mississippi, and Alabama is 3,861 billion cubic feet. (Warwick et al. 2007). The undiscovered CBNG resource in the Olmos Formation in the Maverick Basin of Texas (Study Area 6) was estimated to be 75 billion cubic feet.

*Oil and Natural Gas*

The discussion of oil and natural gas covers conventional and unconventional hydrocarbon resources (exclusive of CBNG) that include shale gas and shale oil. Oil and natural gas are the most abundant mineral resources in the analysis area. Some of the most prolific oil and gas fields in Texas lie within or adjacent to the study areas, especially Study Areas 1 and 2. The counties that intersect the boundaries of the study areas had a total cumulative production of over 9.0 billion barrels of oil as of January 1, 2013, with the earliest production having occurred in 1915 (Texas Almanac 2014). Well over half of the production came from Gregg and Rusk counties that are located above the East Texas Oil Field, the largest oil field in the U.S. until the discovery of oil in Prudhoe Bay, Alaska, in the 1960s. Fifteen of the nation's top 100 gas fields are also located near or within the study areas (EIA 2014). The region overlaps with two of the nation's emerging unconventional oil and gas resource shale trends, including the Eagle Ford Formation play that extends from the Rio Grande to Brazos County and the Haynesville-Bossier shale play that is centered around the Sabine Uplift in northeast Texas and northwest Louisiana (RCT 2014e, 2013) (**Figure 3.1-7**). These hydrocarbon plays are overlapped by previously developed productive trends. In addition to oil and gas wells, hydrocarbon production involves networks of pipelines. **Figures 3.1-8** through **3.8-10** show the larger oil and gas transmission pipelines in the study areas; smaller gathering pipeline systems in the oil and gas fields can be extensive.

The lower Tertiary also has been a prolific oil and gas producing interval and has high potential for continued production in down-dip areas (Warwick 2009). Shallow Wilcox (so-called up-dip) oil and gas production was discovered in the 1950s and 1960s at several small fields in south and central Texas and include Milbur in Milam and Burleson counties and other fields in Wilson and Gonzalez counties (Chuber 1972).

*Other Mineral Resources*

Other mineral resources that occur in the region include aggregate, sand, clay, and salt. Sand and aggregate are mined from alluvial and terrace deposits. Wilcox Group formations host brick clay, bentonite, and kaolinite (Nicot et al. 2011). The salt deposits originated from deep layers of Louann Salt, occur as salt intrusions into the sedimentary section, and are referred to as salt domes (Hamlin 2006). The domes are thought to have resulted from the density contrast between the salt and overlying sediments which caused the salt to move vertically. Not only are domes the sources of salt, but they are used for storage of hydrocarbons and are associated with the natural occurrence of oil and natural gas. Uranium is another important mineral in the southern portion of the Texas coal region and is discussed in more detail below under the Study Area 5 subsection.

<u>Paleontological Resources</u>

The geologic units in the Texas coal region which are discussed above under the Geology subheading have the potential to contain fossils to varying degrees. There is no regulatory fossil evaluation system for assessing fossil potential in Texas. On federal lands, the Potential Fossil Yield Classification (PFYC) system (Bureau of Land Management 2007) is used to evaluate geological units for fossil potential. In the PFYC system, "geologic units are classified based on the relative abundance of vertebrate fossils or scientifically significant invertebrate or plant fossils." Although there is no federally managed land in the analysis area, the rock units could be assigned a moderate potential or Class 3 rating under the PFYC system. According to the PFYC system definition, "units with moderate potential are known to contain vertebrate fossils or scientifically significant nonvertebrate [sic] fossils, but these occurrences are widely scattered. Common invertebrate or plant fossils may be found in the area, and opportunities may exist for hobby collecting. The potential for a project to be sited on or impact a significant fossil locality is low, but is somewhat higher for common fossils."

### 3.1.1.2 Study Area Descriptions

The coal resources in Texas have been grouped into four geographic subdivisions: Northeast Texas, Sabine Uplift, East-Central Texas, and South Texas. The following study area descriptions are presented based on these subdivisions.

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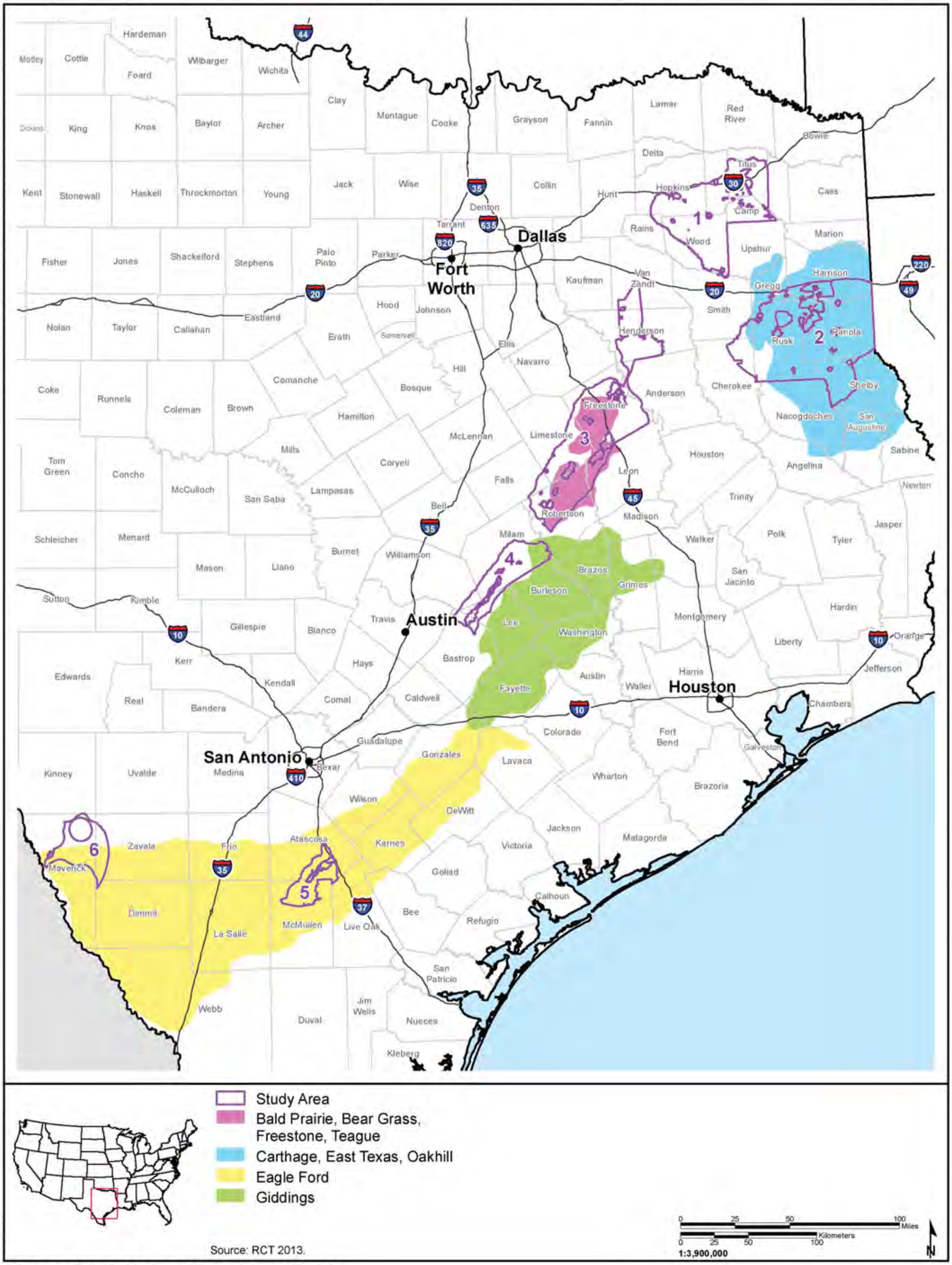


Source: RCT 2013.

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**Figure 3.1-7 Major Oil and Gas Fields**

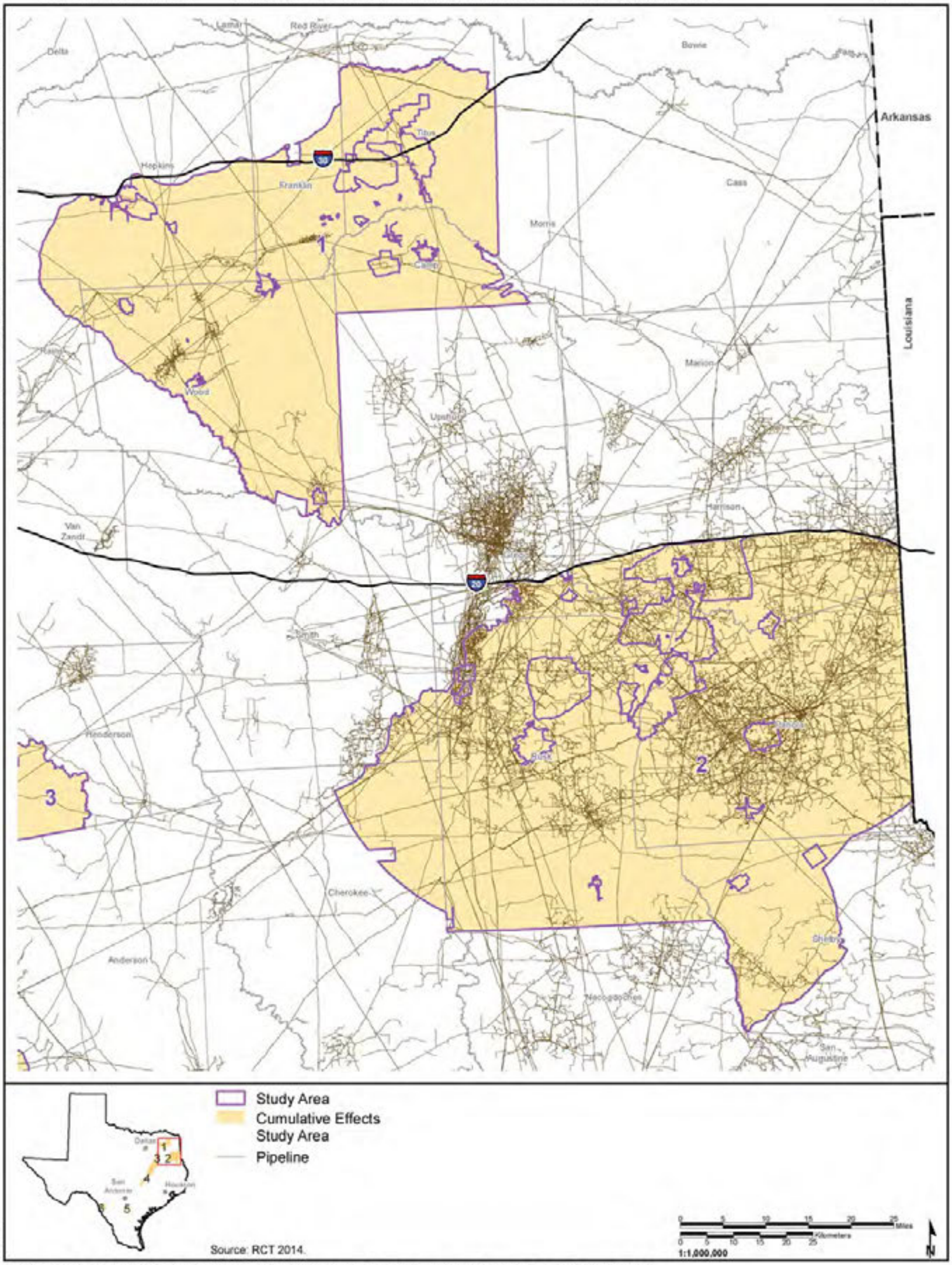


Figure 3.1-8 Oil and Gas Transmission Pipelines in Study Areas 1 and 2

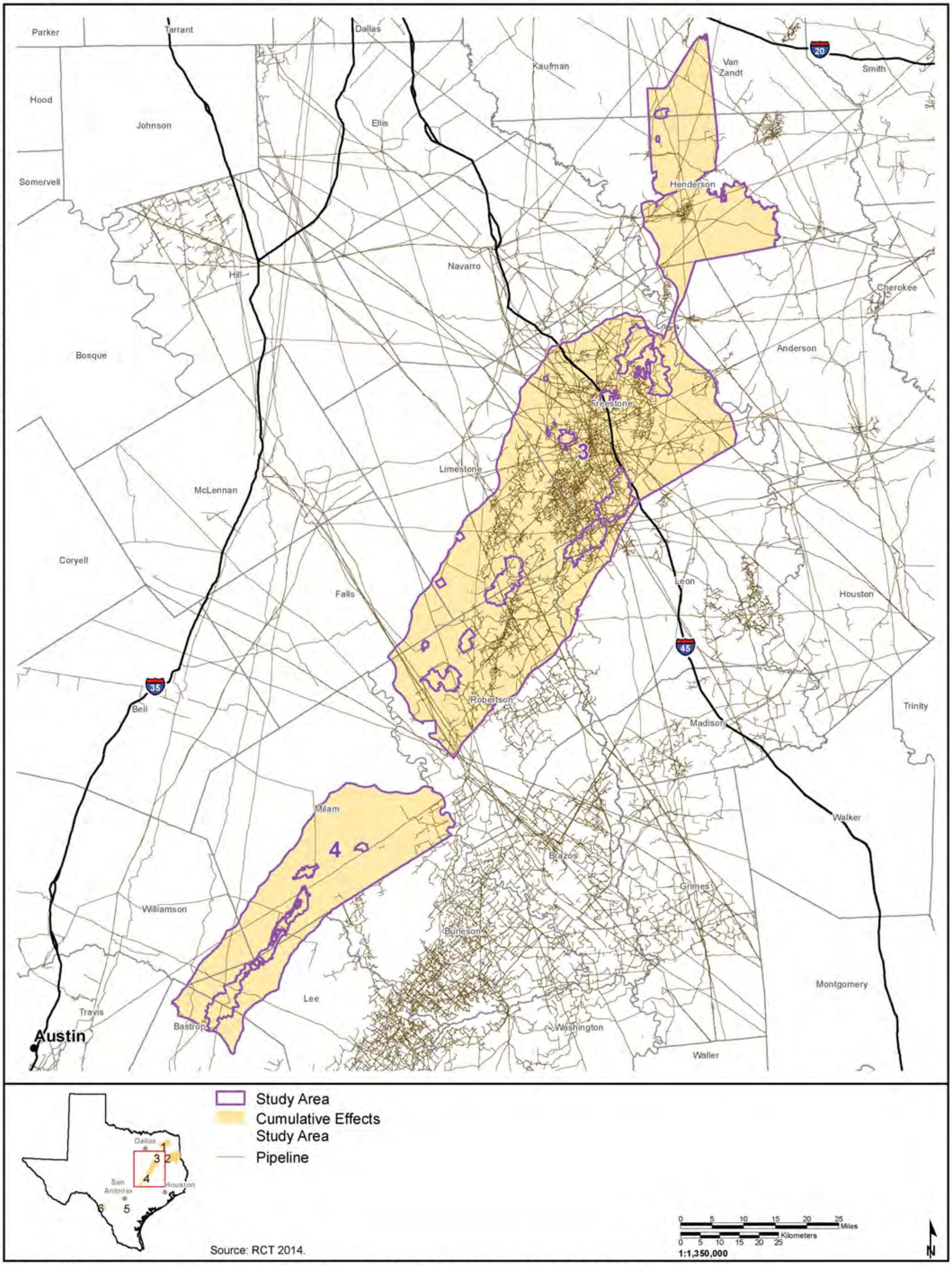


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**Figure 3.1-9 Oil and Gas Transmission Pipelines in Study Areas 3 and 4**

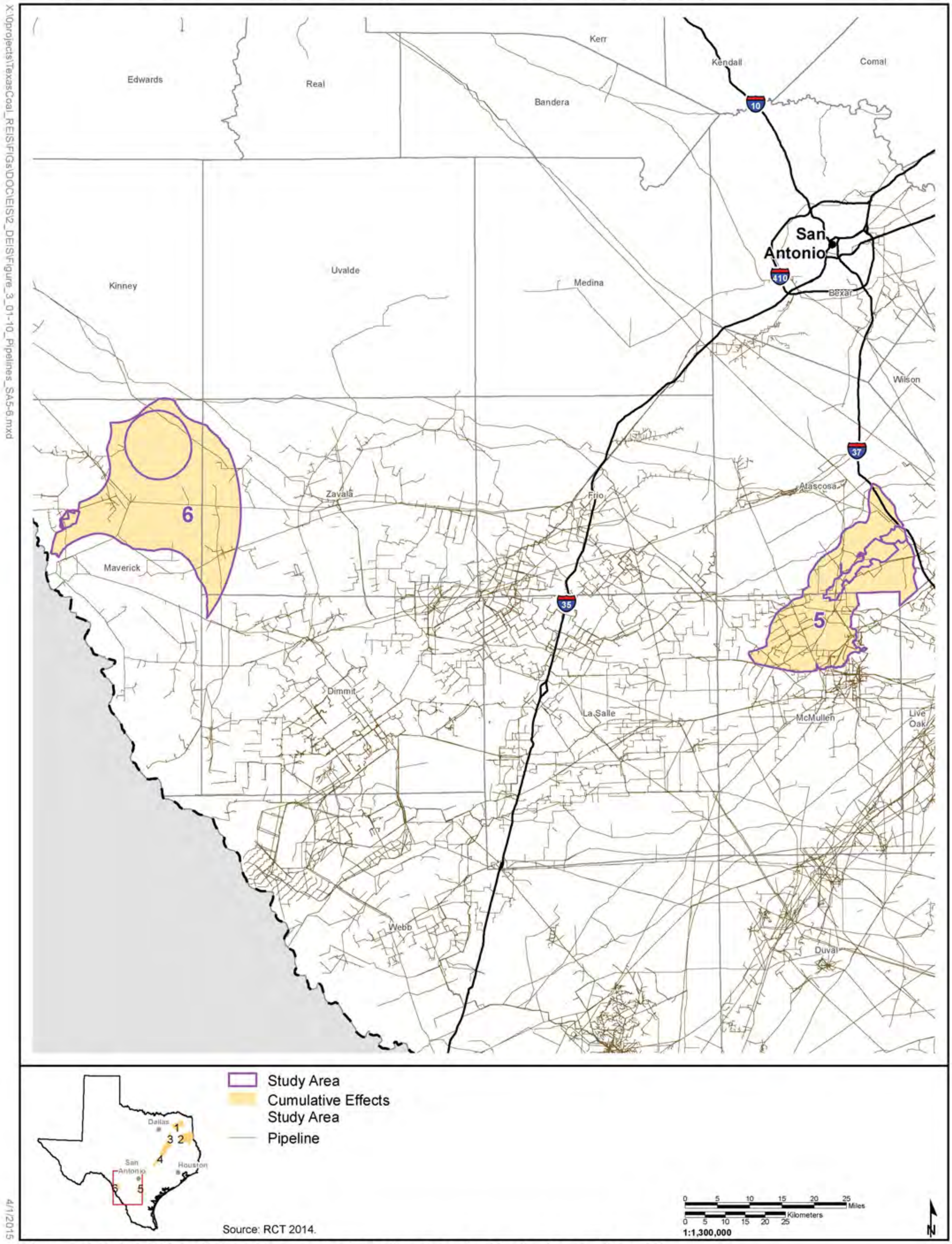


**Figure 3.1-10 Oil and Gas Transmission Pipelines in Study Areas 5 and 6**

## Northeast Texas Coal Zone—Study Area 1

### *Geology*

The bedrock geology of Study Area 1 is shown in **Figure 3.1-11**. In northeast Texas, the Wilcox Group is approximately 500 feet thick and consists of the Hooper, Simsboro, and Calvert Bluff formations, which are composed of fine- to medium-grained sand, silt, clay, and lignite (Broom et al. 1965) (**Figure 3.1-5**). The Carrizo Sand is the lowermost formation of the Claiborne Group. It is found in close stratigraphic association with the upper Wilcox sediments and is an important aquifer in Texas (see Section 3.2, Groundwater Resources). The Carrizo Sand is approximately 80 feet thick and composed of fine- to coarse-grained sand, silt, clay, and lignite (Broom et al. 1965). The major depositional environment for the Wilcox Group/Carrizo Sand was a fluvial dominated system with sediment sources to the north in present-day Arkansas and Oklahoma (Hook et al. 2011c). The fluvial sediments are underlain by the Midway Group, a marine deposit largely composed of clay that also contains beds of limestone and siltstone (Sandeen 1987). The geologic units dip to the south and southeast into the East Texas Basin at an angle of 2 degrees; depositional patterns appear to have been influenced by the movement of salt in response to sediment loading. The Mexia-Talco-Luling Fault Zone trends west to east paralleling the northern boundary of Study Area 1. The fault zone consists of a series of normal faults and grabens parallel to the strike (Jackson 1982).

### *Minerals*

#### Coal

Coal was mined in northeast Texas in the early 20th Century, primarily by underground mining methods in Wood and Hopkins counties. In Hopkins County, modern surface mining operations began in 1974 in the Winfield-Mt. Pleasant area to supply a mine-mouth power plant, with a second surface mine and associated mine-mouth power plant initiating operations in 1990 (Hook et al. 2011c). Production from these two mining areas in Study Area 1 was approximately 2.3 million tons in 2012 (EIA 2014).

The USGS (Hook et al. 2011c) assessed the coal resource in an area that roughly coincides with Study Area 1, delineating six coal zones. Due to the discontinuous nature of the coal seams, the zones have a large lateral extent and are easily correlated over distances. Individual coal seams average almost 4 feet thick, with a maximum of 14 feet. The assessment indicated that there was a coal resource of 16 billion tons.

#### Oil and Natural Gas

The Northeast Texas coal area lies on the northern flank of the East Texas Basin. Oil and gas production in the vicinity of Study Area 1 began in the 1940s with production from Lower Cretaceous sandstones reservoirs in anticlinal or fault traps (Herald 1951). No important oil and gas activity has occurred since then, and currently, the study area is not within an area of potential for unconventional shale development (EIA 2014; Kim and Ruppel 2005).

#### Other Minerals

There are no sand and gravel or crushed stone quarries in Study Area 1 (Nicot et al. 2011). Clay resources may be present in the Simsboro Formation in north Texas; however, there are no major clay mines in Study Area 1. There is no salt production in the area.

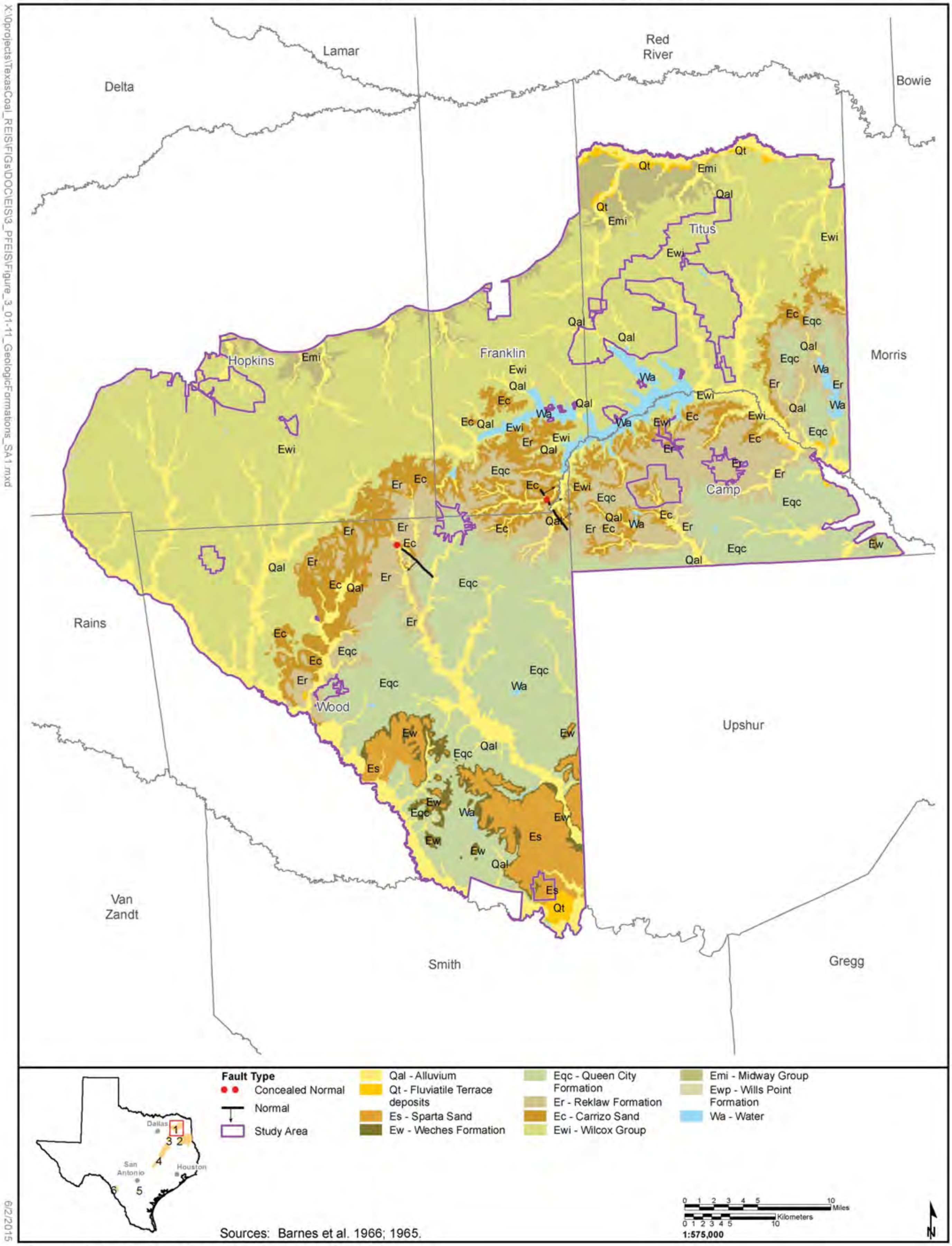


Figure 3.1-11 Surface Geology of Study Area 1

*Paleontological Resources*

Fossils are present in the Wilcox Group and Carrizo Sand, but occurrences are sporadic and mainly consist of invertebrates and plants (Berry 1923; Dumble 1924; Murray and Thomas 1945). Macrofossils are not often found because the geologic units were deposited in environments that that were not conducive to fossil preservation. This is especially true for animals with calcium carbonate shells (Dickey 2011). Microfossils (fossils that can be seen with the use of a microscope) are present and provide tools for correlation within the Wilcox Group-Carrizo Formation. The microfossils are mostly palynomorphs, fossilized pollen and spores. Other important microfossils are foraminifera that were used extensively for correlation in the down-dip areas during the exploration for oil and gas.

<u>Sabine Uplift Coal Zone—Study Area 2</u>

*Geology*

The Sabine Uplift, a near-domal structure that is centered in DeSoto Parish in northwest Louisiana, dominates the geology in Study Area 2. Movement on the uplift occurred from before Cretaceous time through the lower Tertiary (Granata 1963; Moody 1931). The sedimentary rocks are draped over the uplift and dip to the north, west, and south in Texas and to the east in Louisiana. The Mount Enterprise Fault Zone, a series of west to east trending faults, cuts across the south side of Study Area 2 (**Figure 3.1-12**). The fault zone is enigmatic because of the dip to the north and its uncertain origin. The fault may be considered active, but the evidence is not conclusive. The stratigraphy of the lower Tertiary Sabine Uplift is shown on **Figure 3.1-5**. In contrast to the Northeast Texas coal area, there are no formation designations for the Wilcox Group in the Sabine Uplift because the unit that is in a stratigraphically similar position to the Simsboro of East-Central Texas is not mappable (Hook et al. 2011c). The Wilcox Group ranges in thickness from 400 feet thick in the outcrop to 2,000 feet in the subsurface.

*Minerals*

<u>Coal</u>

In the Sabine Uplift, lignite is mined from the lower and upper Wilcox (Hook et al. 2011e). It represents some of the highest quality lignite in Texas because the seams approach bituminous coal rank and have the lowest ash and sulfur content in comparison to other areas in the Texas Coal Region. Limited underground mining occurred in the Study Area 2 from the 1890s to the 1940s. Underground mining at the Darco Mine began in the 1910s; surface mining began in the 1940s. The Darco Mine was permitted by RCT in 1978 and the permit was terminated in 2014. The Martin Lake Mine began surface mining operations in 1977 to supply lignite to a mine-mouth power plant in western Panola County. The Oak Hill Mine in Rusk County opened in 1986, extracting lignite from the upper Wilcox. Mining at South Hallsville began in 1984 to provide fuel for a power plant, with operations expanding into the Rusk Permit Area in 2010. Four active mines in the Texas side of the Sabine Uplift produced 14 million tons in 2012 (EIA 2014).

On the Texas side of the Sabine Uplift, lignite is mined from the upper Wilcox from coal zones and from three lesser coal zones (Hook et al. 2011e). The coal beds range from 5 to 12 feet in thickness and are fairly continuous except for the stratigraphically higher coals, which have been eroded out in places and replaced with Carrizo Sand channels. The coal resource in Study Area 2 was estimated by Warwick (2011) to be 72 billion tons.

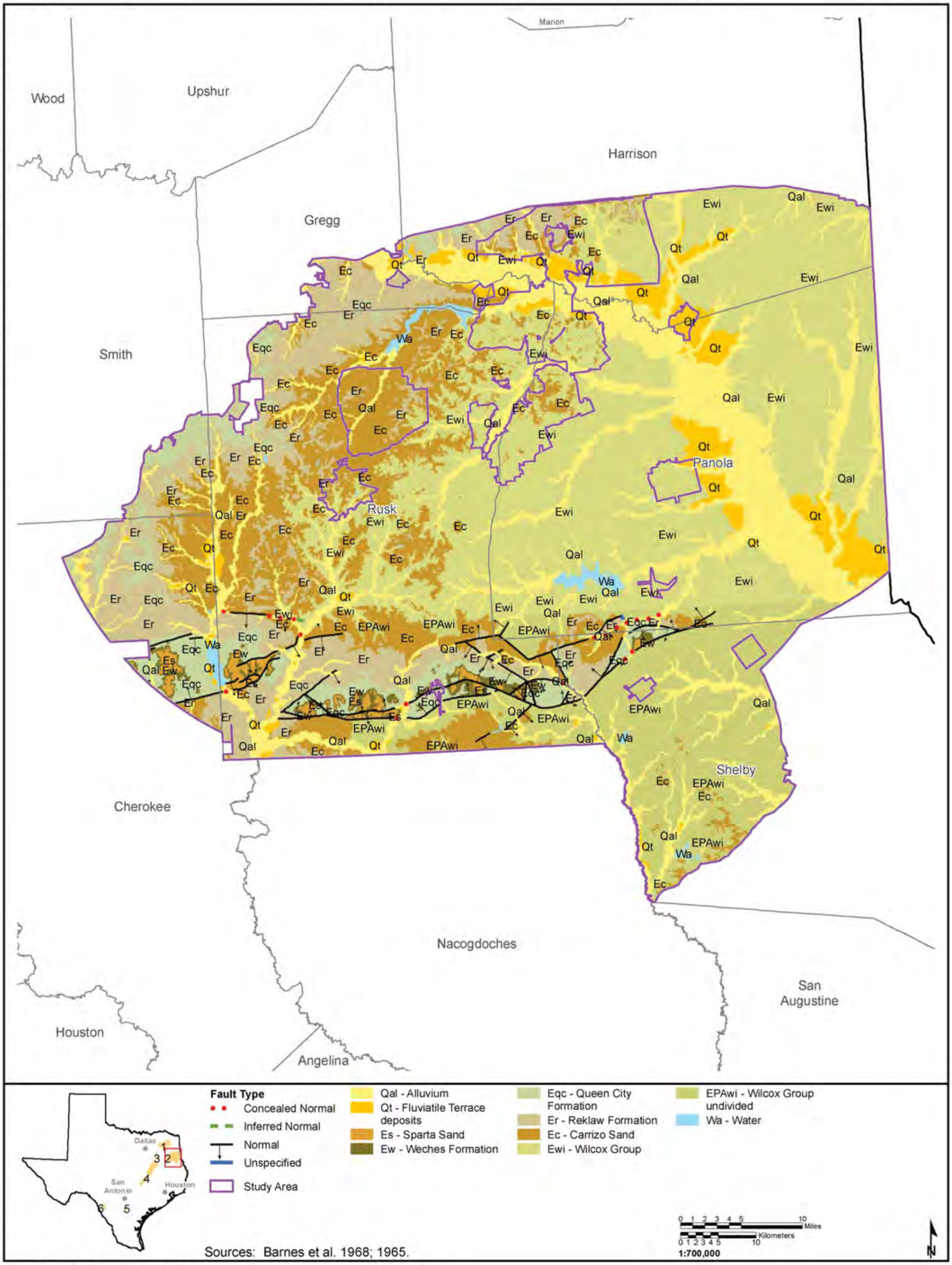


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**Figure 3.1-12 Surface Geology of Study Area 2**

Oil and Natural Gas

Study Area 2 is located in an area that has prolific hydrocarbon production and continues to be an important gas producing area; production is expected to continue into the future. The largest oil field in Study Area 2 is the East Texas Field which was discovered in western Rusk County in 1930 (Sandeen 1987) (see **Figure 3.1-7**). The East Texas Field produced approximately 5 billion barrels of oil, but now is nearly depleted. The Oak Hill and Carthage gas fields are also in the study area. The Oak Hill Field was discovered in 1958, and it is the thirty-fifth largest gas field in terms of reserves in the U.S. based on 2009 data (EIA 2014). Eastern portions of the study area overlie portions of the Carthage gas field that was discovered in 1936. Based on 2009 data, the Carthage field ranked as the twelfth largest in reserves in the U.S. Both fields have produced from multiple pay zones; however, the primary producing zones are Jurassic-aged Cotton Valley sandstones (Drake and Pendleton 1984; Farnham 1984). Below the Cotton Valley sandstones, there is an emerging shale gas play, the Haynesville-Bossier. Study Area 2 lies entirely within the prospective area for the Haynesville-Bossier (EIA 2014). Although drilling activity has slacked off from the peak in 2010, the Haynesville-Bossier remains an important shale gas play (Haynesville Shale 2014).

Other Minerals

One sand and gravel quarry was identified in Study Area 2 (National Atlas 2014). No other important mineral resources were identified (Kyle 2008; Nicot et al. 2011).

*Paleontological Resources*

The fossil resources in Study Area 2 are similar to those described above for Study Area 1.

East-Central Texas Coal Zone – Study Areas 3 and 4

*Geology*

The general stratigraphy of the Paleocene and Eocene coal-bearing deposits in the East-Central Texas coal zone is similar to those described above for Northeast Texas coal zone; it consists of the Wilcox Group (Hooper, Simsboro, and Calvert Bluff formations) and the Carrizo Sand of the lower Claiborne Group (**Figure 3.1-5**). The Wilcox Group in central Texas varies from 1,000 feet thick in the northeast to nearly 4,000 feet thick in the southwest (Hook et al. 2011d). Thicknesses of these units can be highly variable due to the movement of salt during deposition and the influence of the Mexia-Talco-Luling Fault Zone. The deposits are fluvial-deltaic and were deposited during early the Tertiary when sediment was transported from sources to the west and north. North of the Brazos River, the Mexia-Talco-Luling Fault Zone mainly cuts across the Midway Group outcrop that lies to the west of the Wilcox Group outcrop in Study Area 3 (**Figure 3.1-13**). South of the Brazos River, the fault zone crosses the Wilcox Group and cuts across the Claiborne Group deposits to the southeast of the Wilcox Group (**Figure 3.1-14**). The location of the fault zone may have implications for groundwater drawdown in the Wilcox-Carrizo aquifer in Study Area 4 (see Section 3.2).

*Minerals*

Coal

Underground lignite mining began in the area in the 1880s, and mines located in Milam, Leon, Bastrop, and Henderson counties were important during the early years (Hook et al. 2011b). Limited surface mining began in 1918, and the opening of the Sandow Mine in 1950 by Alcoa brought large-scale surface mining to the area. Currently there are nine permitted mines in the east central Texas, six of which had production in 2012. Five of the mines produced 24.5 million tons in 2012 (EIA 2014).

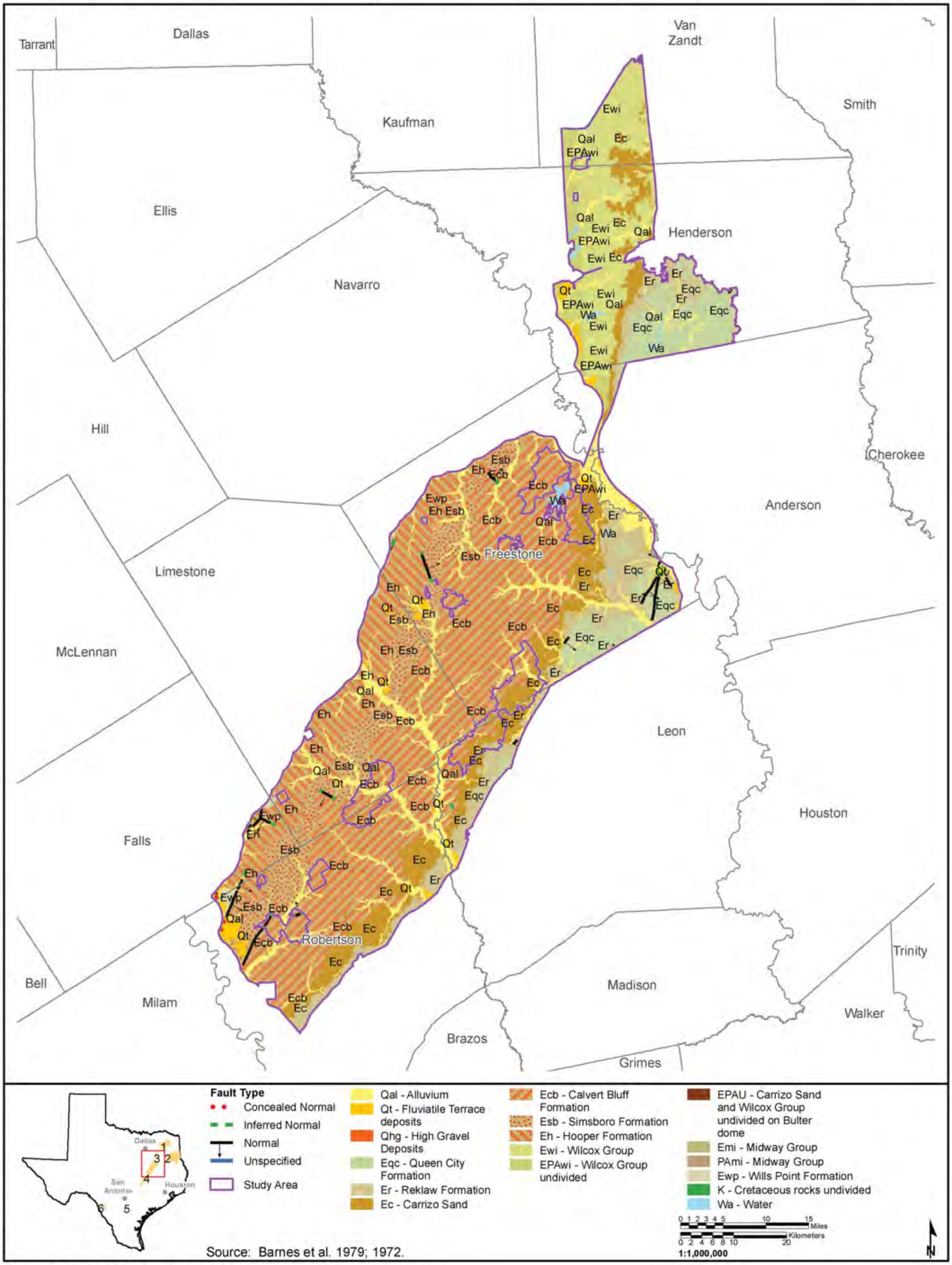


**Figure 3.1-13 Surface Geology of Study Area 3**

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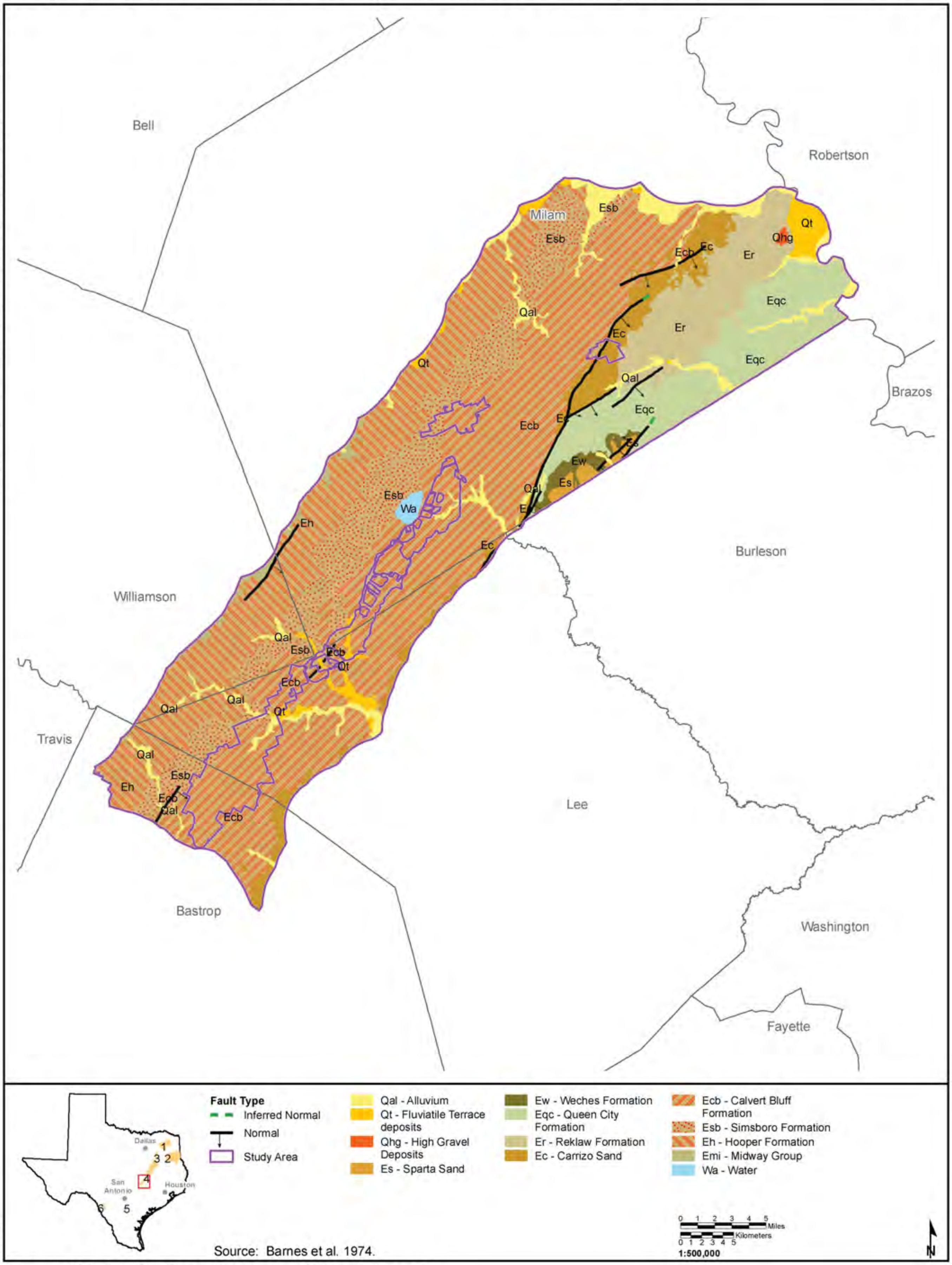


Source: Barnes et al. 1974.

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**Figure 3.1-14 Surface Geology of Study Area 4**

The East-Central Texas coal zone contains abundant and continuous coal zones (Hook et al. 2011b). There are at least 9 mineable coal zones averaging 6 feet thick, with the maximum being 33 feet thick. Coal zones are concentrated in the upper and lower Calvert Bluff Formation with lesser amounts of coal in the top of the Hooper Formation. The coal resource in the East-Central Texas coal zone was estimated to be 7.7 billion tons.

Oil and Natural Gas

West of Study Areas 3 and 4, oil and gas production began at fields along the Mexia-Talco fault zone. Of note are the Corsicana field that was discovered in 1894 and Mexia field discovered in 1920 (Herald 1951). Large gas reserves have been discovered in Freestone and Limestone counties from the upper Jurassic Cotton Valley limestones and more recently in the Haynesville-Bossier Shale (Montgomery 1996; RCT 2013). The major gas fields include: Teague, Freestone, Bear Grass, and Bald Prairie. These gas fields generally coincide with Study Area 3 (**Figure 3.1-7**). The other major oil and gas field that is relevant to this analysis is the Giddings Austin Chalk Field that is adjacent to and overlaps with portions of the southeastern part of Study Area 4.

Other Minerals

Clay, sand, and gravel resources are present in the analysis area; however, there are few quarries (National Atlas 2014; Nicot et al. 2011).

*Paleontological Resources*

The fossil resources in the East-Central Texas coal zone are similar to those described above for the Northeast Texas coal zone, with the following exception. Although macrofossils are rare, oyster beds have been found in the Wilcox Group sediments in Bastrop County, Texas (Beckman and Turner 1943).

South Texas Coal Zone – Study Area 5

*Geology*

The geologic units of interest for this analysis are the formations in the Jackson Group. These are late Eocene sediments that were deposited in depositional environments interpreted to be shoreline and marginal marine that were derived from fluvial-deltaic, barrier bar, lagoon, and coastal muds (Ayers 1989). The sands are generally fine grained and occasionally tuffaceous. The units in the Jackson Group in ascending stratigraphic order are: Caddell Formation, Wellborn Sandstone, Manning Clay, and Whitsett Formation (Hook et al. 2011a). The basal Caddell Formation which rests on the Yegua Formation of the Claiborne Group is a marine deposit composed of mudstone with minor sandstone. The Wellborn Sandstone is composed of persistent sandstones, while the Manning and Whittsett formations primarily are composed of shale with minor amounts of sandstone and lignite (Snedden and Kersey 1981). The Jackson Group in Study Area 5 ranges from 200 to 400 feet thick. The outcrops of the Jackson Group trend southwest to northeast and normal faults are present in the Yegua Formation along the strike (**Figure 3.1-15**).

*Minerals*

Coal

Jackson Group lignites were mined on a small scale from underground mines in the first half of the 20$^{th}$ Century in Fayette, Burleson, Grimes, and Trinity counties (Hook et al. 2011a). Surface mining of Jackson Group lignites began at the San Miguel mine in 1980 with operations in Atascosa and McMullen counties. In 2012 the mine produced approximately 3.3 million tons (EIA 2014).

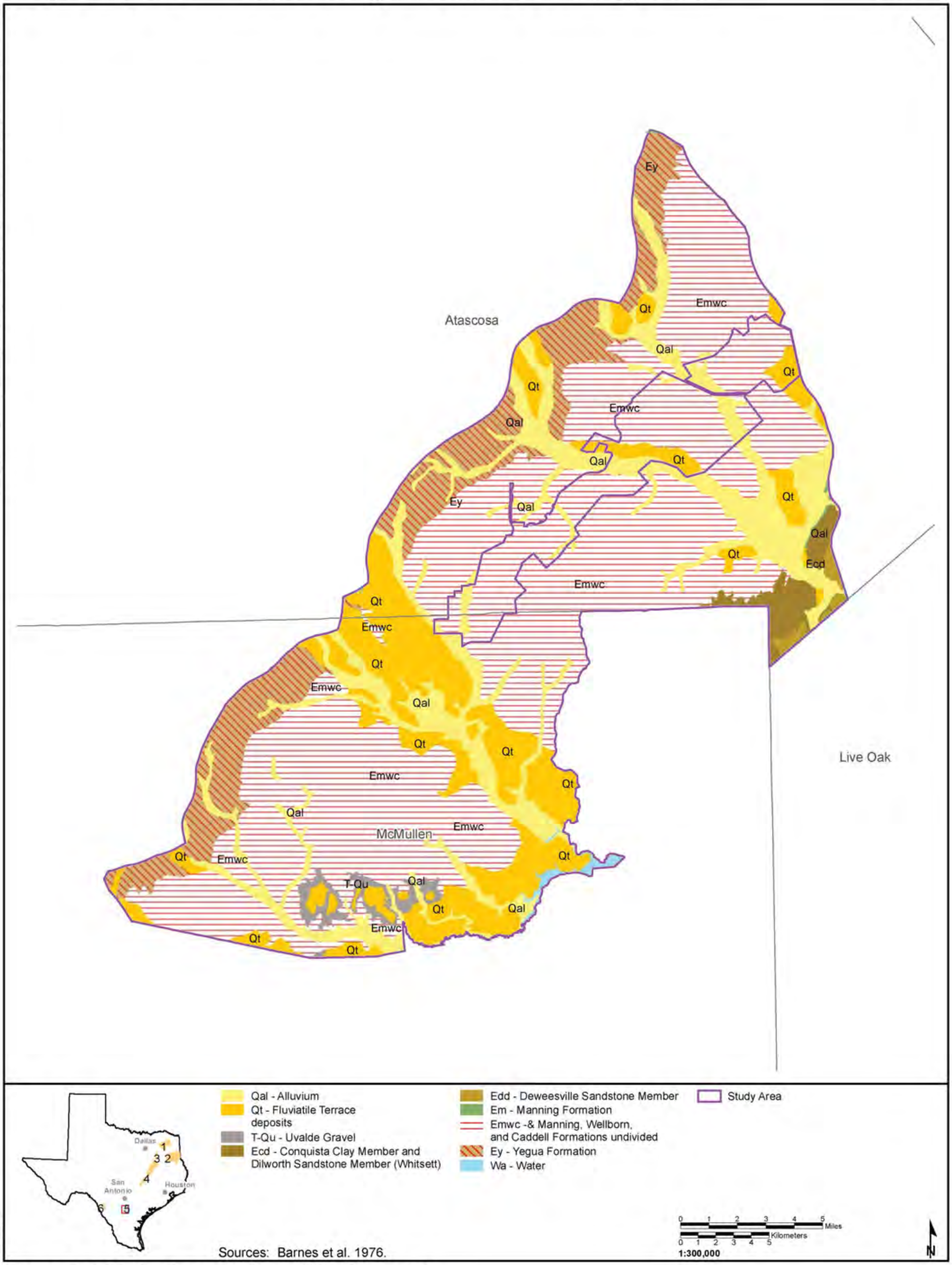



**Figure 3.1-15 Surface Geology of Study Area 5**

Mineable lignites are found in the Manning and Wellborn formations of the Jackson Group. Coal zones average approximately 7 feet thick (Hook et al. 2011a). At the San Miguel Mine, lignite is mined from a zone that that contains four coal seams (Warwick et al. 1999). Jackson Group coals have an estimated reserve in south Texas of 1,990 million tons.

Oil and Natural Gas

Study Area 5 lies within the upper Cretaceous Eagle Ford Shale oil trend of south Texas (**Figure 3.1-7**). The Eagle Ford, previously thought of as a hydrocarbon source rock, is productive of oil and gas through the utilization of horizontal drilling and modern hydraulic fracturing. There are several distinct productive areas in the Eagle Ford trend that stretches from the Rio Grande to Fayette County, Texas, and may stretch further east as evidenced by Eagle Ford production in Brazos County (RCT 2013). Production from the Eagle Ford increased from about 300,000 barrels of oil and 2 million cubic feet of gas per day in 2008 to 721,000 barrels of oil and 3.8 billion cubic feet of gas per day in 2013 (RCT 2014e). Drilling is expected to continue in the foreseeable future with oil production expected to exceed over 1 million barrels per day. Resource estimates for the Eagle Ford range from 3.35 billion barrels of oil and 21 trillion cubic feet of gas to 28.7 billion barrels of oil and 122 trillion cubic feet of gas (Gong et al. 2013). In addition to the Eagle Ford, there are a number of existing and potential oil and gas producing trends that intersect or are adjacent to Study Area 5 including the Edwards, Glen Rose, Pearsall, and Sligo.

Other Minerals

Open pit uranium mining in the south Texas uranium province began in the 1950s and produced 70 million pounds of uranium oxide (yellowcake) to the mid-1990s (Nicot et al. 2010). Study Areas 5 and 6 do not overlap areas of active or former uranium mines; however, uranium was mined a few miles from the eastern boundary of Study Area 5 in southeastern Atascosa County. The uranium deposits in the south Texas uranium province primarily are found in Eocene Whitsett, Oligocene Frio, Oligocene and Miocene Catahoula, Miocene Oakville, and Pliocene Goliad formations (Finch 1996). Uranium has been shown to occur in lignite from the Wilcox and Claiborne groups; however, concentrations have been found to be highly variable (Huang 1979).

Sand and gravel are mined in the northern part of Atascosa County; however, no quarries were identified in Study Area 5 (National Atlas 2014; Nicot et al. 2011).

*Paleontological Resources*

The depositional environments of the Jackson Group were similar to those in the Wilcox Group. Petrified wood and plant fragments are common in Jackson Group formations; however, marine fossils have also been found (Knox et al. 2009). Trace fossils (also referred to as ichnofossils) are structures in the sediment which provide evidence of creatures, consisting of fossilized tracks, burrows, and bioturbation (disruption of sedimentary layers by burrowing animals). Trace fossils have been described in the formations of the Jackson Group (Snedden and Kersey 1981).

South Texas Coal Zone – Study Area 6

*Geology*

The outcrop of the Olmos Formation in Texas is limited to Maverick County (Hook et al. 2011d). The outcrop is exposed on a north-to-south-trending anticlinal structure that plunges to the south (**Figure 3.1-16**). Northeast-trending, down to the north faults, cut across the structure. The outcrop thickness of the Olmos Formation ranges from 400 to 500 feet in Maverick County, and thickens to over

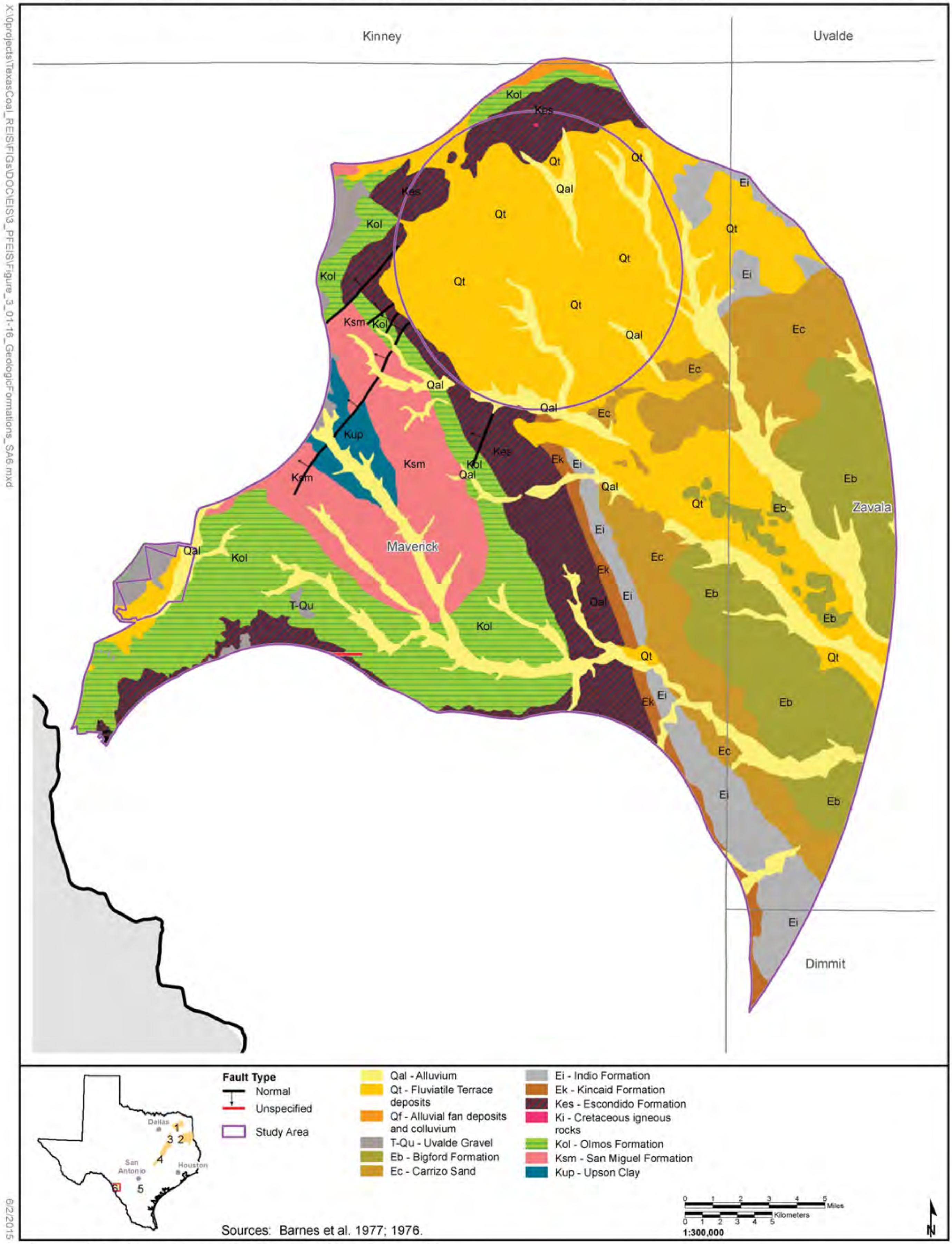



**Figure 3.1-16 Surface Geology of Study Area 6**

1,300 feet down-dip from the outcrop. The Olmos Formation has not been studied extensively in the outcrop; however, it has been studied in cores taken from oil and gas wells in down-dip areas (Hook et al. 2011d).The Olmos Formation was deposited in a deltaic environment and consists of sandstone, mudstone, carbonaceous shale, and coal. The sediment source was believed to have been from a magmatic arc to the west in present-day Mexico (Trevino et al. 2007).

*Minerals*

Coal

Subituminous coal is common in the lower part of the Olmos Formation; however, the coal zones are thin and discontinuous, often less than 6 feet thick (Hook et al. 2011d). Underground coal mining in the area began in the mid-1800s and ended in 1920. In 2000, surface mining began at the Eagle Pass mine, targeting multiple seams in the Olmos Formation.

A resource estimate done in the 1960s (Mapel 1967) indicated that the bituminous coal resource in the Olmos Formation was 525 million tons; however, it may be much larger as it has not been assessed by modern methods (Hook et al. 2011d).

Oil and Gas

The Sacatosa oil field overlaps part of Study Area 6. The field was discovered in 1956 and produces from the San Miguel-1 Sand that is found in the Cretaceous upper Taylor Group (Davis and Shepler 1969). The field has produced over 40 million barrels of oil (Oil and Gas Journal 2004). Other potential oil and gas targets in the area include the Georgetown, Glen Rose, and Jurassic-Deep Cretaceous formations. Oil and gas resources are found in down dip areas of the Olmos Formation which has been a gas drilling target since the 1920s (Trevino et al. 2007). The Eagle Ford trend also overlaps Study Area 6 (RCT 2013).

CBNG

CBNG production was developed from Olmos Formation coals in 2001 that occur above the San Miguel-1 Sand (Barker et al. 2002). Thirty-four wells were developed in the Olmos coal zone to the south and southeast of the Dos Republicas Mine within the footprint of the Sacatosa oil field. The wells varied from 1,300 to 1,500 feet deep and encountered net coal thicknesses from 5 to 30 feet. In 2003, CBNG production per well averaged 208,000 cubic feet per day. After June 2007, no production was reported; cumulative production from this field was 231 million cubic feet of gas (RCT 2014d).

Other Minerals

A crushed stone quarry is located in Maverick County; no other mining operations were identified in the study area (Nicot et al. 2011).

*Paleontological Resources*

Sandstones in the Olmos Formation in Study Area 6 contain abundant trace fossils (Trevino et al. 2007). Plants and woody fossils are also common in the Olmos Formation, but dinosaur bones occur in Mexico (Porras-Múzquiz and Lehman 2011).

### 3.1.2 Environmental Consequences

Public scoping issues related to geology included concerns relative to potential blasting effects in areas with existing underground workings and requests for assessment of unique geologic features on a site-by-site basis. The analysis in this REIS is regional in nature, and potential future site-specific mine locations are not known at this time. Therefore, it is not possible to address these issues until future site-specific NEPA evaluations are conducted. The direct and indirect impacts to geology, minerals, and paleontology are discussed in general.

### 3.1.2.1 Proposed Action

Some of the potential effects from mine-related construction and operations would be similar across all of the study areas. Where impacts apply to specific study areas, the differences are noted. The impacts from construction, operations, and reclamation would be similar under the Proposed Action and the No Action alternatives because the development of future mine expansion areas or satellite mines would occur under either alternative.

Topography

The topography of the study areas where surface mining may occur would be permanently altered on an estimated 158,600 acres (**Table 2-3**). This effect would be minimized to the extent possible through implementation of reclamation plans (see Section 2.2.4.3, Typical Closure and Reclamation) designed to restore mine-related disturbance areas to approximate original topography to the extent practical in accordance with RCT regulations.

Geology

Mining operations in Study Areas 1 – 6 would remove the overburden, interburden, and coal or lignite from each mine pit, with the overburden and interburden selectively handled and placed as backfill in the previous pit. As a result, the original characteristics of the strata in the mine areas would be permanently altered.

Geologic Hazards

Geologic hazards due to natural conditions are not expected to affect mining in the study areas. Mining-induced hazards are not anticipated because properly engineered mine pit highwalls are expected to be stable.

Mineral Resources

*Historical Coal Mining*

Coal mining has been conducted for many decades in the study areas. Prior to modern surface mining, coal was generally extracted by underground mining methods. RCT regulations (RCT 2014d; Subsections 12.135 and 12.136) require that a mine applicant determine the location of previous mining, identify the mining method, and map the extent of old mine workings. When older mine works are identified, proper precautions and procedures can be implemented to reduce blast vibrations that may weaken underground workings, causing unsafe conditions. However, blasting is not expected to be routinely conducted to facilitate the removal of overburden and coal excavation (see Section 2.2.4, Description of a Typical Surface Coal and Lignite Mine).

*Coal Resources*

The EIA reported that the recoverable reserve of active coal mines in Texas was 751 million tons in 2012 (EIA 2013). Based on the maximum estimated annual coal production shown in **Table 2-7**, there would be approximately 22 years of production.

*Oil and Natural Gas Wells*

There is a strong possibility that active and abandoned oil and gas wells may be encountered in prospective mine areas within all study areas. RCT rules (Subsection 12.137) require that oil and gas wells be identified, and oil and gas wells that are located in a proposed mine area be plugged and abandoned in accordance with RCT regulations (RCT 2014d).

*Mineral/Surface Estate Conflicts*

All of the study areas have current and historical oil and gas production. Additionally, Study Areas 2 through 6 are within or adjacent to areas of potential shale oil and shale gas development. There is the potential for conflicts between mineral owners to occur because oil and natural gas are considered as part of the mineral estate, and in most cases in Texas, lignite is considered part of the surface estate (Merrill 2014). If the mineral and surface ownership is severed, then conflicts may occur. Under Texas law, the mineral estate is dominant, and mineral extraction would take precedence over activities governed by the surface estate.

During active mining, it is expected that access to oil and gas resources would be precluded or limited. However, with the advent of widespread horizontal and directional drilling, coal mining could occur simultaneously with oil and gas development, but parties would have to engage in co-development agreements concerning the timing of surface mine development and oil and gas drilling. If oil and gas wells are present in a future proposed coal or lignite mine permit area, agreements would have to be made with royalty owners, oil and gas operators, and mine operators regarding compensation for the loss of resource access.

Oil and gas wells in active mine areas must be sealed or plugged in accordance with applicable regulations prior to the start of mining. Regardless of the potential size of the oil and natural gas resource, coal mining would not result in a permanent loss of the fluid mineral resource but would temporarily preclude access during mining and reclamation. The amount of the fluid mineral resource that temporarily would be unavailable is not quantifiable; however, it is expected to be considerably less than the total potential resource in any given area. Although the oil and natural gas resources would not be lost, delayed access would represent a temporary loss of revenue to leaseholders, royalties, property taxes, and severance taxes.

Paleontological Resources

Surface disturbance within the Wilcox Group, Carrizo Formation, or Olmos Formation may directly damage or destroy fossils that could be used for correlation or scientific purposes. However, even though fossils may be numerous where present, it is unknown whether the fossils that may occur in any of the study areas have high scientific value. Also, given the widespread distribution of the fossils that may be present, there is a low probability for unique or scientifically important or valuable fossils to occur. There are no laws in Texas regarding the protection of paleontological resources, and because there are no federally managed lands in the study areas, federal rules regarding the protection of paleontological resources would not apply.

#### 3.1.2.2 No Action Alternative

Under the No Action Alternative, impacts to geology, minerals, and paleontological resources would be the same as described under the Proposed Action. However, the impacts may be spread over a longer period of time due to the possibly lengthier permitting process.

### 3.1.3 Cumulative Impacts

The cumulative effects study areas for geology, mineral, and paleontological resources are presented in **Appendix A, Figure A-1**.The past and present actions and RFFAs are identified in Section 2.4. The major past and present actions in the geology and mineral resources cumulative effects study area include existing lignite mines, power generation facilities, reservoirs, roads, landfills, urban development, and oil and gas development. The acres of past and present surface disturbance for the CESAs is shown in **Table 3.1-1**.

**Table 3.1-1 Acreage of Past and Present Surface Disturbance in CESAs for Geology, Minerals, and Paleontology**

| Study Area | Disturbed Inside Study Area (acres) | Disturbed Outside Study Area/Inside CESA (acres) | Total CESA Disturbed (acres) |
|---|---|---|---|
| 1 | 52,238 | 43,537 | 95,775 |
| 2 | 40,132 | 137,809 | 177,941 |
| 3 | 38,569 | 84,853 | 123,421 |
| 4 | 5,846 | 28,115 | 33,961 |
| 5 | 3,603 | 20,448 | 24,051 |
| 6 | 2,363 | 3,005 | 5,369 |

Other than future oil and gas development and the future mine expansion areas and satellite mines projected for each study area, listed in **Table 2-3**, the RFFAs identified in Section 2.4 (highway construction and water supply projects), would have little effect on mining operations. All of these RFFAs would contribute to future surface disturbance in the CESAs, although mines would be stabilized due to their incremental reclamation over the life of these operations. Permit requirements and RCT regulations for mines would require that mine-related disturbance areas be returned to approximate original topography, but the topography would be permanently altered to some degree.

It would be impossible to quantify the cumulative impact of mine development on oil and gas resources in the CESAs due to the lack of site-specific locations of both the future mines and the oil and gas well target formations. However, it is possible that mining could have the potential to delay access to oil and gas resources, or oil and gas development could affect the locations of future mines.

The total cumulative disturbance may have an effect on the fossil-bearing formations that occur in each CESA, depending on the depth of the disturbance. This disturbance could affect the Wilcox Group and Carrizo Formation in CESAs 1, 2, 3, and 4; fossils in the Jackson Group in CESA 5; and the Olmos Formation in CESA 6.

### 3.1.4 Monitoring and Mitigation Measures

No monitoring or mitigation is recommended for geology or mineral resources beyond the reclamation procedures, which include the regrading of spoils to approximate original contour, in compliance with RCT requirements.

### 3.1.5 Residual Adverse Effects

Overall, the coal and lignite mining in the CESAs would result in the permanent removal of an estimated 35 million tons of coal or lignite annually, based on the information presented in **Table 2-7**. Access conflicts to oil and gas resources in the mine permit areas would cease following the completion of mining.

# 3.2 Water Resources

## 3.2.1 Hydrologic Setting

Study Areas 1 and 2 generally have low relief with occasional rolling hills interspersed with wide, flat floodplains. Elevations range from 150 to 300 feet amsl. Annual precipitation ranges from 42 to 50 inches in Study Area 1 and 46 to 50 inches in Study Area 2 (Texas State Historical Association [TSHA] 2014a).

The topography in Study Areas 3 and 4 ranges from flat to low rolling hills incised by generally southeast trending drainages. Elevations range from 150 to 300 feet amsl in the Brazos and Trinity River valleys and from 300 to 600 feet amsl in the upland areas. The Brazos and Trinity River floodplains are several miles wide and have little or no relief (Cronin et al. 1973; Peckham et al. 1963). Average annual precipitation ranges from 34 to 42 inches per year (TSHA 2014a).

The topography in Study Area 5 is characterized by low rolling hills cut by major southeast trending drainages that have narrow floodplains and terraces (Alexander and White 1966). Elevations range from 250 to 350 feet amsl. The average annual precipitation ranges from 26 to 30 inches (TSHA 2014a).

The topography on the eastern side of Study Area 6 is characterized by low rolling hills or plateaus cut by generally southeast trending drainages in the Nueces River Basin. The western extremity of the study area extends almost to the Rio Grande where a 100-foot escarpment meets the low-relief flood plain and drainages flow to the Rio Grande. Elevations range from 600 to approximately 900 feet amsl. Annual precipitation ranges from 18 to 26 inches (TSHA 2014a).

## 3.2.2 Water Resources-related Regulations

Potential future surface coal or lignite mine construction, operation, and reclamation activities would require water protection measures in accordance with applicable regulations and agency programs. These requirements include:

- Section 404 of the CWA and Section 10 of the RHA administered by USACE;
- RCT coal mining performance standards regarding protection of the hydrologic balance (16 TAC 12);
- Water quality regulations from TCEQ pertaining to Section 401 (water quality) certification (30 TAC 279 and related guidelines);
- TPDES programs (Construction Stormwater General Permit TXR150000; Industrial Stormwater General Permit TXR050000, Multi Sector H; and individual Industrial Wastewater permit);
- Water rights administration by TCEQ; and
- Executive Order 11988 (Floodplain Management) as addressed by USACE for a federal action.

Compliance with these regulations and programs, and agency requirements for mine-specific reviews and approvals, would reduce the potential for impacts to water resources.

## 3.2.3 Groundwater

The description of groundwater resources provides a regional description of aquifers, resources, and water use in the broader Texas Coal Region followed by discussions of the study areas within the coal sub-regions as defined by Kaiser et al. (1980).

### 3.2.3.1 Affected Environment

Regional Groundwater Resources

The Texas Water Development Board (TWDB) has defined 9 major and 21 minor aquifers in the State of Texas (George et al. 2011). In the Texas Coal Region, there is one major aquifer (Carrizo-Wilcox aquifer system) and four minor aquifers (Yegua-Jackson, Queen City, Sparta, and Brazos River alluvial aquifer). The TWDB defines a major aquifers as “aquifers that produce large amounts of water over large areas “and minor aquifers as those “that produce minor amounts of water over large areas or large amounts of water over small areas” (George et al. 2011).

*Major Aquifers*

Carrizo-Wilcox Aquifer System

The only major aquifer in the Texas Coal Region is the Carrizo-Wilcox aquifer. The geologic framework of the Carrizo-Wilcox aquifer is described in Section 3.1. It is composed of the hydrologically connected lower Tertiary Wilcox Group and Carrizo Sand, the stratigraphically lowest formation of the Claiborne Group. The outcrop of these units extends from the Rio Grande to the Louisiana-Texas state line (**Figure 3.2-1**) and encompasses an area of 11,186 square miles, with the subcrop or down-dip portion encompassing 25,409 square miles (George et al. 2011). The overall thickness of the Carrizo-Wilcox ranges from 200 to over 3,000 feet; and the saturated thickness averages 670 feet (George et al. 2011). **Figure 3.2-2** presents a cross-section of the Carrizo-Wilcox in east-central Texas showing the general relationships of the formations that make up the aquifer. While sandstones generally are discontinuous and interbedded with gravel, silt, clay, and lignite seams in the Wilcox Group formations, the Carrizo Sand is somewhat more widespread and continuous as shown on **Figure 3.2-2**. The Carrizo Sand is composed of “massive, cross-bedded, medium-grained sands ranging in thickness from 150 to 1,200 feet” (Boghici 2009).

**Figure 3.2-3** shows the relationship between the stratigraphy of the Wilcox and Claiborne Groups and hydrologic units. Recharge occurs at the outcrop and from leakage of groundwater from the Queen City aquifer through the leaky confining Reklaw Formation confining layer (Dutton 1985). Confining layers contain groundwater that is confined under pressure between relatively impermeable or substantially less permeable material (Lohman 1972). Groundwater discharge to major drainages occurs by upward flow of water along fault zones and upward leakage between formations.

A measure of groundwater quality is the salinity in terms of the total dissolved solids (TDS) concentration, with fresh water less than 1,000 milligrams per liter (mg/L); brackish water from 1,000 to 3,000 mg/L; moderately saline water from 3,000 to 10,000 mg/L; highly saline water from 10,000 to 35,000 mg/L; and brine greater than 35,000 mg/L. TDS concentration in the Carrizo-Wilcox aquifer generally is less than 1,000 mg/L. However, in the down-dip areas (see **Figure 3.2-1**) the TDS concentration is generally less than 3,000 mg/L, with higher concentrations in localized areas. In the Wintergarden area of south Texas, groundwater is moderately saline with TDS concentrations ranging up to 7,000 mg/L. Other isolated areas near the outcrop can be moderately saline as at the Milbur oil field which straddles the Milam-Burleson county line a few miles south of the outcrop. Geophysical log-derived salinity in lower Wilcox sandstones was estimated to be 8,000 mg/L (Chuber 1972). Isolated areas of moderately saline groundwater may be related to upward movement of water along fault zones as in the case of the Milbur field, which is cut by the Mexia-Talco fault zone. Moderately saline water is also found in very shallow areas near the outcrop and is associated with finer-grained claystones and mudstones that have low rates of transmissivity and are less subject to flushing by meteoric waters (Dutton 1985). A groundwater TDS concentration of 3,000 mg/L meets the conceivable uses for the aquifer (Ashworth and Hopkins 1995).

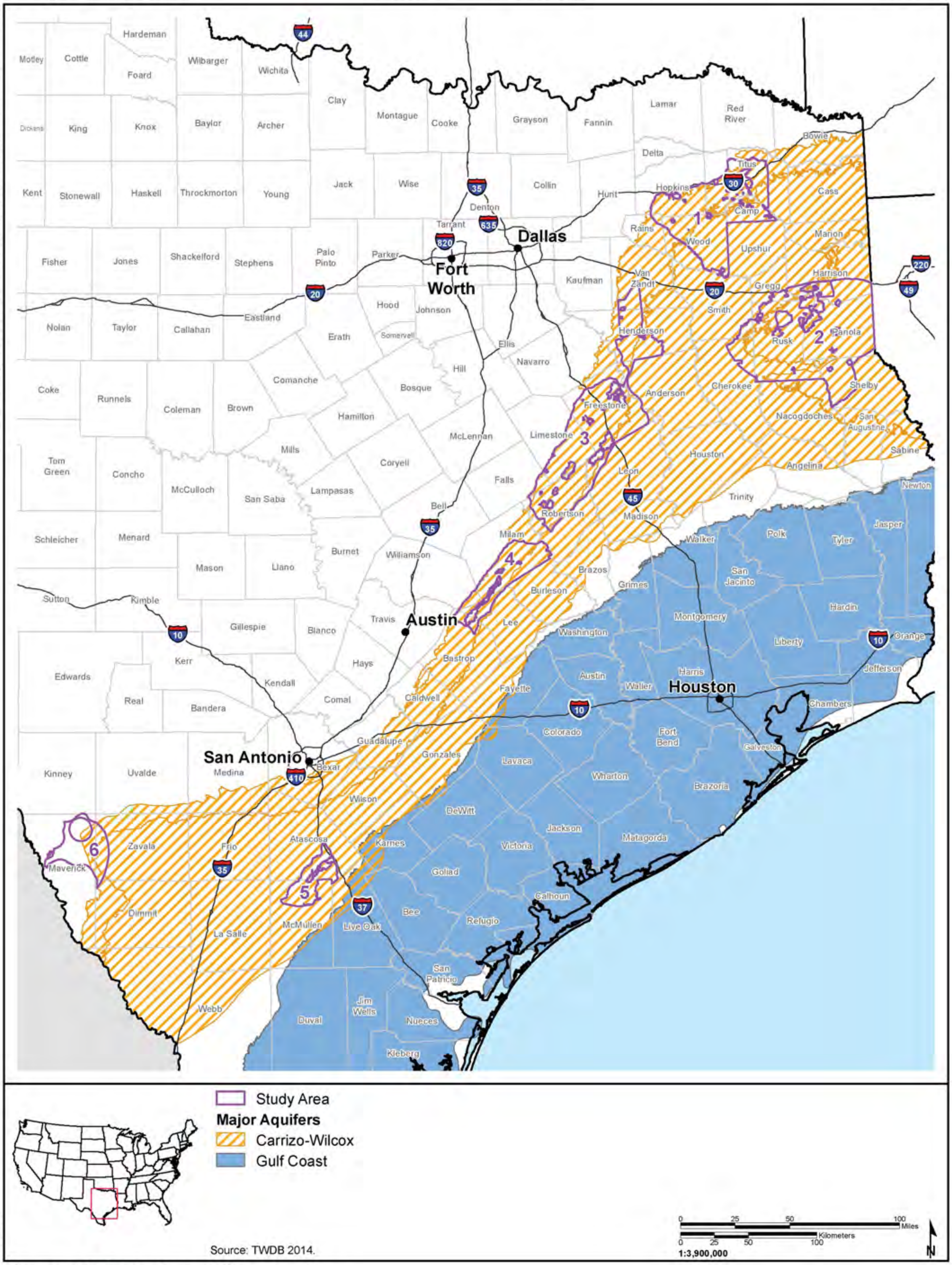



Figure 3.2-1 Carrizzo-Wilcox Aquifer

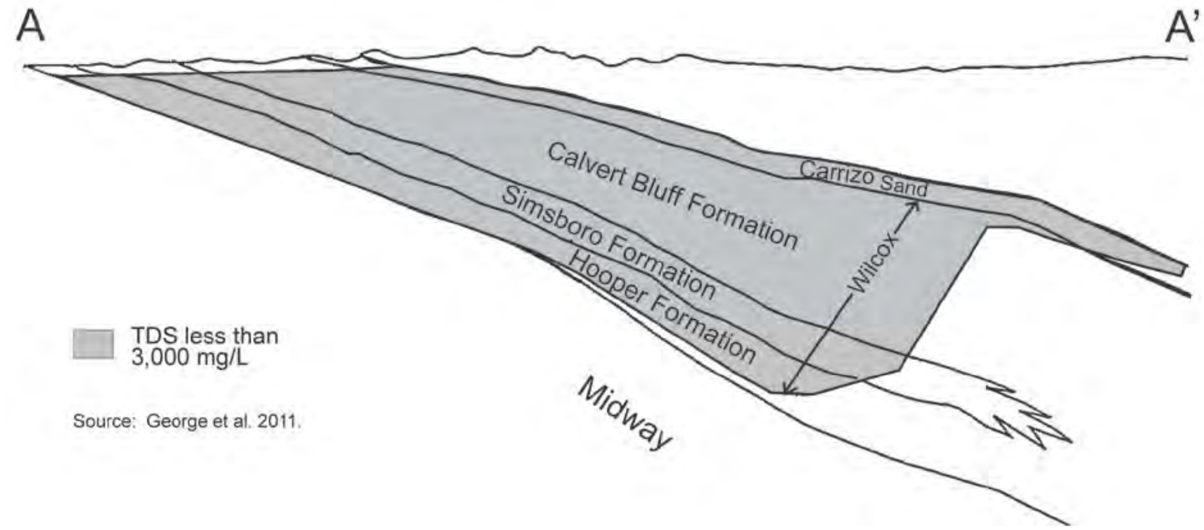
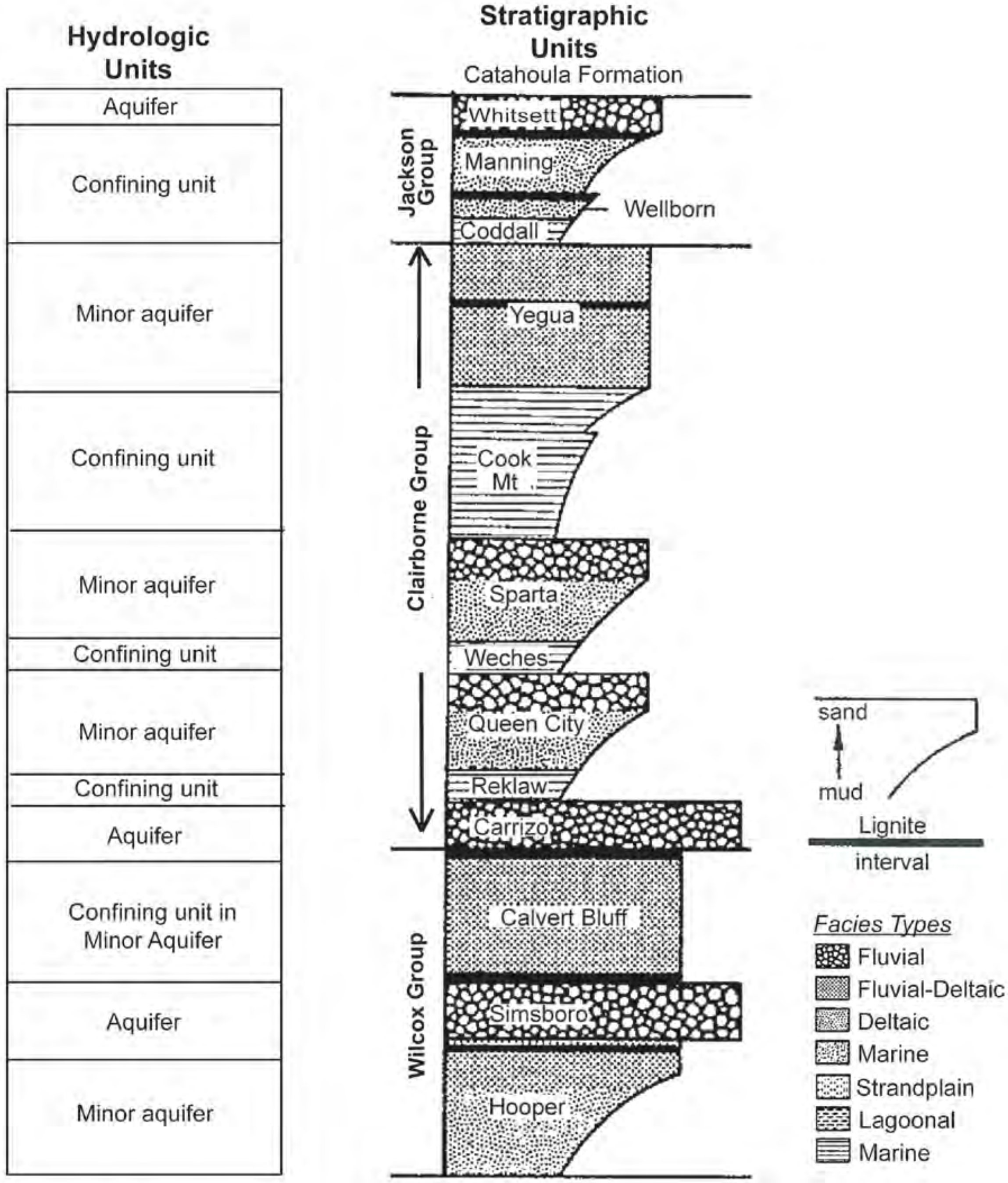



**Figure 3.2-2 Cross-section of the Carrizo-Wilcox in East-Central Texas**




Source: Dutton 1985.

**Figure 3.2-3 Stratigraphy and Hydrologic Units of the Wilcox and Claiborne Groups**

Groundwater quality is also affected by hardness (concentration of calcium carbonate) in up-dip areas of the aquifer and widespread high iron content that contributes to corrosion problems (Ashworth and Hopkins 1995). In the down-dip areas, hydrogen sulfide and methane gas have been reported. Groundwater produced from the lower Wilcox by the City of Bryan, Texas, contains unspecified gas that required separation prior to use in the city water supply system (Ethridge 1968). Groundwater quality is also affected by oil field contamination, as documented in the Wintergarden area in South Texas (Ashworth and Hopkins 1995).

Groundwater levels fluctuate in response to changes in the volume of water stored in the aquifer. Groundwater from the Carrizo-Wilcox aquifer primarily is used for agriculture (approximately 46 percent) and municipal water supply (46 percent) (TWDB 2014a). Several areas have experienced 300 to over 500 feet of estimated drawdown due to agricultural pumping (south Texas) and municipal and industrial pumping (east-central Texas and the Sabine Uplift). Total water pumped from the Carrizo-Wilcox aquifer in 2012 was estimated at 418,250 acre-feet (1 acre-foot = 325,859 gallons) (TWDB 2014a). Of that total, 3,427 acre-feet (less than 1 percent) was pumped for mining (mining as an industrial category, the data did not distinguish type of mining). At the surface coal and lignite mines, most groundwater pumping is for pit dewatering and, where needed, aquifer depressurization (Nicot et al. 2011), with the produced water used on site (e.g., dust suppression) or discharged in accordance with mine-specific TPDES permit criteria.

Well yields in the Carrizo-Wilcox aquifer are commonly 500 gallons per minute (gpm), but can be as high as 3,000 gpm in down-dip areas that have not experienced depletion and are under artesian pressure conditions (Ashworth and Hopkins 1995).

*Minor Aquifers*

Yegua-Jackson Aquifers

The Jackson-Yegua aquifers are composed of water-bearing sands in the Yegua Formation of the upper Claiborne Group and sands in the Jackson Group formations (George et al. 2011). The Jackson-Yegua aquifers extend from the Rio Grande on the southwest to the Sabine River on the east (Knox et al. 2009) (**Figure 3.2-4**). The outcrops of the formations vary from 10 to 40 miles wide and encompass an area of approximately 11,000 square miles. The stratigraphic thickness of the Yegua-Jackson varies from 1,800 to 3,000 feet; however, the water saturated thickness averages 170 feet (Deeds et al. 2010; Knox et al. 2009).

Groundwater in the shallow sands in the Yegua-Jackson aquifers have TDS values ranging from 50 to 1000 mg/L; however, it can become moderately saline at depth, with TDS concentrations ranging up to 10,000 mg/L (George et al. 2011). Total pumping from the Yegua-Jackson aquifers in 2012 was 11,367 acre-feet, of which 71 percent was for municipal use, 21 percent for irrigation, and the remainder used for manufacturing. There was no reported groundwater pumpage for mining.

Queen City Aquifer

The Queen City aquifer is composed of the Queen City Formation that is in lower Claiborne Group. The formation is composed of poorly consolidated deposits formed in a fluvial-deltaic system. The sand can be up to 2,000 feet thick in South Texas; however, the saturated thickness averages 140 feet (George et al. 2011). The average TDS in the shallow areas is approximately 300 mg/L; however, TDS concentrations increase with depth to an average of 750 mg/L. Iron content is elevated in the northern areas. Groundwater from the Queen City aquifer primarily has been used for livestock, domestic, and industrial purposes, with maximum drawdown in the central and southern portions of the aquifer ranging from 70 to 130 feet. In 2012, 17,364 acre-feet of groundwater were pumped from the Queen City aquifer, with the primary uses being municipal and irrigation.

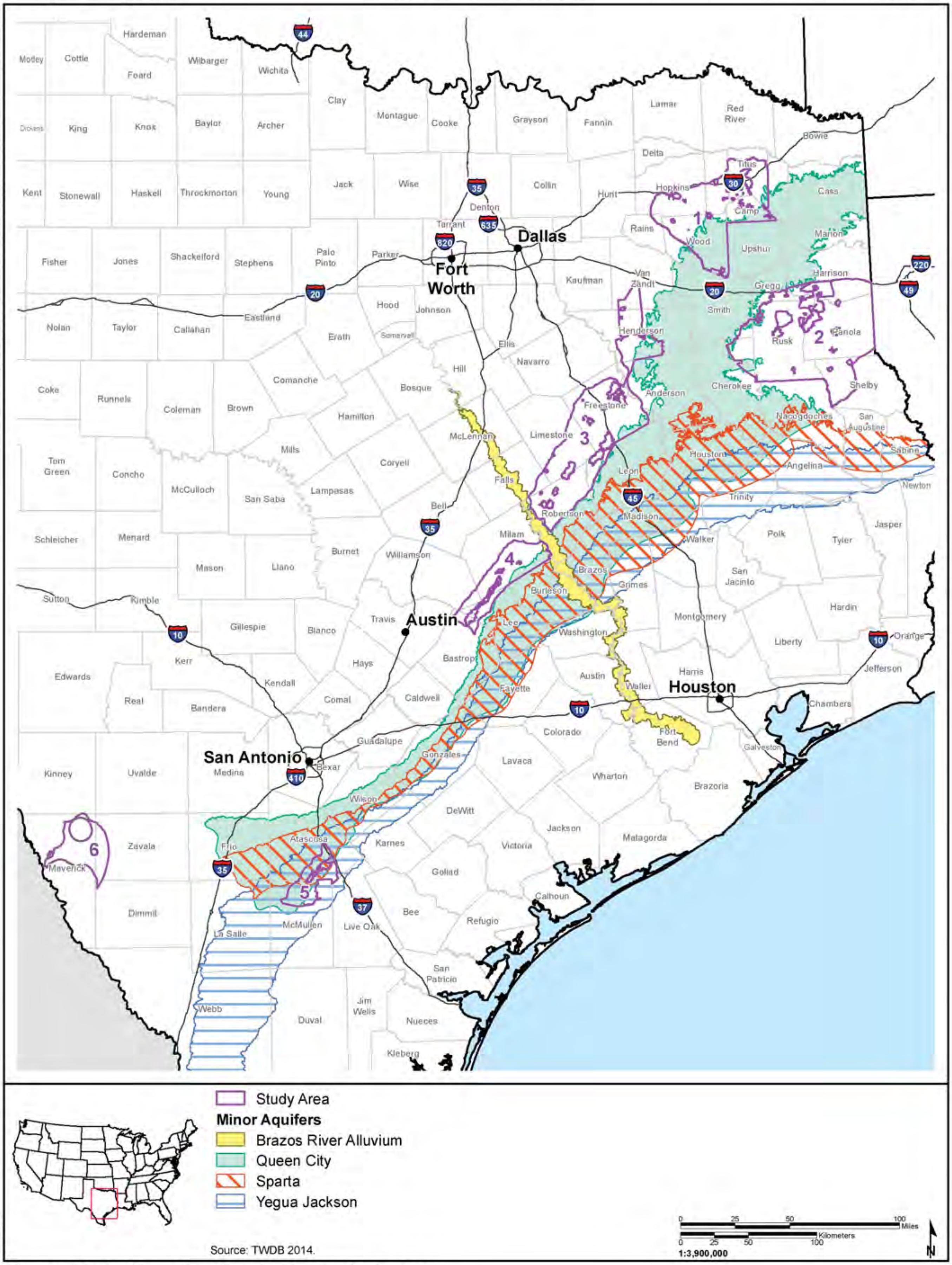



Figure 3.2-4 Minor Aquifers in the Analysis Area

Sparta Aquifer

The Sparta aquifer consists of water-bearing sands in the Sparta Formation. This formation ranges in thickness from 700 feet in the northeast to 200 in the southwest; the average saturated thickness is approximately 200 feet (George et al. 2011). The average TDS in the shallow portion of aquifer is 300 mg/L, increasing to an average of 800 mg/L at depth. The Sparta aquifer primarily is used for municipal (60 percent), agricultural (31 percent), and manufacturing (8 percent) purposes, with a total groundwater withdrawal of 14,637 acre-feet in 2012 (TWDB 2014a). No major drawdown declines have been observed in this aquifer.

Brazos River Aquifer

The Brazos River aquifer is located in east-central Texas and extends 350 river miles from Bosque County to Fort Bend County (George et al. 2011). The aquifer is composed of gravel, fine- to coarse-grained sands, silt and clay. Since it is made up of fluvial deposits associated with the Brazos River, the aquifer is a complex of channels and bars with rapid changes over short distances and ranges in thickness from 50 to almost 170 feet (George et al. 2011). Groundwater quality is generally fresh to slightly saline. The aquifer is under water table conditions and is unconfined. The Brazos River aquifer is recharged by precipitation that moves into the saturated zone; discharge is via base flow to the river, to wells, and through evapotranspiration. Common well yields range from 250 to 500 gpm; however, some yields have been as high as 1,000 gpm. In 2012, over 129,000 acre-feet of groundwater were withdrawn from the Brazos River aquifer, primarily for irrigation (75 percent) (TWDB 2014a).

Study Area Groundwater Resources

*Study Area 1*

Carrizo-Wilcox Aquifer

The main aquifer in Study Area 1 is Carrizo-Wilcox (see **Figure 3.2-1**). Recharge to the aquifer occurs through infiltration of precipitation at the outcrop (Baker et al. 1963a), which is located in the northern part of the study area. The outcrop in this area is approximately 10 to 15 miles wide, and the semi-consolidated sandstones probably contribute to the infiltration. Groundwater flow in this aquifer follows the general dip of the units into the East Texas Basin. Discharge from the aquifer occurs mainly through withdrawal by wells.

Groundwater produced from the Carrizo-Wilcox aquifer in Study Area 1 is generally of good quality, with TDS typically less than 500 mg/L TDS; however, elevated iron levels and hardness occur in localized areas (Baker et al. 1963a). Recent water quality sampling and analysis indicate no major changes in Carrizo-Wilcox groundwater quality in this area (Boghici 2009).

In the counties that overlap with Study Area 1, almost 14,000 acre-feet of groundwater were withdrawn from the Carrizo-Wilcox aquifer in 2012 (TWDB 2014a). Most of the groundwater (76 percent) was used for municipal water supply, with 22 percent used for agriculture and less than 1 percent (2 acre-feet) pumped for mining purposes.

Queen City Aquifer

The primary aquifer in the Claiborne Group in northeastern Texas is the Queen City aquifer as defined by George et al. (2011). The groundwater in this aquifer is largely under unconfined conditions, with localized areas under confined conditions. The Queen City aquifer is recharged mainly by precipitation, and discharge occurs through spring flow, base flow to streams, transpiration, well pumping, and leakage into the Carrizo-Wilcox aquifer. Where groundwater is under unconfined conditions, flow is vertical to the water table and then to the northeast along the general topographic gradient. In the vicinity of Study Area 1, TDS in the Queen City aquifer ranges from 100 to 150 mg/L; however, elevated iron concentration and high acidity do occur (George et al. 2011). Approximately 168 acre-feet of groundwater was pumped from the Queen City aquifer in 2012, of which 63 percent was for municipal water supply and the remainder for agricultural purposes (TWDB 2014a).

*Study Area 2*

The hydrologic units in Study Area 2 and their associated water-bearing properties are presented in **Table 3.2-1** and discussed below. The hydrologic units are essentially the same as for Study Area 1; however, they have a distinct difference in structural aspect because the Carrizo-Wilcox aquifer is on the structurally high parts of the Sabine Uplift which is centered on Panola County, Texas.

**Table 3.2-1 Water-bearing Properties for the Hydrologic Units in Study Areas 1 and 2**

| Period | Epoch | Group | Formation | Approximate Thickness (feet) | Composition | Water-bearing Properties[1] |
|---|---|---|---|---|---|---|
| Quaternary | Pleistocene and Recent | | Alluvium and terrace deposits | 0-50 | Unconsolidated sand, silt, clay and gravel | Yields variable amounts of groundwater |
| Tertiary | Eocene | | Queen City | 300-600 | Sand, shale, and sandy shale | Yields small amounts of groundwater; may have high iron content |
| | | | Reklaw | 290 | Shale with thin sand layers | Yields small amounts of groundwater from shallow sand layers |
| | | | Carrizo Sand | 180 | Fine- to medium-grained sand, thin beds of shale | Yields small to moderate amounts of groundwater where sands are thick |
| | | Wilcox[2] Group | Upper Wilcox | 2,500 + | Interbedded sand and shale with lignite beds. | Major aquifer; yields small to moderate amounts of groundwater; used for public water supply, industry, and agriculture |
| | Paleocene | | Lower Wilcox | | | |
| | | Midway Group | | 900 | Calcareous clay and limestone, sandy and silty in part | Does not yield groundwater to wells; not an aquifer |

[1] Small: less than 100 gpm; moderate: 100 to 1,000 gpm; large: more than 1,000 gpm.

[2] North of the Trinity River it may not be possible to differentiate the formations of the Wilcox Group.

Sources: Baker et al. 1963a,b; George et al. 2011.

Carrizo-Wilcox Aquifer

The main aquifer in Study Area 2 is the Carrizo-Wilcox, which occupies the crest of the Sabine Uplift where the units are essentially flat, dipping approximately 0.5 degree or less west and south (**Figure 3.2-1**). On the south flank of the uplift, dips to the south increase to approximately 1.5 degrees (Baker et al. 1963b). The outcrop area is approximately 80 miles north to south, and the Texas side is 60 miles wide. Recharge to the aquifer occurs through the infiltration of precipitation at the outcrop (Baker et al. 1963b; Sandeen 1967). The aquifer is unconfined, and groundwater flow is assumed to follow the dip of the units. Groundwater discharge from the aquifer primarily is through withdrawal by wells.

In the vicinity of Study Area 2, TDS concentrations in groundwater from the Carrizo-Wilcox ranges from less than 500 mg/L up to 3,000 mg/L. Monitoring conducted over several decades indicates TDS concentrations have remained fairly stable since the 1970s (Boghici 2009).

In 2012, over 50,000 acre-feet of groundwater were withdrawn from the Carrizo-Wilcox aquifer in the counties that overlap Study Area 2 (TWDB 2014a). Of this total, 93 percent was for municipal water supply. Less than 2 percent (900 acre-feet) was pumped for mining purposes. The remaining approximately 5 percent was used for manufacturing, power generation, and agricultural purposes.

Queen City Aquifer

Only a small portion of the Queen City outcrop occurs in Rusk County and Study Area 2, and no down-dip areas of the aquifer underlie Study Area 2. The attributes of the Queen City aquifer in Study Area 2 are the same as described above for Study Area 1. In the counties that overlap with Study Area 2, Queen City aquifer withdrawals in 2012 totaled 4,067 acre-feet, with 84 percent of the total used for municipal water supply (TWDB 2014a).

*Study Areas 3 and 4*

The hydrologic units in Study Areas 3 and 4 and their associated water-bearing properties are presented in **Table 3.2-2** and discussed below.

**Table 3.2-2 Water-bearing Properties for the Hydrologic Units in Study Areas 3 and 4**

| Period | Epoch | Group | Formation | Approximate Thickness (feet) | Description | Water-bearing Properties[1] |
|---|---|---|---|---|---|---|
| Quaternary | Pleistocene and Recent | | Alluvium and terrace deposits | 0-50 | Unconsolidated sand, silt, clay, and gravel | Yields variable amounts of groundwater |
| Tertiary | Eocene | Claiborne Group | Yegua | 750-1,500 | Interbedded sand, sandy clay, clay, and lignite | Small to moderate amounts of groundwater |
| | | | Cook Mountain | 400-700 | Mostly shale and clay, sandy beds in middle part | Small to moderate amounts of fresh to slightly saline groundwater |
| | | | Sparta | 170-380 | Semi-consolidated fine- to medium-grained sand, lignitic shale | Small to moderate amounts of groundwater |
| | | | Weches | 110-240 | Shale, some limestone | Does not yield usable groundwater |

**Table 3.2-2 Water-bearing Properties for the Hydrologic Units in Study Areas 3 and 4**

| Period | Epoch | Group | Formation | Approximate Thickness (feet) | Description | Water-bearing Properties[1] |
|---|---|---|---|---|---|---|
| | | | Queen City | 300-600 | Sand, shale, and sandy shale | Small amounts of groundwater; may have high iron content |
| | | | Reklaw | 270-310 | Shale and interbedded sandstone | Small amounts of groundwater |
| | | | Carrizo Sand | 220-880 | Fine- to coarse-grained sand, thin beds of shale | Small to moderate amounts of groundwater where sands are thick |
| | | Wilcox Group[2] | Calvert Bluff | 2,100 | Fine- to coarse-grained lenticular sandstones, interbedded mudstone, and lignite seams | Small to moderate quantities of fresh to slightly saline groundwater |
| | Paleocene | | Simsboro | 900 | Fine- to coarse-grained quartz sand, minor amounts of clay and mudstone | Small to moderate amounts of fresh to slightly saline groundwater |
| | | | Hooper | 1400 | Mostly mudstone with varying amounts of medium- to coarse-grained sandstone, lignite seams | Small to moderate quantities of fresh to slightly saline groundwater |
| | | Midway Group | | 900 | Calcareous clay and limestone, sandy and silty in part | Does not yield water to wells; not an aquifer |

1 Small: less than 100 gpm; moderate: 100 to 1,000 gpm; large: more than 1,000 gpm.

2 North of the Trinity River and south of the Colorado River it may not be possible to differentiate the formations of the Wilcox Group.

Sources: Cronin et al. 1973; Peckham et al. 1963; Thompson 1966; Thorkildsen and Price 1991.

The outcrops of the Wilcox and Claiborne trend from southwest to northeast along the Gulf Coast regional trend, and the formations dip approximately 1 to 2 degrees to the southeast into the Gulf Coast Basin. The southwest extension of the Mexia-Talco Fault zone cuts southwest across the Carrizo-Wilcox aquifer at the Brazos River and parallels the trend of the geologic outcrops of the Carrizo-Wilcox and other Claiborne Group aquifers. These faults may influence down-dip groundwater flow since flow is generally to the southeast in the down-dip direction.

Carrizo-Wilcox Aquifer

The principal aquifer in Study Areas 3 and 4 is the Carrizo-Wilcox aquifer, which is composed of the Carrizo Sand and the formations of the Wilcox Group: Hooper, Simsboro, and Calvert Bluff. The Wilcox Group formations in east-central Texas are identifiable; however, north of the Trinity River and south of the Colorado River the Simsboro is not easily distinguishable, and it is difficult assign positions for the stratigraphic units (Thorkildsen and Price 1991). In shallower areas, the units dip slightly to the southeast towards the Gulf of Mexico, and the dips increase in the deeper areas. The Hooper is the lowest formation in the group and, since it is primarily composed of fine-grained clay, is not used as much as the other units in the aquifer. The Simsboro aquifer is commonly used as a municipal water supply because of its relatively high permeability, thickness, and good quality water (Thorkildsen and Price 1991). The Calvert Bluff Formation is the thickest of the Wilcox Group formations and may be underutilized as an aquifer; however, it has abundant lignite seams that are mined in Study Areas 3 and 4. The Carrizo Sand is more widespread and continuous than the other units and in some places is the principal aquifer (Thorkildsen and Price 1991). Saturated thickness ranges from 200 to approximately 800 feet in the more southerly areas.

The Carrizo-Wilcox aquifer is under water table conditions at the outcrop and is under confined conditions in down-dip areas (Thorkildsen and Price 1991). Recharge is from precipitation and leakage from overlying aquifers in the Claiborne. Discharge is through transpiration, base flow to surface waters, well pumping. Groundwater flow rates in the aquifer range from 10 to 100 feet per year.

Thorkildsen and Price (1991) reported that a majority of the groundwater wells sampled in their study of the Carrizo-Wilcox in central Texas had TDS concentrations of less than 500 mg/L. Recent analyses have shown that in Study Areas 3 and 4, most groundwater samples have TDS concentrations less than 500 mg/L, with a few between 500 and 1,000 mg/L (Boghici 2009).

The aquifers in the Carrizo-Wilcox are commonly used in the shallower areas; however, they are also accessed by deeper wells. In the counties that overlap with Study Area 3, the total pumpage from the Carrizo-Wilcox in 2012 was 38,695 acre-feet. Of that total, approximately 70 percent was used for municipal water supply, 13 percent for agriculture, 11 percent for steam power generation, and 4 percent (1,702 acre-feet) for mining purposes (TWDB 2014a).

The Simsboro is used for water supply by the communities of Bastrop, Bryan, College Station, and Elgin (Thorkildsen and Price 1991), which are located in or near Study Areas 3 and 4. In the counties that overlap with Study Area 4, pumpage from the Carrizo-Wilcox in 2012 was 34,480 acre-feet (TWDB 2014a). Of that total, 53 percent was used for municipal water supply, 28 percent for manufacturing, 19 percent for agriculture, and less than 1 percent for mining. Counties within the CESA for Study Area 4 with reported withdrawal from the Carrizo-Wilcox aquifer affecting Brazos and Burleson counties. Reported pumpage in 2012 was 15,556 acre-feet, 90 percent for water supply to the cities of Bryan and College Station (TWDB 2014a).

The Brazos River and Trinity River alluvial aquifers are present in the CESA boundaries of Study Areas 3 and 4. The Trinity River alluvial aquifer is not considered an important aquifer for current or potential future use (George et al. 2011; Peckham et al. 1963; Trinity River Authority 2012). Of the remaining aquifers, all except the Brazos River alluvial aquifer are underused with comparison to the Carrizo-Wilcox aquifer. Pumpage from these aquifers in 2012 in the counties that overlap with Study Areas 3 and 4 included 236 acre-feet from the Queen City aquifer, 285 feet from the Sparta aquifer, and 36 acre-feet from the Yegua-Jackson aquifer. In Brazos, Burleson, and Robertson counties, reported withdrawal for 2012 from the Brazos River alluvial aquifer was 116,252 acre-feet, nearly all for irrigation (TWDB 2014a).

*Study Areas 5*

The hydrologic units in Study Area 5 and their associated water-bearing properties are presented in **Table 3.2-3** and discussed below.

The formation outcrops trend southwest to northeast. In the vicinity of Study Area 5, the width of the Yegua-Jackson is approximately 20 miles.

The aquifers discussed below all have similar attributes to those discussed in Study Areas 1 through 4. Groundwater flow is primarily to the southeast in the direction of regional structural dip. The aquifers are under unconfined conditions at the outcrop and become confined (artesian) at depth. Recharge occurs at the outcrop from precipitation and surface water sources. Discharge is through base flow to streams, upward migration along fault zones, evapotranspiration, and well pumping.

The Carrizo-Wilcox aquifer is the higher quality aquifer in terms of yield and quality in the Atascosa County area, with the Carrizo Sand more productive than the Wilcox. The down-dip portion (to the slightly saline limit) of the Carrizo-Wilcox aquifer extends under Study Area 5, where the top of the aquifer is approximately 2,800 feet below ground surface (bgs) (Alexander and White 1966). The depth to the top of the Carrizo-Wilcox aquifer makes it a less likely target for water supply drilling than the area to the northwest towards the outcrop where it is shallower. The down-dip areas of both the Queen City and Sparta formations underlie the northwestern part of Study Area 5; however, the top of the Sparta occurs at a depth of approximately 1,200 feet bgs and the Queen City at a depth of approximately 1,800 feet bgs (Alexander and White 1966). In the study area, these aquifers have TDS values in the slightly saline range.

The Yegua-Jackson outcrops within the boundary of Study Area 5; however, most of the water-bearing sands are near the middle of the unit corresponding to the upper Wellborn Sandstone- Manning Clay intervals as described in Section 3.1. The aquifer was elevated to minor aquifer status in 2002, but has not undergone a comprehensive study (Preston 2006). The Yegua Formation occurs at the surface of the study area to depths of more than 800 feet bgs. Although water-bearing sands are present, it is not considered a quality aquifer due to high-mineralization (Alexander and White 1966).

Withdrawal from the Carrizzo-Wilcox aquifer during 2012 in Atascosa and McMullen counties was 37,668 acre-feet (TWDB 2014a). Most of the production was from wells northwest of the study area where the aquifer is shallower and of better quality, as evidenced by the production in McMullen County where only 345 acre-feet were withdrawn 2012. Most of the water (60 percent) was used for irrigation. Groundwater level declines of more than 300 feet have been estimated in the Carrizo-Wilcox aquifer west of Atascosa County; however, declines of up 200 feet may have occurred in the study area (George et al. 2011). In Atascosa and McMullen counties, withdrawals from the Yegua-Jackson, Queen City, and Sparta aquifers were 310, 1,842, and 387 acre-feet, respectively, with the largest portion of the water use for irrigation.

*Study Area 6*

The hydrologic units in Study Area 6 and their associated water-bearing properties are presented in **Table 3.2-4** and discussed below.

**Table 3.2-3 Water-bearing Properties for the Hydrologic Units in Study Area 5**

| Period | Epoch | Group | Formation | Approximate Thickness (feet) | Description | Water-bearing Properties[1] |
|---|---|---|---|---|---|---|
| Quaternary | Pleistocene and Recent | | Alluvium and terrace deposits | 35-50 | Unconsolidated sand, silt, clay and gravel | Small amounts of fresh groundwater |
| | | Jackson Group | Undifferentiated | 1,000 | Clay, sand, silt, bentonitic clay, conglomerate, sand and lignite | Small amounts of slightly to moderately saline groundwater |
| Tertiary | Eocene | Claiborne Group | Yegua | 700-1,100 | Gypsum-bearing clay, interbedded sand, sandy clay, clay, and thin lignite seam | Small to moderate amounts of slightly to moderately saline groundwater in outcrop area |
| | | | Cook Mountain | 410-560 | Clay and shale with limestone and sandstone lenses | Small amounts of slightly saline groundwater in outcrop area |
| | | | Sparta | 110-160 | Sand with clay beds in lower part | Small to moderate amounts of fresh to moderately saline groundwater |
| | | | Weches | 90-170 | Primarily shale with thin beds of sand | Not know to yield groundwater in the area |
| | | | Queen City | 600-1,100 | Sand and shale | Moderate to large quantities of fresh groundwater in central Atascosa County |
| | | | Reklaw | 250-450 | Sand and shale | Small to moderate quantities of fresh groundwater in Central Atascosa County |
| | | | Carrizo Sand | 300-1,300 | Sand with small amounts of shale and lignite | Large quantities of fresh groundwater to many wells |
| | Eocene / Paleocene | Wilcox Group[2] | | 400-1,800 | Lenticular sand bodies within clay and shale, non–continuous lignites | Small to moderate quantities of fresh groundwater |
| | Paleocene | Midway Group | | 450 | Sandy clay | Not known as an aquifer in this area |

[1] Small: less than 100 gpm; moderate: 100 to 1,000 gpm; large: more than 1,000 gpm.

[2] The Wilcox is not differentiated.

Sources: Alexander and White 1966; Preston 2006.

**Table 3.2-4 Water-bearing Properties for the Hydrologic Units in Study Area 6**

| Period | Epoch | Group | Formation | Approximate Thickness (feet) | Description | Water-bearing Properties[1] |
|---|---|---|---|---|---|---|
| Quaternary | Pleistocene and Recent | | Alluvium and terrace deposits | 30 | Unconsolidated sand, silt, clay, and gravel | Small to moderate amounts of fresh groundwater |
| Tertiary | Pliocene (?) | | Uvalde Gravel | 30 | Gravel mostly composed of flint | Does not yield much groundwater |
| | Eocene | Claiborne Group | Bigford | 400-800 | Sandy clay with sandstone lenses, thin limestone beds and lignite seams | Small quantities of slightly to very saline groundwater |
| | | | Carrizo Sand | 200-1,000 | Coarse- to fine-grained sand, silt, shale, and clay | Large to moderate quantities of fresh to slightly saline groundwater |
| | | Wilcox Group | Upper | 150-2,300 | Sand, silt, clay, and thin lignite seams | Small to moderate quantities of fresh to very saline groundwater |
| | Paleocene | | Lower | | | |
| | | Midway Group | | 250-550 | Shale and clay | Not known as an aquifer |
| Cretaceous | | Navarro Group | Escondido | 450-1,300 | Shale and sandstone | Small quantities of fresh to slightly saline water |
| | | | Olmos | 400-920 | Clay, thin sandstones beds, coal | Not known as an aquifer |
| | | Taylor Group | San Miguel | 300-800 | Calcareous sandstone and sandy limestone | Not known as an aquifer |
| | | | Upson Clay | 750+ | Clay, marl, limestone | Small quantities of very saline water |

[1] Small: less than 100 gpm; moderate: 100 to 1,000 gpm; large: more than 1,000 gpm.

Source: Alexander et al. 1964.

The Carrizo-Wilcox aquifer is the most important aquifer in Study Area 6. The outcrop band enters the study area near the intersection of Maverick, Dimmet, and Zavala counties and trends to the northwest for approximately15 miles until it turns 90 degrees to the northeast. Where the outcrop turns northeast, the Wilcox portion is largely covered by Pleistocene terrace deposits. The hydrology of the Carrizo-Wilcox aquifer in Study Area 6 is similar to that described above for the other study areas. At the outcrop, the aquifer is under unconfined conditions and becomes confined (artesian) at depth. Groundwater flow is down-dip with the structural dip of the units. Recharge occurs via infiltration of precipitation at the outcrop and contributions from surface water (Alexander et al. 1964). Discharge occurs through evapotranspiration, spring flow, leakage to other aquifers, and through well pumping. Water quality in the Carrizo-Wilcox in Study Area 6 is largely fresh (less than 1,000 mg/L) (Boghici 2009).

The Bigford Formation outcrops on the east and south of the Carrizo-Wilcox aquifer and yields small amounts of groundwater from the outcrop in Zavala County; however, it is not identified as an important aquifer (Alexander et al. 1964). The Escondido Formation outcrops in the central portion of the study area and yields small amounts of groundwater that is primarily slightly saline; it is not identified as an important aquifer.

In the eastern portion of Study Area 6, the following aquifers have been identified but are of limited extent and use: Elm Creek Alluvium, Uvalde Gravel, Olmos Formation coal seams, and the San Miguel Formation (Dos Republicas Coal Partnership 2008; RCT 2011a).

### 3.2.3.2 Environmental Consequences (Study Areas 1 – 6)

Groundwater resources issues in the study areas include potential direct, indirect, or cumulative impacts to groundwater quantity and quality associated with potential future coal or lignite mining and mine-related groundwater drawdown. Additional issues are associated with potential impacts to the water supply wells (e.g., industrial, municipal, and rural water districts), landowners' water rights, and disruption of the hydrologic cycle resulting in soils with lower infiltration rates and groundwater recharge.

The potential effects to groundwater are as follows:

- Disruption of groundwater flow, recharge, discharge, and water levels during and after mining;
- Post-mining changes in the hydraulic characteristics of the reclaimed mine pits;
- Post-mining changes in recharge characteristics and groundwater flow;
- Degradation of groundwater quality; and
- Impacts on groundwater quantity due to groundwater withdrawal.

Major effects associated with groundwater would be related to the withdrawal of groundwater for purposes of dewatering and depressurization in advance of and during mining. Specific potential impacts due to groundwater withdrawal would include drawdown of aquifers; loss of or reduction of groundwater for industrial, municipal, agricultural, and private use; and potential reduction of water available to surface water resources (i.e., perennial and intermittent streams and springs). Degradation of groundwater quality primarily would occur as the groundwater regime regains equilibrium and moves through backfilled areas.

Water quality degradation also could result from contamination from spills or releases of hazardous materials. Potential impacts due to contamination are discussed in Section 3.12, Hazardous Materials and Solid Waste.

The following analysis is based on development of a "typical mine" as described in Section 2.2.4. Groundwater impacts from potential future mine expansion areas and satellite mines would be assessed as required by applicable regulatory requirements at the time they are proposed, taking into account mine-specific and site-specific information available at that time.

<u>Proposed Action</u>

*Study Area 1*

In Study Area 1, the aquifers above the mineable coals consist of "stacked channel" sandstones with individual sandstones ranging from 60 to 160 feet thick (RCT 2012a). These sandstones are the most transmissive of the overburden materials and are interspersed with finer-grained deposits of silt and clay. The overburden aquifers can either be under confined or unconfined conditions within a mine area. The underburden is commonly composed of fine-grained clays that are much less transmissive than the sand bodies in the overburden, but their thickness is not well defined. However, the lithologic variability above and below the coals dictates whether dewatering and depressurization would occur. Where depressurization and dewatering have occurred, the drawdown effects have been less than expected by predictive models and effects have been transitory. As future mine expansion areas or satellite mines in the study area would likely encounter similar aquifer conditions, impacts to aquifers due to mine-related drawdown are expected to be minimal. In addition, it is not a given that either the overburden or underburden would have to undergo dewatering or depressurization.

Groundwater drawdown at the mines is estimated through modeling or determined by direct measurement in monitoring wells. The overburden and underburden are monitored separately. Because overburden and underburden are composed of different lithological materials and commonly have internal complexity, there are differences in drawdown. From location to location and from mine to mine, there are localized differences in aquifer characteristics and materials that prevent generalization concerning extent of drawdown. Depth of mining would affect the extent of drawdown measured concurrently with mining.

The extent of drawdown effects is based on the modeled or observed maximum extent of the 5-foot drawdown contour around areas of dewatering or depressurization. The 5-foot contour is used because it is the smallest drawdown that can be measured fairly accurately (Office of Surface Mining Reclamation and Enforcement [OSMRE] 1984). Based on modeling and monitoring at the various mines in Study Area 1 (RCT 2012a), the areal extent of drawdown at a typical mine is expected to be about 1 mile. The drawdown at potential future surface coal or lignite mine expansion areas or satellite mines would be further assessed at the time they are proposed.

After the coal is removed, the spoil (overburden and interburden that was removed to access the coal) is backfilled into the pits. The backfill, due to its physical condition, will have altered hydrological properties compared to undisturbed areas. Studies have shown that backfilled spoil initially undergoes a bulking in volume (or fluffing) that results in transmissivity that is comparable to pre-mining overburden (Pollack 1982; Schneider 1977). However, as settlement occurs, transmissivity may decrease over time. As the hydrologic regime recovers from mining and the backfilled material becomes re-saturated, the backfilled areas essentially become unconfined aquifers, and the direction of flow follows topography or moves downdip. The quality of groundwater in backfilled areas may be slightly poorer than groundwater in undisturbed overburden, and there is the potential that as groundwater migrates from backfill areas, groundwater quality would be diminished in the adjacent undisturbed areas. However, analysis by the RCT indicates that because of dilution and the general similarity of groundwater in backfilled and undisturbed areas, there is likely to be little effect on overall groundwater quality outside of a mined area (RCT 2012a).

A major concern regarding groundwater is water use and available supply. The groundwater that is pumped from aquifers to facilitate coal and lignite mining is generally discharged to nearby surface waters or used for dust suppression (Nicot et al. 2011). The groundwater that is pumped to facilitate mining probably represents about 10 to 15 percent of the groundwater pumped from the Carrizo-Wilcox aquifer in the counties that overlap Study Area 1 and does not constitute a major use. In addition, the pumping is temporary, taking place while mining is occurring. Mine-related groundwater pumping impacts for future mines would be confined to the portion of the affected aquifers within a mine-related groundwater drawdown area, until mining ends and groundwater levels recover. In accordance with RCT requirements, water supply would be replaced if water supply wells are impacted by mining operations (see Section 2.2.5.2).

An analysis was conducted to determine the effects of spoils groundwater on undisturbed adjacent overburden groundwater at three mines in Study Area 1 (RCT 2012a). The results of this analysis indicate that, in the mixing area immediately adjacent to the mine spoils, TDS concentrations increased by less than 20 percent over the baseline value at two mines and slightly decreased at one mine. The

TDS values for the mines would generally result in groundwater that would be considered fresh, with TDS less than 1,000 mg/L.

Another potential groundwater quality concern is the presence of pyrite in the deposits. After pyrite is exposed to an oxidizing environment, the oxidation process may result in the acidification of surface and groundwater, resulting in acid mine drainage. However, the generation of acid drainage can be mitigated by returning the spoil to reducing conditions or the presence of carbonate in the spoil (USACE 2010, 2002). In addition, mine operators are required by RCT regulations to identify overburden with strong acid generating potential and handle such soils in a manner to reduce the acid generating potential.

The summary of potential mine-related effects in Study Area 1 are considered to be typical of the impacts likely to be encountered in the area. Impacts associated with a typical mine are expected to be similar in extent and degree as the mines that have been permitted and operating over many years.

*Study Area 2*

The coal seams that are mined in Study Area 2 are generally in the stratigraphically uppermost portion of the Wilcox Group (Hook et al. 2011e). The Green coal zone is at the very top of the Wilcox Group and is overlain by the Carrizo Sand. The other coals are within a few hundred feet of the top of the Wilcox. Overburden dewatering occurs largely in sands in the uppermost Wilcox Group and in the Carrizo Sand. The aquifers are isolated sand bodies that are up to 70 feet thick and are surrounded by beds of silt and clay (RCT 2008). The sands have higher transmissivities as compared to the finer-grained strata and the sands in the overburden typically are unconfined while sands in the underburden are usually confined. Typically, groundwater in the overburden aquifers has better quality than the underburden. For dewatering of the overburden in Study Area 2, the areal extent of drawdown at existing mines has ranged from 0.5 mile to about 1.1miles (RCT 2008; Pastor, Behling, and Wheeler, LLC 2010). The need for underburden depressurization is not likely because currently the operating mines are not conducting depressurization pumping. The drawdown at potential future surface coal or lignite mine expansion areas or satellite mines would be further assessed at the time they are proposed.

As in Study Area 1, the quality of groundwater in backfilled areas may be slightly poorer than groundwater in undisturbed overburden, but the overall effects from mining are likely to be minimal (RCT 2012b). Analytical results for the various mines in Study Area 2 indicate pre- and post- mining increases in TDS in adjacent undisturbed overburden would range from 0.5 to 42 percent, but even the largest increase would represent a change in median TDS concentrations from 80 mg/L to 114 mg/L, indicating low salinity. Further mixing of groundwater outside the spoil areas would cause minimal adverse impacts to water quality.

Water that is pumped from aquifers to facilitate coal mining is generally discharged to nearby surface water or used for dust suppression (Nicot et al. 2011). The water that is pumped to facilitate mining probably represents less than 10 percent of the groundwater that is pumped from the Carrizo-Wilcox aquifer in the counties that overlap Study Area 2 and does not constitute a major use. In addition the pumping is temporary, taking place only while mining is occurring.

The summary of potential effects in Study Area 2 are considered to be typical of the impacts likely to be encountered from mining in the area. Impacts associated a typical mine are expected to be similar in extent and degree to the mines that have been permitted and operating over many years.

*Study Areas 3 and 4*

The Wilcox Group can be divided into three distinct formations and are, in ascending order, the Hooper Formation, Simsboro Formation, and the Calvert Bluff. The thickest and most mineable coals are in the lower and upper Calvert Bluff Formation. In order to mine seams in the lower Calvert Bluff, it may be necessary to dewater the aquifers in the Calvert Bluff and mining upper Calvert Bluff seams may require dewatering Calvert Bluff aquifers and the Carrizo Sand aquifer. In addition to dewatering the overburden, mines in Study Areas 3 and 4 also require depressurization pumping of the aquifers in the Simsboro Formation, so it is likely that dewatering and depressurization would have to be conducted at any future mine expansion areas or satellite mines. For the overburden, modeling and monitoring conducted for existing mines in these study areas indicate that drawdown at a typical mine could extend from 0.5 mile to almost 2 miles (RCT 2011c, 2010). The drawdown at potential future surface coal or lignite mine expansion areas or satellite mines would be further assessed at the time they are proposed.

In Study Area 3, modeling for one mine permit indicated that underburden depressurization drawdown effects could extend as far as approximately 3.75 miles from the mining area (Pastor, Behling, and Wheeler 2005). In Study Area 4, Simsboro (underburden) could extend as far as 15 miles from the mine area (R.W. Hardin & Associates 2013). However, the presence of Mexia-Talco Fault zone within 10 miles down dip from the mine area may limit the extent of drawdown effects since the faults are generally impermeable (USACE 2002).

Similar to Study Areas 1 and 2, the quality of groundwater in backfilled areas of Study Areas 3 and 4 may be poorer than groundwater in undisturbed overburden, but the differences in water quality are likely to be minimal (RCT 2011c, 2010). Analysis results for the various mines in Study Area 3 indicate pre- and post- mining increases of TDS in the mixing zones adjacent to the spoils areas would range from 3 to 39 percent, at most causing an increase in TDS concentrations of 30 mg/L with TDS concentrations below 500 mg/L. Further mixing of groundwater outside the spoil areas would present minimal adverse impacts to water quality. In Study Area 4, research at one mine that is now closed indicated that although groundwater in spoil areas had lower quality with higher TDS than groundwater in adjacent undisturbed areas, mixing of waters and solute transport mechanisms would make the water similar to pre-mine water by the time it reached the mine permit boundary (RCT 2011c, 2010).

Water that is pumped from aquifers to facilitate coal mining is generally discharged to nearby surface water or used for dust suppression (Nicot et al. 2011). In Study Areas 3 and 4, the water that is pumped to facilitate mining may represent about 30 percent of the groundwater pumped in the counties that overlap these areas. Mine-related groundwater pumping impacts for future mines would be confined to the portion of the affected aquifers within a mine-related groundwater drawdown area, until mining ends and groundwater levels recover. In accordance with RCT requirements, water supply would be replaced if water supply wells are impacted by mining operations (see Section 2.2.5.2).

The summary of potential effects in Areas 3 and 4 are considered to be typical of the impacts likely to be encountered from mining in the area. Impacts associated with a typical mine are expected to be similar in extent and degree to the mines that have been permitted and operating over many years.

*Study Area 5*

One active mine in Study Area 5 does not conduct dewatering of the overburden, but needs to depressurize the underburden to prevent heaving of pit floors because of aquifers that are below the coal being mined. The extent of groundwater drawdown is expected to be as far as approximately 3 miles from an active mine (Pastor, Behling, and Wheeler 2008). The drawdown at potential future surface coal or lignite mine expansion areas or satellite mines would be further assessed at the time they are proposed.

In this study area, mine water that is withdrawn for depressurization is disposed in injection disposal wells because it is moderately saline, ranging from 6,000 to 8,000 mg/L TDS and is not appropriate for surface discharge (Pastor, Behling, and Wheeler 2007). The overburden at the mine contains alluvial aquifers and limited sandstone aquifers, but water from these aquifers is little utilized. Groundwater quality in backfilled areas is expected to be minimally affected by mining. Because the water pumped for depressurization is of poor quality, the water withdrawn should not have adverse effects on potable water supplies.

The potential effects in Study Area 5 are typical of the impacts likely to be encountered in the area. Impacts associated with a typical mine are expected to be similar in extent and degree to the mining activities that have been permitted and operating for many years.

*Study Area 6*

No dewatering or depressurization activities are expected to occur in Study Area 6 (RCT 2011a). Therefore, potential adverse impacts to groundwater due to drawdown are not expected.

In backfilled areas, TDS concentrations in the Elm Creek alluvium may increase from 3,335 mg/L to 3,735 mg/L post-mining (RCT 2011a) but this change is too small to have any measureable effect on water quality.

The summary of potential effects in Study Area 6 are typical of the impacts likely to be encountered in the area. Impacts associated with a typical mine are expected to be similar in extent and degree to those previously permitted and operating mining operations.

No Action

Impacts under the No Action would be the same as those described for the Proposed Action.

### 3.2.3.3 Cumulative Impacts

The cumulative impacts for groundwater resources involve estimated consumption of water for coal mining in comparison to consumptive uses for extraction of other mineral resources (oil and gas) and overall estimated future water consumption. Most of the study areas overlap areas of major oil and gas development primarily involving the extraction of unconventional shale hydrocarbon resources. Development of shale resources is heavily dependent on the use of hydraulic fracturing which consumes large amounts of water in comparison to conventional oil and gas reservoir stimulation.

**Table 3.2-5** compares the projected future water demand in the six study areas from 2020 through 2050. Shown are the estimated demands for coal mining, oil and gas development, and total water demand. The total water demand represents surface and groundwater and uses include irrigation, livestock, manufacturing, mining, municipal, and steam power generation. The oil and gas category includes water for drilling, completions (including hydraulic fracturing), and secondary recovery and is comprised of about 70 percent groundwater (Nicot et al. 2011). The sources are expected to include groundwater and surface water. In Study Area 5, Nicot et al. (2011) projected zero usage because the water withdrawn for dewatering/depressurization would not be usable and currently is disposed by deep underground injection. However, dewatering/depressuriztion for a typical mine in Study Areas 1 through 5 incrementally would contribute to groundwater quantity impacts until mining has been completed and groundwater levels recover. In accordance with RCT requirements, water supply would be replaced if water supply wells are impacted by mining operations (see Section 2.2.5.2). In Study Area 6, dewatering and depressurization are not expected to occur to any great degree (RCT 2011a).

**Table 3.2-5 Future Estimated Water Use**

| Analysis Area | Use Category | 2020 Usage (acre-feet[1]) | 2040 Usage (acre-feet) | 2050 Usage (acre-feet) |
|---|---|---|---|---|
| Area 1 | Coal | 1,556 | 1,862 | 2,036 |
| | Oil and Gas | 79 | 67 | 58 |
| | Total Demand | 101,694 | 124,612 | 1,396,975 |

**Table 3.2-5 Future Estimated Water Use**

| Analysis Area | Use Category | 2020 Usage (acre-feet[1]) | 2040 Usage (acre-feet) | 2050 Usage (acre-feet) |
|---|---|---|---|---|
| Area 2 | Coal | 3050 | 4,124 | 4,409 |
| | Oil and Gas | 14,277 | 7,545 | 3,837 |
| | Total Demand | 296,831 | 347,751 | 385,272 |
| Area 3 | Coal | 18,959 | 21,657 | 25,106 |
| | Oil and Gas | 3,944 | 3,843 | 2,426 |
| | Total Demand | 236,817 | 273,985 | 302,254 |
| Area 4 | Coal | 5,518 | 14,522 | 15,882 |
| | Oil and Gas | 0 | 0 | 0 |
| | Total Demand | 236,617 | 313,633 | 362,428 |
| Area 5 | Coal | 0 | 0 | 0 |
| | Oil and Gas | 7,499 | 6,120 | 4,218 |
| | Total Demand | 49,807 | 51,510 | 50,139 |
| Area 6 | Coal | 0 | 0 | 0 |
| | Oil and Gas | 11,010 | 8,363 | 5,816 |
| | Total Demand | 140,338 | 137,673 | 134,084 |

[1] 1 acre-foot = 325,851 gallons.

Source: Nicot et al. 2011; TWDB 2014b.

#### 3.2.3.4 Monitoring and Mitigation Measures

No monitoring or mitigation measures are recommended.

#### 3.2.3.5 Residual Adverse Effects

The principal residual adverse effect involves the mixing of water in backfilled areas. The mixing may take place over the span of many years.

### 3.2.4 Surface Water

#### 3.2.4.1 Affected Environment

Descriptions and assessments of surface water resources are oriented to the watersheds encompassing the study areas and their associated CESAs. The USGS has delineated river basins and their subdivisions across the country into Hydrologic Units, which are then further specified at progressively greater detail through numeric Hydrologic Unit Codes (HUCs). This configuration is referenced in water quality documentation by the USEPA, and in other watershed studies.

The selected scale for this EIS is the HUC 10 watershed, which provides information at a reasonable level of detail for assessment purposes. Since each pair of numbers identifies a level of hydrographic classification; a HUC 10 delineation also can be referred to as a fifth-order hydrologic unit or watershed.

The State of Texas also has delineated major river basins and their subdivisions to manage water resources and water quality at local and regional levels. For general reference, these major river basins where the study areas occur are indicated in **Figure 3.2-5**. River basin authorities, the TWDB, and the TCEQ orient their respective programs to these basins and subareas, and to stream segments and lakes within them.

A classified segment is a waterbody or portion of a waterbody that is defined individually by TCEQ in state surface water quality standards. They are established by TCEQ on the basis of relatively homogeneous hydrology, water chemistry, and physical characteristics. Defined segments provide a basic unit for assigning site-specific standards and for applying state water quality management programs. Classified segments may include streams and rivers, lakes or reservoirs, wetlands, bays, or estuaries (TCEQ 2004).

Surface water quality standards are assigned according to beneficial uses, whether existing, designated, presumed, or attainable uses (TCEQ 2014a). Designated uses are those formally assigned to specific waterbodies and typically include Domestic Water Supply, Aquatic Life categories, Recreation categories, General Uses and associated criteria, Fish Consumption, and sometimes Aquifer Protection. Classified stream segments or other waterbodies are those that are specifically listed in the state water quality standards as having designated site-specific uses and criteria. Presumed uses apply to generic categories of waterbodies (e.g., perennial streams).

A number of unclassified streams also have listings for specific uses (TCEQ 2012). Typically the major beneficial use is a level of Aquatic Life Use, with accompanying dissolved oxygen and other habitat-oriented standards. Water quality standards for dissolved oxygen concentrations vary according to Aquatic Life Use categories. For Low Aquatic Life Use, the standard is 3.0 mg/L, for Intermediate Aquatic Life Use it is 4.0 mg/L, and for High Aquatic Life Use it is 5.0 mg/L.

Perennial streams, rivers, and lakes that are not specifically listed by TCEQ as classified (or selected unclassified) segments are presumed to have high aquatic life uses and corresponding dissolved oxygen criteria (TCEQ 2014a). Intermittent streams having seasonal aquatic life uses must maintain appropriate dissolved oxygen concentrations during the appropriate seasons of use. Unclassified intermittent streams with perennial pools are presumed to have a limited aquatic life use, and have related dissolved oxygen criteria (TCEQ 2014a). A formal procedure for assigning recreational uses also is set forth in the state standards.

Impaired waterbodies are those that have water quality characteristics that no longer support designated or presumed uses. State-wide monitoring is conducted to assess surface water quality conditions. Inventories and assessments are published every 2 years by the state in accordance with USEPA requirements. Impaired water quality categories are assigned to waters for which pollutants have been documented to reduce water quality such that designated or presumed uses are no longer supported. A Category 4 impaired waterbody has a standard that is not supported or is threatened for one or more designated uses, but for various reasons it does not require the further development of a pollutant Total Maximum Daily Loads (TMDLs). Category 4 includes impaired waters for which TMDLs have already been adopted, or for which other management strategies are underway to improve water quality (TCEQ 2012). A Category 5 waterbody does not meet applicable water quality standards or is threatened for one or more designated uses by one or more pollutants (TCEQ 2012). Category 5 includes impaired waters for which TMDLs or other management strategies are planned (TCEQ 2012).

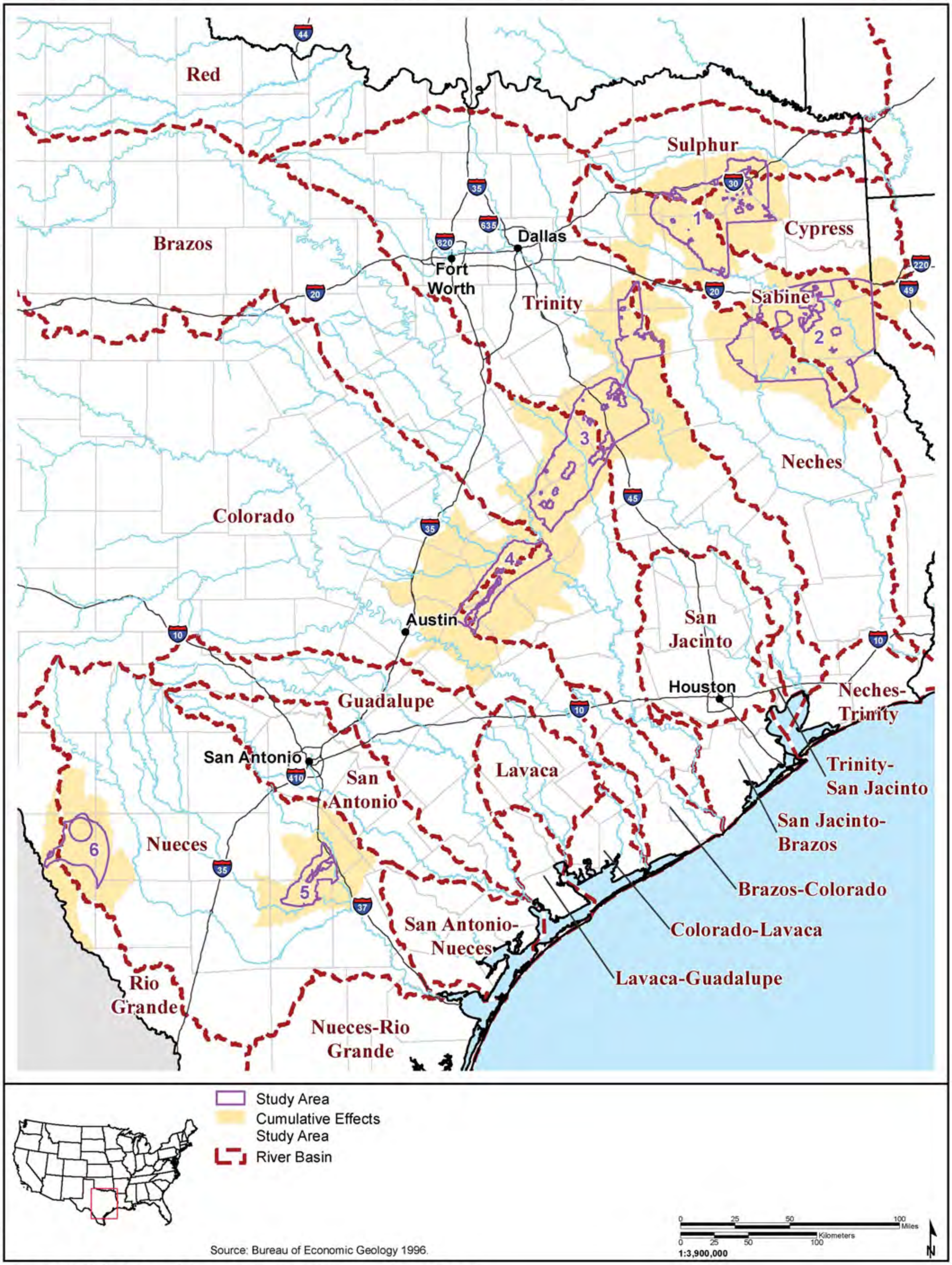





Figure 3.2-5 Major River Basins in the Analysis Area

Texas water quality standards form part of a CWA Section 401 (Water Quality Certification) approval process. TCEQ administers a water quality anti-degradation policy that applies to actions regulated under state and federal authority that could increase pollution of the water in the state (TCEQ 2012). Discharges authorized by the Texas Water Code, the federal CWA, or other applicable laws must not lower water quality to the extent that the Texas Surface Water Quality Standards are not attained (TCEQ 2012).

Texas water quality standards indicate that vegetative and physical components of the aquatic environment are to be maintained or mitigated to protect aquatic life uses. Procedures to protect habitat in dredge-and-fill permits are specified in Section 404 of the federal CWA, and in Chapter 279, Title 30, of the TAC (relating to Water Quality Certification) (TCEQ 2014a).

Study Area 1

*Surface Water Features and Flows*

Study Area 1 is located in the White Oak Bayou portion of the Big Cypress and Sulphur River basins, and the Lake Fork portion of the Sabine River Basin. (There is also a negligible area of 0.1 acre in the Neches River Basin.) Major flow systems include White Oak Creek across the northern portion of the study area, and a number of other streams mainly flowing southeastward. Big Cypress Creek flows southeastward from the Monticello Reservoir headwaters through Camp and Morris counties, and Little Cypress Creek (or Bayou) flows southeastward through Upshur County. Big Sandy Creek and the Lake Fork flow southeastward mainly through Wood County, and the Sabine River forms the county line between Wood and Smith Counties in the southern part of the study area. These features, the watersheds occurring within Study Area 1 (approximately 1,513 square miles), and the CESA (approximately 1,493 square miles) are indicated in **Figure 3.2-6** and in **Table 3.2-6**. **Table 3.2-6** also includes small portions of some HUC 10 watersheds (i.e., Harris Creek, Prairie Creek-Sabine River, and Black Fork Creek-Neches River) in the CESA. Based on groundwater resource inputs, these additional areas represent locations where future mine-related groundwater pumping could affect groundwater levels, as well as surface water features that have a hydraulic connection to an affected aquifer, up to a few miles beyond a drainage. General flow characteristics for streams with reasonably long historical periods of record are indicated in **Table 3.2-7**.

The flows indicated in **Table 3.2-7** are affected by reservoir storage and releases. Therefore, although they reflect wide seasonal flow variations, they do not represent natural flow regimes. Based on NHD examinations, approximately 831 miles of perennial stream reaches are within Study Area 1. An additional 942 miles of perennial stream reaches occur in the outlying CESA (portions of the CESA outside of the study area), bringing the total of perennial stream lengths within the analysis area to 1,773 miles. Approximately 2,808 miles of intermittent stream reaches are within Study Area 1. Approximately 3,363 miles of intermittent stream occur in the outlying CESA, bringing the total of intermittent stream lengths within the analysis area to 6,171 miles. In the NHD, the intermittent stream category includes ephemeral streams.

Streamflows originate from both rainfall and runoff as well as from groundwater contributions (baseflow). Low-flow rates in **Table 3.2-7** are more likely to reflect minimum flow releases from upstream reservoirs. However, where the streams intersect the water table, groundwater contributions also provide flow in the channel on at least a seasonal basis. For example, in 1963 and 1964 (prior to the construction of Lake Fork Reservoir), Lake Fork Creek near Quitman went dry from late summer through early winter (Broom 1968). That gage has a watershed area of 585 square miles. In contrast, Big Sandy Creek near Big Sandy maintained a minimum flow of 8 cfs with a watershed area of 231 square miles (Broom 1968). Big Sandy Creek receives groundwater discharge from the outcrop of the Sparta-Queen City Aquifer.

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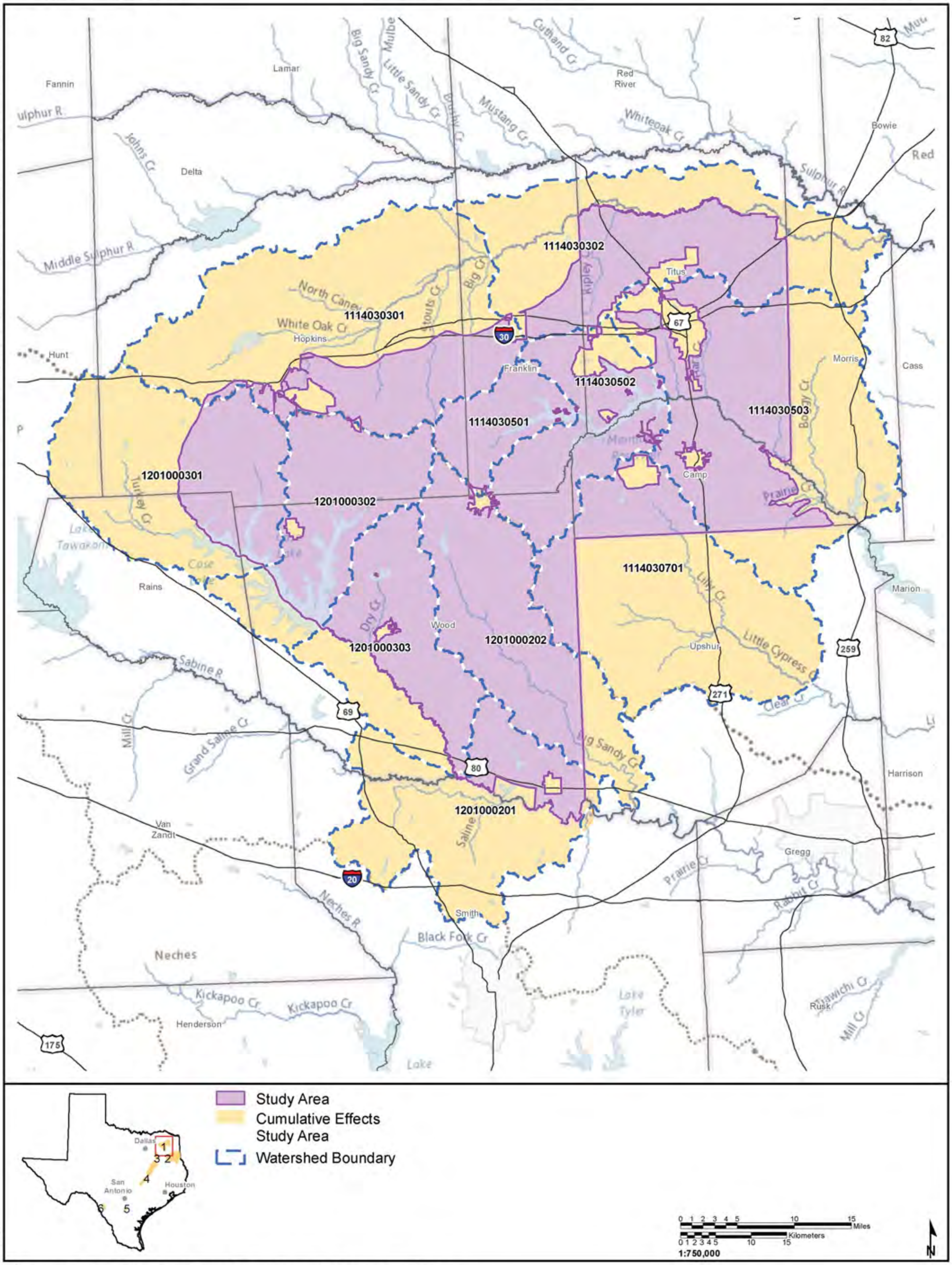


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**Figure 3.2-6 Study Area 1 Surface Water Features**

**Table 3.2-6 Watersheds, Study Area 1**

| HUC 10 Watershed Identifier | Watershed Name | Watershed Area within Study Area (acres) | Watershed Area in CESA Outside of Study Area (acres) | Total Watershed Area within Analysis Area (acres) |
|---|---|---|---|---|
| 1114030301 | Upper White Oak Creek | 73,368 | 212,425 | 285,793 |
| 1114030302 | Lower White Oak Creek | 91,172 | 133,650 | 224,822 |
| 1114030501 | Glade Branch-Big Cypress Creek | 47,029 | 539 | 47,569 |
| 1114030502 | Brushy Creek-Big Cypress Creek | 92,372 | 12,846 | 105,218 |
| 1114030503 | Boggy Creek | 139,976 | 143,764 | 283,740 |
| 1114030701 | Little Cypress Creek | 52,135 | 170,060 | 222,195 |
| 1201000201 | Old Sabine River Channel-Sabine River | 36,026 | 129,113 | 165,140 |
| 1201000202 | Lake Winnsboro-Big Sandy Creek | 124,051 | 29,454 | 153,504 |
| 1201000203 | Harris Creek | 0 | 803 | 803 |
| 1201000204 | Prairie Creek-Sabine River | 0 | 144 | 144 |
| 1201000301 | Lake Fork Creek-Case Lake | 71,151 | 115,967 | 187,118 |
| 1201000302 | Running Creek-Case Lake | 97,864 | 24,091 | 121,955 |
| 1201000303 | Dry Creek-Lake Fork Creek | 87,354 | 38,359 | 125,712 |
| 1202000101 | Black Fork Creek-Neches River | 0 | 0.1 | 0.1 |
| **Totals** | | **912,497** | **1,011,214** | **1,923,711** |

**Table 3.2-7 General Monthly Flow Characteristics for Select Streams in Study Area 1** [1]

| Waterbody | Monitoring Site | General Location | Drainage Area (square miles) | Period of Record | Average High Flow (cfs) | Average Low Flow (cfs) |
|---|---|---|---|---|---|---|
| White Oak Creek near Talco | USGS 07343500 | Near Highway 96 crossing of White Oak Creek in northwest Titus County | 494 | 10/1972 to 09/2013 | 891 (Mar) | 75 (Sep) |
| Big Cypress Creek near Pittsburg | USGS 07344493 | At Highway 271 crossing of Big Cypress Creek directly south of Mount Pleasant | 278 | 01/2005 to 09/2013 | 194 (May) | 30 (Jun, Jul) |
| Big Cypress Creek near Pittsburg | USGS 07344500 | Near Highway 11 crossing of Big Cypress Creek west of Cason, Titus County | 370 | 10/1970 to 09/2013 | 420 (Mar) | 13 (Aug) |
| Lake Fork Creek near Quitman | USGS 08019000 | Near the Highway 37/45 crossing of Lake Fork Creek at the Dry Creek confluence below Lake Fork Reservoir, Wood County | 585 | 10/1979 to 09/2013 | 772 (Mar) | 56 (Sep) |

**Table 3.2-7 General Monthly Flow Characteristics for Select Streams in Study Area 1 [1]**

| Waterbody | Monitoring Site | General Location | Drainage Area (square miles) | Period of Record | Average High Flow (cfs) | Average Low Flow (cfs) |
|---|---|---|---|---|---|---|
| Sabine River near Mineola | USGS 08018500 | Sabine River, Highway 69 crossing north of Hideaway, southern Wood County | 1,357 | 10/1967 to 09/2013 | 1,590 (Mar) | 55 (Aug) |
| Sabine River near Hawkins | USGS 08019200 | Sabine River in southeast corner of Wood County north of Owentown | 2,259 | 10/1997 to 09/2103 | 2,560 (Mar) | 148 (Aug) |

[1] Based on available data for a multi-year period of record.

Note: cfs = cubic feet per second.

Source: USGS-National Water Information Service (NWIS) 2014.

Recent large streamflows contain reservoir releases in addition to runoff during and after rains. Storm event magnitudes, in inches over durations of a quarter-day, half-day, or a full day, have been approximated based on the current National Weather Service reference for the area (see **Table 3.2-8**). The recurrence intervals, in years, are indicated across the top row of the table. The recurrence interval is a long-term average that reflects the probability (based on 100 percent) of an event happening in any given year. For example, a 2-year event has a 50 percent chance of occurring in any given year; a 10-year event has a 10 percent chance of occurring in any given year, and a 100-year event has a 1 percent chance of occurring in any given year. Rainfall intensity is reflected in the duration. For example, for a 10-year event, approximately 4.9 inches of rain would fall in 6 hours compared to 6.8 inches falling in 24 hours as shown in **Table 3.2-8**.

**Table 3.2-8 Estimates of Storm Event Magnitudes for Study Area 1 (inches)**

| Storm Event Duration | Storm Event Recurrence Intervals | | | | |
|---|---|---|---|---|---|
| | **2-year** | **10-year** | **25-year** | **50-year** | **100-year** |
| **6-hour** | 3.2 | 4.9 | 5.8 | 6.4 | 7.0 |
| **12-hour** | 3.8 | 5.8 | 6.8 | 7.8 | 8.8 |
| **24-hour** | 4.3 | 6.8 | 7.9 | 9.0 | 10.0 |

Source: Hershfield 1961.

A number of large impoundments occur in the analysis area (**Figure 3.2-6**). Lake Fork Reservoir (shown in **Figure 3.2-6** as Case Lake), provides a storage capacity of 617,857 acre-feet on Lake Fork Creek, and is owned and operated by the Sabine River Authority. It was constructed primarily to provide water for industrial uses and municipalities (Longview and Dallas), but also provides recreation. The Lake Bob Sandlin/Monticello Reservoir/Lake Cypress Springs system consists of three adjoining reservoirs separated by dams. Lake Bob Sandlin supplies the City of Mount Pleasant, Luminant, and City of Pittsburg. Monticello dam and reservoir are owned and operated for industrial purposes by the Texas Utilities Electric Company (TWDB 2014c). Lake Cypress Springs is owned and operated for municipal and irrigation uses; it supplies water to the Cypress Springs Special Utility District, City of Mount Vernon, City of Winnsboro, and the M&W Recreational Facility (Franklin County Water District 2006).

*Floodplains*

Delineated floodplains, defined as Federal Emergency Management Agency (FEMA) Flood Hazard Zone A, have been identified along the major streams in the study area as indicated in **Figure 3.2-7**. Some counties, including Morris, Camp, Franklin, and Rains, do not have current floodplain delineations under the FEMA program. However, floodplains do occur along major streams and their tributaries in those counties, similar to the floodplains depicted in the other counties.

Within Study Area 1, major streams bordered by relatively broad floodplains include the Lake Fork Creek, Big Sandy Creek, and Big Cypress Creek. Within the associated CESA, White Oak Creek and the Sabine River also support broad floodplains. Smaller floodplains occur as narrow, low-lying stream deposits along many of the streams and sloughs in the region. Within Study Area 1, delineated floodplains occupy approximately 231,630 acres (362 square miles) combined in Titus, Hopkins, and Wood counties. In the outlying CESA, approximately 274,630 acres (429 square miles) of additional delineated floodplains occur in these counties combined with Upshur County.

*Surface Water Uses and Quality*

There are no identified navigable streams in Study Area 1 or its CESA (USACE 1999). The Sulphur River is a navigable stream outside the analysis area to the north, and the Sabine River is navigable to its confluence with Big Sandy Creek at the southeastern edge of the CESA (**Figure 3.2-1**).

The following waterbodies are sole-source drinking water supplies (TAC 2014d):

- Lake Cypress Springs
- Lake Bob Sandlin
- Lake Fork Reservoir
- Big Sandy Creek

The following communities or facilities have surface water intakes at the indicated sources within Study Area 1 or its CESA (TCEQ 2014b):

- City of Mount Pleasant (Study Area 1 – Tankersley Creek Lake, Lake Bob Sandlin)
- City of Mount Vernon (Study Area 1 – Mount Vernon Municipal Reservoir, Lake Bob Sandlin, Lake Cypress Springs)
- City of Sulphur Springs (CESA – Lake Sulphur Springs)
- City of White Oak (CESA – Big Sandy Creek)
- International Alert Academy (CESA – Big Sandy Creek, Lake Loma)
- City of Quitman (Study Area 1 – Lake Fork Reservoir)
- Cypress Springs Special Utility District (Study Area 1 – Lake Cypress Springs)
- City of Winnsboro (Study Area 1 – Lake Cypress Springs)

Several USGS water quality stations have been monitored recently within Study Area 1 or nearby. The monitoring data are summarized in **Table 3.2-9**. In addition, a large amount of surface water quality data is available from TCEQ and the Texas Clean Rivers Program, which can provide information for more detailed future analyses, if needed.

**Table 3.2-9 Water Quality Overview for Streams in or near Study Area 1**

| Location | Identifier | Sampling Period | Measure | pH | TDS | Specific Conductance | Dissolved Oxygen[1] | Total Suspended Solids | Turbidity | Hardness | Calcium | Magnesium | Sodium | Bicarbonate | Chloride | Sulfate | Iron | Manganese |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Big Cypress Creek near Pittsburg | USGS 07344500 | 03/2000 to 08/2006 | Median | 7.4 | 274 | 433.5 | 5.9/74 | 22 | 18 | 100.3 | 27.5 | 6.75 | 38.1 | 67 | 40.5 | 70.7 | 72.3 | 69.1 |
| | | | Range | 6.6 to 7.8 | 64 to 772 | 79 to 1,100 | 4.2/52 to 13.4/116 | 10 to 232 | 5.4 to 260 | 21.9 to 230 | 5.34 to 78.3 | 2.1 to 10.3 | 4.7 to 124 | 19 to 118 | 4.9 to 106 | 10.8 to 217 | 7.3 to 313 | 14.2 to 344 |
| White Oak Creek near Talco, Texas | USGS 07343500 | 01/2000 to 09/2007 | Median | 7.6 | 189.5 | 323.5 | 3.95/52 | 44 | 57.5 | 70.5 | 18.2 | 6.31 | 30.8 | 91 | 23.3 | 38.3 | No Data | 153 |
| | | | Range | 7.3 to 8.0 | 133 to 468 | 230 to 951 | 1.2/14 to 9/82 | 23 to 120 | 27 to 130 | 51.8 to 132 | 13.2 to 31.8 | 4.1 to 12.8 | 20 to 128 | 61 to 279 | 13.3 to 82.7 | 24.5 to 97.5 | No Data | 84.4 to 306 |
| Sabine River near Mineola | USGS 08018500 | 01/1990 to 08/2000 | Median | 7.4 | 190 | 338.5 | 8/86 | No Data | No Data | 86.95 | 25.5 | 6 | 29 | No Data | 43 | 39 | No Data | No Data |
| | | | Range | 6.8 to 8.0 | 75 to 3,460 | 98 to 7,250 | 5.2/64 to 13.5/123 | No Data | No Data | 34.8 to 282 | 9.5 to 85 | 2.7 to 17 | 9.2 to 1,200 | No Data | 6.8 to 2,000 | 11 to 120 | No Data | No Data |

[1] Dissolved oxygen values reflect concentration (mg/L) and percent saturation.

Note: All data in mg/L except for pH (standard units), specific conductance (microsiemens per centimeter), iron and manganese (mg/L), and turbidity (Nephelometric Turbidity Units for Big Cypress Creek; Nephelometric Turbidity Ratio Units for White Oak Creek).

Source: USGS-NWIS 2014.

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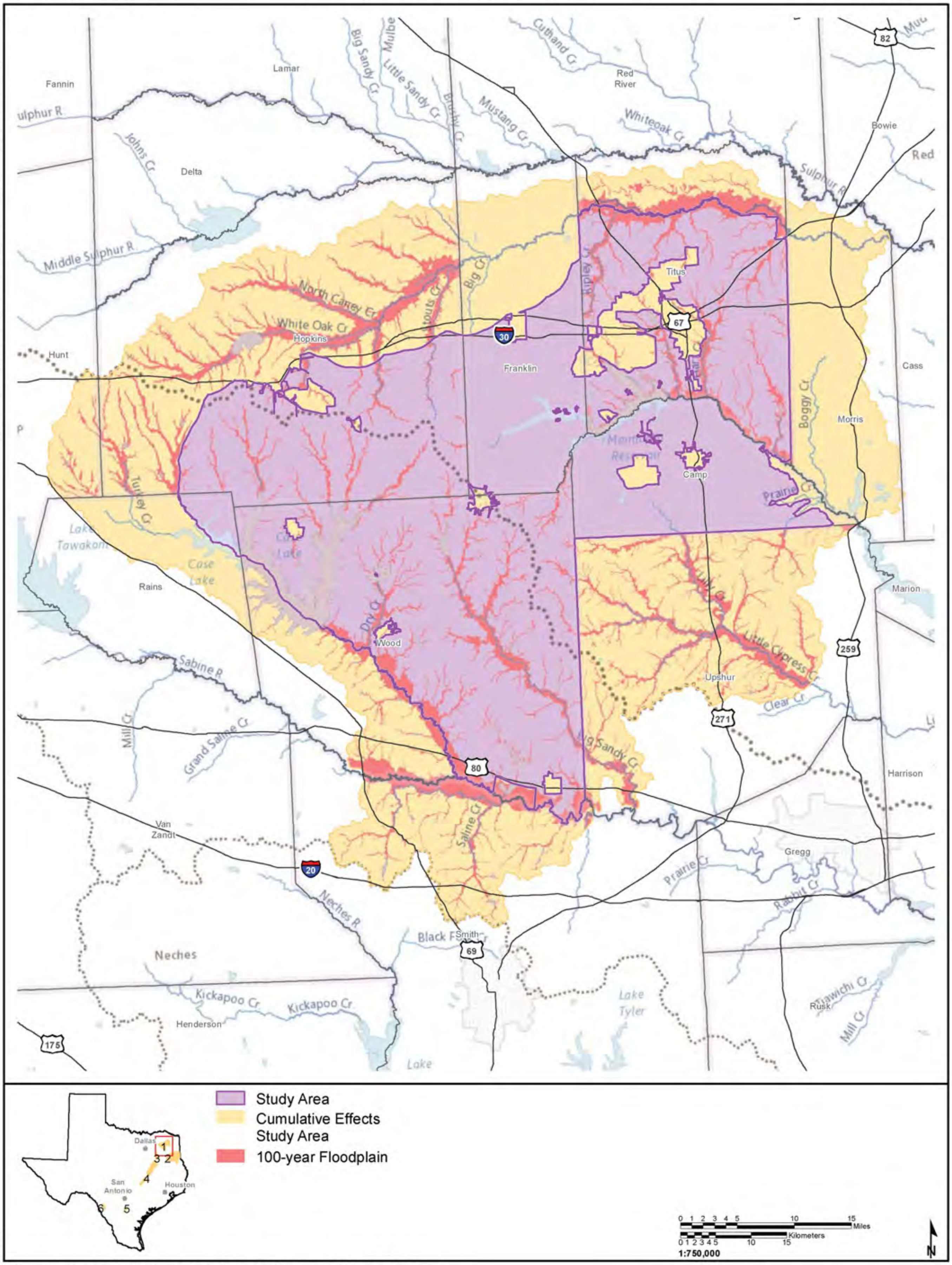


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Figure 3.2-7 100-year Floodplains - Study Area 1

Part of Study Area 1 lies within the Sulphur River Basin (TCEQ Basin 03). Within the TCEQ Sulphur-South Sulphur area (TCEQ Segment 0303), there are no classified waterbody segments in Study Area 1 or its associated CESA. White Oak Creek (Segment 0303B) is an unclassified stream that has a site-specific dissolved oxygen standard of 4.0 mg/L for Intermediate Aquatic Life Use (TCEQ).

The following classified segments occur within the Cypress Creek Basin (TCEQ Basin 04):

- 0404 (Big Cypress Creek below Lake Bob Sandlin)
- 0405 (Lake Cypress Springs)
- 0408 (Lake Bob Sandlin)
- 0409 (Little Cypress Bayou [Creek])

In addition, within TCEQ Basin 04 the following unclassified streams in the analysis area have specified Aquatic Life Uses as indicated, and corresponding dissolved oxygen standards (TCEQ):

- Sparks Branch (Intermediate)
- Tankersley Creek (High)
- Hart Creek (High)
- Walnut Creek (High)

The following classified waterbody segments occur within the Sabine River Basin (TCEQ Basin 05):

- 0506 (Sabine River below Lake Tawakoni)
- 0512 (Lake Fork Reservoir)
- 0514 (Big Sandy Creek)
- 0515 (Lake Fork Creek)

Unclassified streams with specific Aquatic Life Use standards occur in the Wood County portion of Segment 0506 (TCEQ 2014a):

- Ninemile Creek (High)
- Number 5 Branch (High)

In general, there were only a few water quality standards exceedances in the sampling used for the TCEQ integrated assessment (TCEQ 2012). Water quality in White Oak Creek had some standards exceedances for dissolved oxygen, *E. coli* bacteria, chlorophyll-a, and orthophosphorus (TCEQ 2012). In upper White Oak Creek (Segment 0303B_04), total phosphorus and nitrate concentrations have also exceeded General Use standards. In other waterbodies, relatively few exceedances occurred and mainly involved pH, and chorophyll-a, and depressed dissolved oxygen levels.

More consistent water quality issues are reflected in the bi-annual list of impaired waterbodies prepared by TCEQ in accordance with CWA Section 303(d). Impaired waters in Study Area 1 and its CESA include (TCEQ 2012):

- White Oak Creek for bacteria and depressed levels of dissolved oxygen (Category 5);
- Big Cypress Creek below Lake Bob Sandlin for bacteria (Category 5);
- Tankersley Creek for bacteria (Category 5);

- Hart Creek for bacteria (Category 5);
- The upper 2,600 acres of Lake Cypress Springs, for pH (Category 5);
- Little Cypress Bayou (Creek) for bacteria and depressed levels of dissolved oxygen (Category 5);
- Running Creek in Segment 0512B (Lake Fork Reservoir) for bacteria (Category 5);
- Elm Creek in Segment 0512B (Lake Fork Reservoir) for bacteria (Category 5); and
- Big Sandy Creek for bacteria (Category 5).

Study Area 2

*Surface Water Features and Flows*

Study Area 2 is mainly located in the Sabine River Basin, with smaller portions in the Angelina, Red-Saline, and Big Cypress-Sulphur river basins. Major flow systems include the mainstem of the Sabine River; its eastward-flowing tributaries Martin Creek, Murvaul Creek, and Flat Fork Creek; the Angelina River headwaters including Mud Creek; and the upper Attoyac River. In the far northeastern part of the analysis area, Cross Lake and the Cross Bayou and Bayou Pierre watersheds occur mainly in the CESA extending into Caddo County, Louisiana.

These features, the watersheds occurring within the Study Area 2 (approximately 2,509 square miles), and the outlying CESA (approximately 2,041 square miles) are indicated in **Figure 3.2-8** and **Table 3.2-10**. **Table 3.2-10** also includes small portions of some HUC 10 watersheds (i.e., Big Cypress Bayou-Frontal Caddo Lake, Little Cypress Bayou, and Grand Cane Bayou-Toledo Bend Reservoir) in the CESA. Based on groundwater resource inputs, these additional areas represent locations where future mine-related groundwater pumping could affect groundwater levels, as well as surface water features that have a hydraulic connection to an affected aquifer, up to a few miles beyond a drainage divide.

General flow characteristics for streams with reasonably long historical periods of record are indicated in **Table 3.2-11**.

Some of the flows indicated in **Table 3.2-11** are affected by reservoir storage and releases. These streams primarily include Mud Creek, the Sabine River, and Martin Creek. Therefore, although these flows reflect seasonal flow variations, they do not represent natural flow regimes. According to the NHD, approximately 1,797 miles of perennial stream reaches are within Study Area 2. Additionally, 1,272 miles of perennial stream reaches occur in the outlying CESA, bringing the total of perennial stream lengths within the analysis area to 3,069 miles. Approximately 5,968 miles of intermittent stream reaches are within Study Area 2. Approximately 3,987 intermittent stream miles occur in the outlying CESA, bringing the total of intermittent stream lengths within the analysis area to 9,955 miles. In the NHD, the intermittent stream category includes ephemeral streams.

Storm event magnitudes, in inches over durations of a quarter-day, half-day, or a full day, have been approximated based on the current National Weather Service reference for the area (see **Table 3.2-12**). The recurrence intervals, in years, are long-term averages that reflect the probability (based on 100 percent) of an event happening in any given year. For example, an event with an estimated 2-year recurrence interval has a 50 percent chance of occurring in any given year. Rainfall intensity is reflected in the duration. For example, for a 10-year event, approximately 5.0 inches of rain would fall in 6 hours as shown in **Table 3.2-12**.

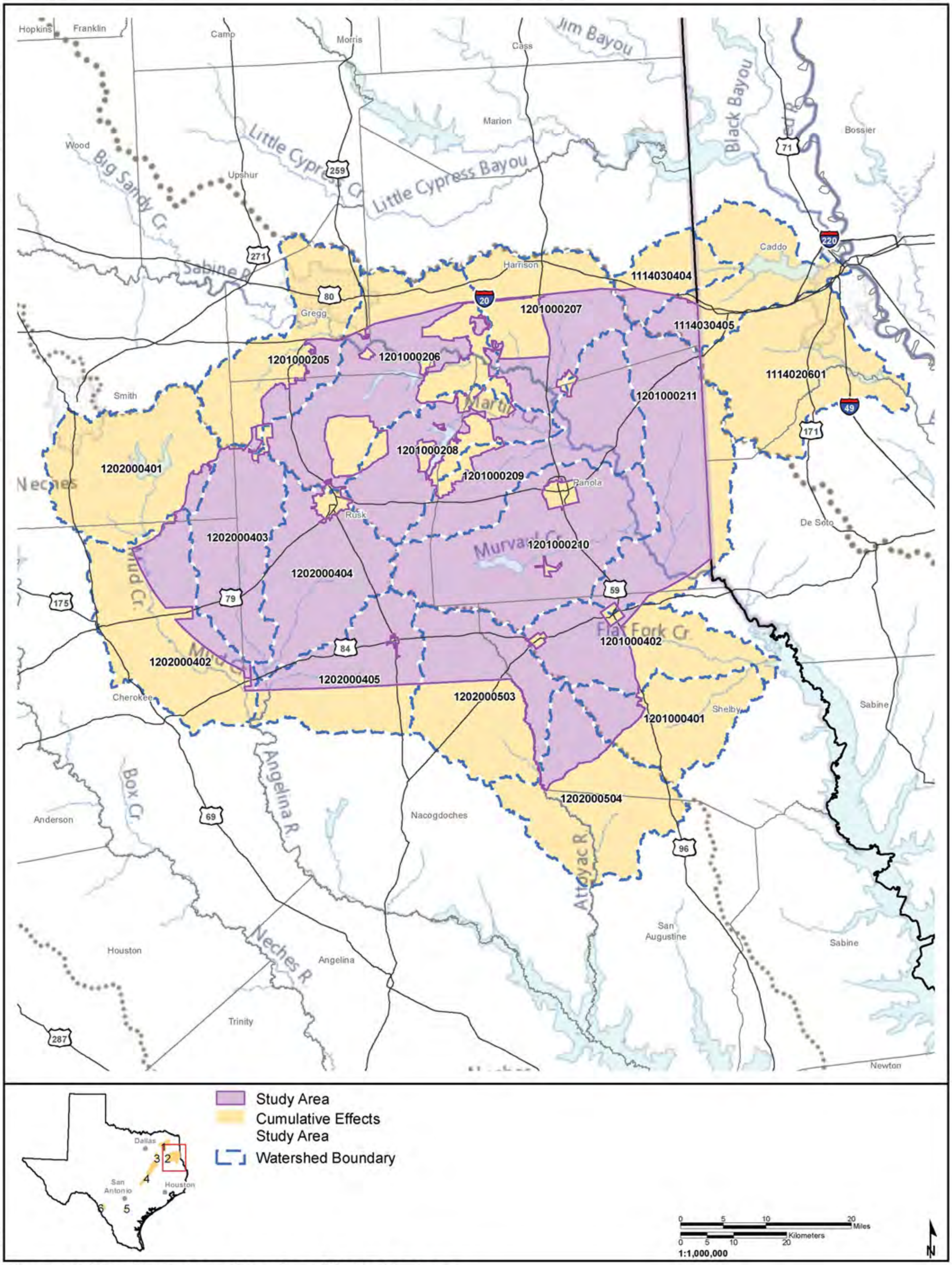


Figure 3.2-8 Study Area 2 Surface Water Features

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**Table 3.2-10 Watersheds, Study Area 2**

| HUC 10 Watershed Identifier | Watershed Name | Watershed Area within Study Area (acres) | Watershed Area in CESA Outside of Study Area (acres) | Total Watershed Area within Analysis Area (acres) |
|---|---|---|---|---|
| 1114020601 | Wallace Bayou | 177 | 172,832 | 173,008 |
| 1114030404 | Paw Paw Bayou | 10,610 | 42,264 | 52,873 |
| 1114030405 | Cross Bayou | 15,914 | 97,402 | 113,316 |
| 1114030604 | Big Cypress Bayou-Frontal Caddo Lake | 0 | 164 | 164 |
| 1114030702 | Little Cypress Bayou | 0 | 0.2 | 0.2 |
| 1201000205 | Rabbit Creek-Sabine River | 26,852 | 120,759 | 147,611 |
| 1201000206 | Cherokee Bayou-Sabine River | 126,315 | 104,576 | 230,891 |
| 1201000207 | Eightmile Creek-Sabine River | 66,601 | 83,957 | 150,558 |
| 1201000208 | Martin Creek | 88,981 | 35,505 | 124,486 |
| 1201000209 | Irons Bayou | 138,617 | 9,238 | 147,854 |
| 1201000210 | Murvaul Creek-Sabine River | 217,942 | 8,121 | 226,063 |
| 1201000211 | Socagee Creek-Sabine River | 159,232 | 44,551 | 203,784 |
| 1201000401 | Tenaha Creek | 21,684 | 88,005 | 109,689 |
| 1201000402 | Flat Fork Creek | 61,968 | 69,844 | 131,812 |
| 1201000403 | Grand Cane Bayou-Toledo Bend Reservoir | 0 | 158 | 158 |
| 1202000401 | West Mud Creek-Mud Creek | 7,014 | 162,441 | 169,456 |
| 1202000402 | Caney Creek-Mud Creek | 49,090 | 137,642 | 186,732 |
| 1202000403 | Johnson Creek | 126,695 | 1,384 | 128,079 |
| 1202000404 | Shawnee Creek-Angelina River | 139,192 | 6,489 | 145,680 |
| 1202000405 | East Fork Angelina River-Angelina River | 77,184 | 58,040 | 135,224 |
| 1202000503 | Naconiche Creek-Attoyac River | 81,927 | 87,522 | 169,449 |
| 1202000504 | Big Iron Ore Creek-Attoyac River | 33,327 | 132,212 | 165,539 |
| **Totals** | | **1,449,322** | **1,463,106** | **2,912,428** |

**Table 3.2-11 General Monthly Flow Characteristics for Select Streams in Study Area 2 [1]**

| Waterbody | Monitoring Site | General Location | Drainage Area (square miles) | Period of Record | Average High Flow (cfs) | Average Low Flow (cfs) |
|---|---|---|---|---|---|---|
| Sabine River near Beckville | USGS 08022040 | Panola County between Deberry and Tatum | 3,589 | 01/1990 to 09/2013 | 5,520 (Mar) | 461 (Sep) |
| Mud Creek near Jacksonville | USGS 08034500 | Cherokee County east of Jacksonville | 376 | 01/1990 to 09/2013 | 381 (Feb) | 42 (Sep) |
| Attoyac Bayou near Chireno | USGS 08038000 | Southeast of Martinsville at Highway 21 | 503 | 10/1965 to 09/1985 | 759 (Apr) | 91 (Aug) |
| East Fork Angelina River near Cushing | USGS 08033900 | Along Rusk County line, south of Laneville and Highway 84 | 158 | 10/1965 to 09/1985 | 207 (Apr) | 23 (Aug) |
| Martin Creek near Tatum | USGS 08022070 | Below Martin Lake in western Panola County | 148 | 10/1974 to 09/1996 | 292 (Feb) | 7.5 (Sep) |

[1] Based on available data for a multi-year period of record.

Source: USGS-NWIS 2014.

**Table 3.2-12 Estimates of Storm Event Magnitudes for Study Area 2 (inches)**

| Storm Even Duration | Storm Event Recurrence Intervals | | | | |
|---|---|---|---|---|---|
| | 2-year | 10-year | 25-year | 50-year | 100-year |
| **6-hour** | 3.3 | 5.0 | 5.9 | 6.8 | 7.5 |
| **12-hour** | 3.9 | 6.3 | 7.2 | 8.2 | 9.0 |
| **24-hour** | 4.6 | 7.2 | 8.5 | 9.5 | 10.5 |

Source: Hershfield 1961.

A number of large impoundments occur in Study Area 2 and the larger CESA (**Figure 3.2-8**). These include Lake Cherokee, Martin Creek Lake, and Murvaul Lake in Rusk and Panola counties; Lake Tyler and Lake Tyler East north of Jacksonville; Cross Lake in the Louisiana part of the CESA; and Lake Striker approximately 10 miles west of Laneville in Rusk County.

Lake Cherokee is owned and operated by the Cherokee Water Company. It supplies water for municipal, industrial, and recreational purposes (TWDB 2014b). The lake provides municipal supply for the City of Longview, and cooling water for the Knox Lee Power Plant. Martin Creek Lake occupies 5,000 acres and is the primary feature of the surrounding state park. It provides cooling water for the coal-fired Martin Creek Power Plant operated by Luminant. Lake Murvaul is owned and operated by the Panola County Fresh Water Supply District Number One, and is used for municipal, industrial, and recreational purposes (TDWB 2014b). Lake Tyler (and connected Lake Tyler East) is owned and operated by the City of Tyler for municipal, domestic and industrial purposes. Lake Striker supplies industrial (power plant) water for Luminant and Southern Company, as well as providing recreational uses and potentially drinking water for the City of Henderson. Toledo Bend Reservoir stores water for municipal, industrial, agricultural, and recreational purposes, and extends for over 100 river miles (TWDB 2014b).

*Floodplains*

Delineated floodplains, defined as FEMA Flood Hazard Zone A, have been identified along the major streams in Study Area 2 as indicated in **Figure 3.2-9**. Some counties, including Panola, Shelby, and San Augustine, do not have current floodplain delineations under the FEMA program. However, floodplains do occur along major streams and their tributaries in those counties, similar to the floodplains depicted in the other counties. It is likely that extensive floodplains occur along the Sabine River and its tributaries in Panola County, similar to their distribution indicated in Harrison County (**Figure 3.2-9**).

Within Study Area 2, major streams bordered by relatively broad floodplains include the Sabine River, Cherokee Bayou, Martin Creek, a small reach of Mud Creek, and the Angelina River headwaters. Within the associated CESA, Mud Creek and short reaches of the Sabine and Angelina rivers also support broad floodplains. Smaller floodplains occur as narrow, low-lying stream deposits along many of the streams and sloughs in the region. Within Study Area 2, delineated floodplains occupy approximately 226,878 acres (354 square miles) combined in Harrison, Rusk, Smith, and Cherokee counties. In the outlying CESA, approximately 146,060 acres (228 square miles) of additional delineated floodplains occur in these counties combined with Nacogdoches and Upshur counties.

*Surface Water Uses and Quality*

The Sabine River is navigable throughout Study Area 2 and its associated CESA (USACE 1999). No other navigable streams are recognized by the USACE within the analysis area. Several USGS water quality stations have been monitored recently within Study Area 2 or nearby. Data from these are summarized in **Table 3.2-13**. In addition, a large amount of surface water quality data is available from TCEQ and the Texas Clean Rivers Program, which can provide information for more detailed future analyses, if needed.

The following waterbodies are sole-source drinking water supplies (TAC 2014d):

- Sabine River above Toledo Bend Reservoir
- Lake Murvaul

The following communities or facilities have surface water intakes at the indicated sources within Study Area 2 or its CESA (TCEQ 2014b):

- City of Center (Study Area 2 – Pinkston Reservoir)
- City of Center (CESA – Lake Center)
- City of Carthage (Study Area 2 – Lake Murvaul)
- City of Tyler (CESA – Lake Tyler)
- City of Longview (Study Area 2 – Lake Cherokee)
- City of Longview (CESA – Sabine River)
- City of Kilgore (CESA – Sabine River)
- City of Henderson (CESA – Sabine River)
- Pirkey Power Plant (Study Area 2 – Brandy Branch Reservoir)

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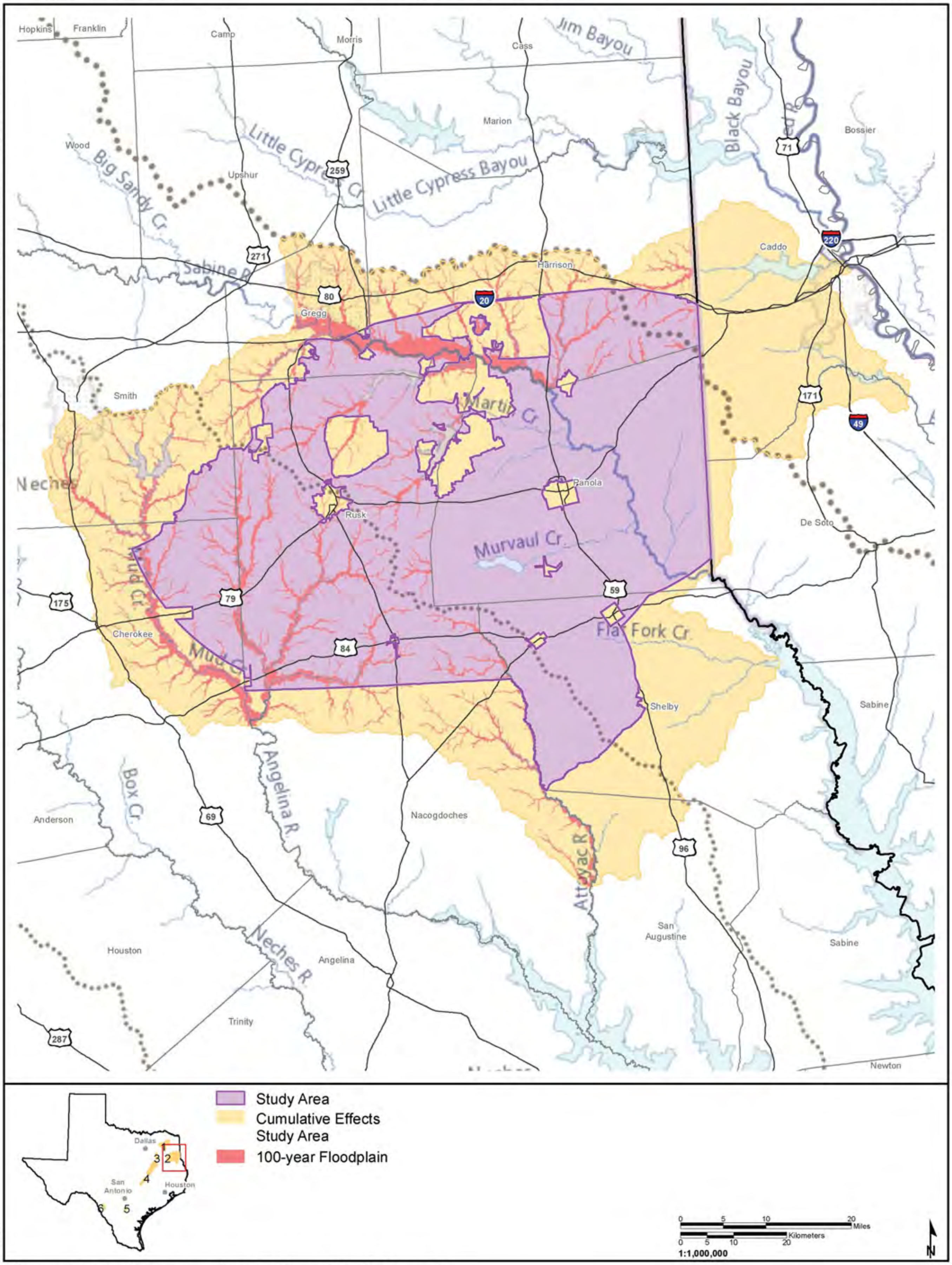


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Figure 3.2-9 100-year Floodplains - Study Area 2

**Table 3.2-13 Water Quality Overview for Streams in or near Study Area 2**

| Location | Identifier | Sampling Period | Measure | pH | TDS | Specific Conductance | Dissolved Oxygen[1] | Total Suspended Solids | Turbidity | Hardness | Calcium | Magnesium | Sodium | Bicarbonate | Chloride | Sulfate | Iron | Manganese |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sabine River near Beckville | USGS 08022040 | 11/1990 to 10/2000 | Median | 7.4 | 125 | 251 | 8.4 / 87 | No Data | No Data | 50.6 | 14 | 3.75 | 24 | No Data | 31 | 27 | 220 | 74 |
| | | | Range | 6.5 to 8.5 | 80 to 713 | 120 to 1230 | 5.4 / 68 to 11.6 / 109 | No Data | No Data | 27.8 to 106 | 7.5 to 32.8 | 2.2 to 6.3 | 11 to 227 | No Data | 12 to 130 | 11 to 172 | 16 to 530 | 8 to 150 |
| Irons Bayou at SH 149 near Beckville | USGS 08022100 | 05/2003 to 07/2005 | Median | 7.2 | 268 | 387 | 4.4 | 14 | No Data | No Data | No Data | No Data | No Data | No Data | 30 | 52 | No Data | No Data |
| | | | Range | 6.7 to 7.3 | 107 to 524 | 298 to 752 | 2.6 to 6.2 | 6 to 52 | No Data | No Data | No Data | No Data | No Data | No Data | 13 to 54 | 5 to 200 | No Data | No Data |
| Attoyac Bayou near Chireno | USGS 08038000 | 01/1994 to 08/1999 | Median | 7.1 | 71 | 112 | 7 / 83 | 29 | 27 | 30.5 | 5.9 | 3.8 | 8.4 | No Data | 9.4 | 14 | 281 | 68.3 |
| | | | Range | 6.6 to 7.5 | 55 to 125 | 84 to 200 | 4.9 / 62 to 11.6 / 100 | 4 to 100 | 10 to 72 | 20 to 65.6 | 3.9 to 14 | 2.5 to 7.4 | 4.9 to 12 | No Data | 6.6 to 15 | 4.4 to 47 | 13.2 to 730 | 34 to 131 |

[1] Values reflect concentration (mg/L) and percent saturation, where available. No saturation data for Irons Bayou.

Note: All data in mg/L except for pH (standard units), specific conductance (microsiemens per centimeter), iron and manganese (mg/L), and turbidity (Nephelometric Turbidity Units).

Source: USGS-NWIS 2014.

Within the Sabine River area (TCEQ River Basin 5) and the Neches basin (TCEQ River Basin 6), classified waterbody segments in Study Area 2 and its associated CESA include:

- 0504 (Toledo Bend Reservoir) in eastern Shelby County and southern Panola County;
- 0505 (Sabine River above Toledo Bend Reservoir) in Panola, Harrison, Gregg, and Rusk counties;
- 0509 (Murvaul Lake) in Panola County;
- 0510 (Lake Cherokee) in Rusk and Gregg counties;
- 0611 (Angelina River above Sam Rayburn Reservoir) in Nacogdoches, Cherokee, and Rusk counties;
- 0612 (Attoyac Bayou) in Shelby and Nacogdoches counties; and
- 0613 (Lake Tyler and Lake Tyler East) in Smith County.

Specific surface water quality standards for these segments are chiefly oriented to their beneficial uses of Primary Contact Recreation category 1 (PCR1), High Aquatic Life Use, and Public Supply of drinking water (TCEQ 2014a). In addition to general use criteria and standards for dissolved oxygen and temperature, other specific water quality standards apply for chloride, sulfate, total dissolved solids, pH and indicator bacteria (TCEQ 2014a).

Segment 0504 has no unclassified segments; however, Toledo Bend Reservoir is divided into several sub-segments that have similar water quality standards.

Within Sabine River Segment 0505, the following unclassified stream segments within the analysis area have specified Aquatic Life Uses as indicated, and corresponding dissolved oxygen standards (TCEQ 2014c):

- Grace Creek (Longview vicinity) – Intermediate
- Hawkins Creek (Longview vicinity) – Low
- Mason Creek (east of Longview) – Low
- Eightmile Creek (south-southeast of Marshall, Harrison County) – Intermediate
- Wards Creek (east of Hallsville, alongside the Sabine Mine) – Intermediate
- Wall Branch (tributary to Irons Bayou along State Route 149 between Martins Creek Lake and Carthage, Panola County) – Intermediate
- Little Rabbit Creek (approximately 5 miles east of Lake Tyler East on the Rusk County line) – Intermediate
- Unnamed perennial tributary to the Sabine River (western edge of Easton, Rusk County) – Intermediate

No site specific standards for unclassified segments occur in the Murvaul Lake Segment (0509). In Sabine River segment 0510 (Lake Cherokee), both Mill and Adaway creeks are unclassified streams with specific standards within the analysis area near the City of Henderson in Rusk County. They have Intermediate Aquatic Life Use standards (4.0 mg/L dissolved oxygen).

Within Angelina River Segment 0611 of the Neches River basin (TCEQ Basin 6), the following unclassified streams within the analysis area have specified Aquatic Life Uses as indicated, and corresponding dissolved oxygen standards (TCEQ 2014c):

- Keys Creek (east of Jacksonville in Cherokee County) – High
- Mud Creek (east of Jacksonville) – High
- Ragsdale Creek (in and near Jacksonville) - Intermediate
- Unnamed perennial tributary of Johnson Creek (in Rusk County west of Henderson) – Low
- Blackhawk Creek (tributary to Mud Creek west of Lake Tyler, Smith County) – Intermediate
- Henshaw Creek (in the Mud Creek drainage, Smith County) – High
- West Mud Creek (in Cherokee and Smith counties toward the City of Tyler) – Low

There are no unclassified streams within the Attoyac River area (Attoyac Bayou, TCEQ Segment 0612), the Lake Tyler/Lake Tyler East segment (TCEQ Segment 0613), or the Lake Jacksonville segment (TCEQ Segment 0614).

In most of these waterbodies, water quality exceedances consisted of a few instances of depressed dissolved oxygen concentrations, high or low pH, or excessive nutrient concentrations such as ammonia or orthophosphorus (TCEQ 2012). These generally were not of concern with respect to water quality action levels, although some instances of screening level concerns were recorded.

However, a few waterbodies have more notable water quality issues. Hills Lake, a 40-acre oxbow-lake (unclassified assessment identifier 0505O_01) near Carthage in Panola County, has a fish consumption restriction due to mercury in edible tissue (TCEQ 2012; Texas Department of State Health Services 2007). Wards Creek (identifier 0505G_01) had several instances of depressed dissolved oxygen levels, as well as ammonia. It does not support its intermediate Aquatic Life Use designation and has a screening level concern for ammonia. Within the upper Angelina River portion of the Neches Basin (TCEQ Segment 0611_03), aluminum and lead exceedances are of concern, and are pending issues for Aquatic Life Use; excessive ammonia also was noted (TCEQ 2012). Mud Creek (Segments 0611C and D) generally had depressed dissolved oxygen levels, occasional nutrient exceedances (e.g., ammonia, orthophosphorus), and high bacteria counts. The latter creates non-supporting conditions for designated Recreation Use.

For Sabine River Segment 0505, impaired waters in Study Area 2 and its CESA include (TCEQ 2012):

- Tenaha Creek Arm of Toledo Bend Reservoir, for mercury in edible tissue (Category 5);
- Uppermost 5,210 acres of Toledo Bend Reservoir, for mercury in edible tissue (Category 5);
- Sabine River from Hatley Creek upstream to Grace Creek in Gregg County, for bacteria and depressed dissolved oxygen (Category 5);
- Grace Creek in the City of Longview upstream to headwaters, for bacteria and depressed dissolved oxygen (Category 5);
- Wards Creek, for depressed dissolved oxygen (Category 5); and
- Hills Lake, for mercury in edible tissue (Category 5).

For Segment 0611 (Angelina River) and its tributaries within analysis area 2, the following impaired waters are listed for bacteria (non-supporting of designated Recreation Use) (TCEQ 2012):

- East Fork of the Angelina River (Category 5)
- Mud Creek (Category 5)
- West Mud Creek (Category 5)

For Segment 0612 (Attoyac Bayou) within Study Area 2 and its associated CESA, the following is listed for bacteria (non-supporting of designated Recreation Use) (TCEQ 2012):

- Attoyac Bayou to FM 95 in Rusk County (Category 5)

Study Area 3

*Surface Water Features and Flows*

Study Area 3 stretches across the Trinity and Brazos river basins (with the latter's Navasota tributary) and small parts of the Sabine and Neches river basins. These features, the watersheds occurring within the study area (approximately 2,050 square miles), and the outlying CESA (approximately 3,692 square miles) are indicated in **Figure 3.2-10** and **Table 3.2-14**. **Table 3.2-14** also includes small portions of some HUC 10 watersheds (i.e., Town of Grand Saline-Sabine River, Flat Creek-Neches River, Brushy Creek-Neches River, Alligator Creek-Richland Creek, Lower Keechi Creek, Pond Creek, and Cedar Creek-Navasota River) in the CESA. Based on groundwater resource inputs, these additional areas represent locations where future mine-related groundwater pumping could affect groundwater levels, as well as surface water features that have a hydraulic connection to an affected aquifer, up to a few miles beyond a drainage divide.

General flow characteristics for streams with reasonably long historical periods of record are indicated in **Table 3.2-15**.

**Table 3.2-14 Watersheds, Study Area 3**

| HUC 10 Watershed Identifier | Watershed Name | Watershed Area within Study Area (acres) | Watershed Area in CESA Outside of Study Area (acres) | Total Watershed Area within Analysis Area (acres) |
|---|---|---|---|---|
| 1201000105 | Mill Creek-Sabine River | 3,779 | 180,232 | 184,011 |
| 1201000106 | Town of Grand Saline-Sabine River | 0 | 2,499 | 2,499 |
| 1202000102 | Kickapoo Creek | 27,069 | 151,798 | 178,867 |
| 1202000103 | Flat Creek-Neches River | 0 | 31,108 | 31,108 |
| 1202000104 | Brushy Creek-Neches River | 0 | 23,666 | 23,666 |
| 1203010505 | Rush Creek-Trinity River | 40,113 | 143,534 | 183,647 |
| 1203010702 | Cedar Creek-Cedar Creek Reservoir | 0 | 764 | 764 |
| 1203010703 | Cedar Creek Reservoir-Cedar Creek | 110,326 | 180,706 | 291,032 |
| 1203010804 | Alligator Creek-Richland Creek | 0 | 12,781 | 12,781 |
| 1203020101 | Caney Creek-Tehuacana Creek | 146,371 | 130,889 | 277,260 |
| 1203020102 | Catfish Creek | 79,092 | 108,732 | 187,824 |
| 1203020103 | Lake Creek-Trinity River | 43,684 | 96,608 | 140,292 |
| 1203020104 | Box Creek-Trinity River | 24,547 | 172,491 | 197,039 |
| 1203020105 | Buffalo Creek | 64,654 | 109,948 | 174,602 |
| 1203020106 | Upper Keechi Creek | 93,710 | 58,426 | 152,135 |
| 1203020107 | Big Elkhart Creek-Trinity River | 1,669 | 217,049 | 218,717 |

**Table 3.2-14 Watersheds, Study Area 3**

| HUC 10 Watershed Identifier | Watershed Name | Watershed Area within Study Area (acres) | Watershed Area in CESA Outside of Study Area (acres) | Total Watershed Area within Analysis Area (acres) |
|---|---|---|---|---|
| 1203020201 | Lower Keechi Creek | 0 | 6,565 | 6,565 |
| 1207010103 | Little Brazos River-Brazos River | 40,741 | 120,585 | 161,326 |
| 1207010104 | Pond Creek | 0 | 1,865 | 1,865 |
| 1207010105 | Walnut Creek-Brazos River | 81,754 | 27,959 | 109,713 |
| 1207010106 | Cedar Creek-Brazos River | 40,791 | 320,028 | 360,819 |
| 1207010301 | Christmas Creek-Navasota River | 14,528 | 217,851 | 232,379 |
| 1207010302 | Steele Creek | 84,744 | 33,907 | 118,651 |
| 1207010303 | Sanders Creek-Navasota River | 225,862 | 17,455 | 243,316 |
| 1207010304 | Duck Creek-Navasota River | 95,711 | 65,181 | 160,893 |
| 1207010305 | Cedar Creek-Navasota River | 0 | 22,709 | 22,709 |
| **Totals** | | **1,219,146** | **2,455,335** | **3,674,481** |

**Table 3.2-15 General Monthly Flow Characteristics for Select Streams in Study Area 3** [1]

| Waterbody | Monitoring Site | General Location | Drainage Area (square miles) | Period of Record | Average High Flow (cfs) | Average Low Flow (cfs) |
|---|---|---|---|---|---|---|
| Tehuacana Creek near Streetman | USGS 08064700 | Freestone County southwest of Cayuga | 142 | 10/1990 through 09/2013 | 191 (Feb) | 10 (Sep) |
| Big Creek near Freestone | USGS 08110430 | Freestone County near Teague, above Lake Limestone | 97.2 | 10/1990 through 09/2013 | 105 (Feb) | 4.0 (Aug) |
| Trinity River at Trinidad | USGS 08062700 | Henderson County at Trinidad, west of Cedar Creek Reservoir | 8,538 | 10/1990 through 09/2013 | 8,890 (Mar) | 1,870 (Aug) |
| Trinity River near Oakwood | USGS 08065000 | Corner of Anderson County, south of Tennessee Colony, southwest of Palestine | 12,833 | 10/1990 through 09/2013 | 12,000 (Mar) | 2,140 (Aug) |
| Upper Keechi Creek near Oakwood | USGS 08065200 | Leon County, near county line northeast of Flo | 150 | 10/1990 through 09/2013 | 133 (Feb) | 7.3 (Aug) |

[1] Based on available data for a multi-year period of record.

Source: USGS-NWIS 2014.

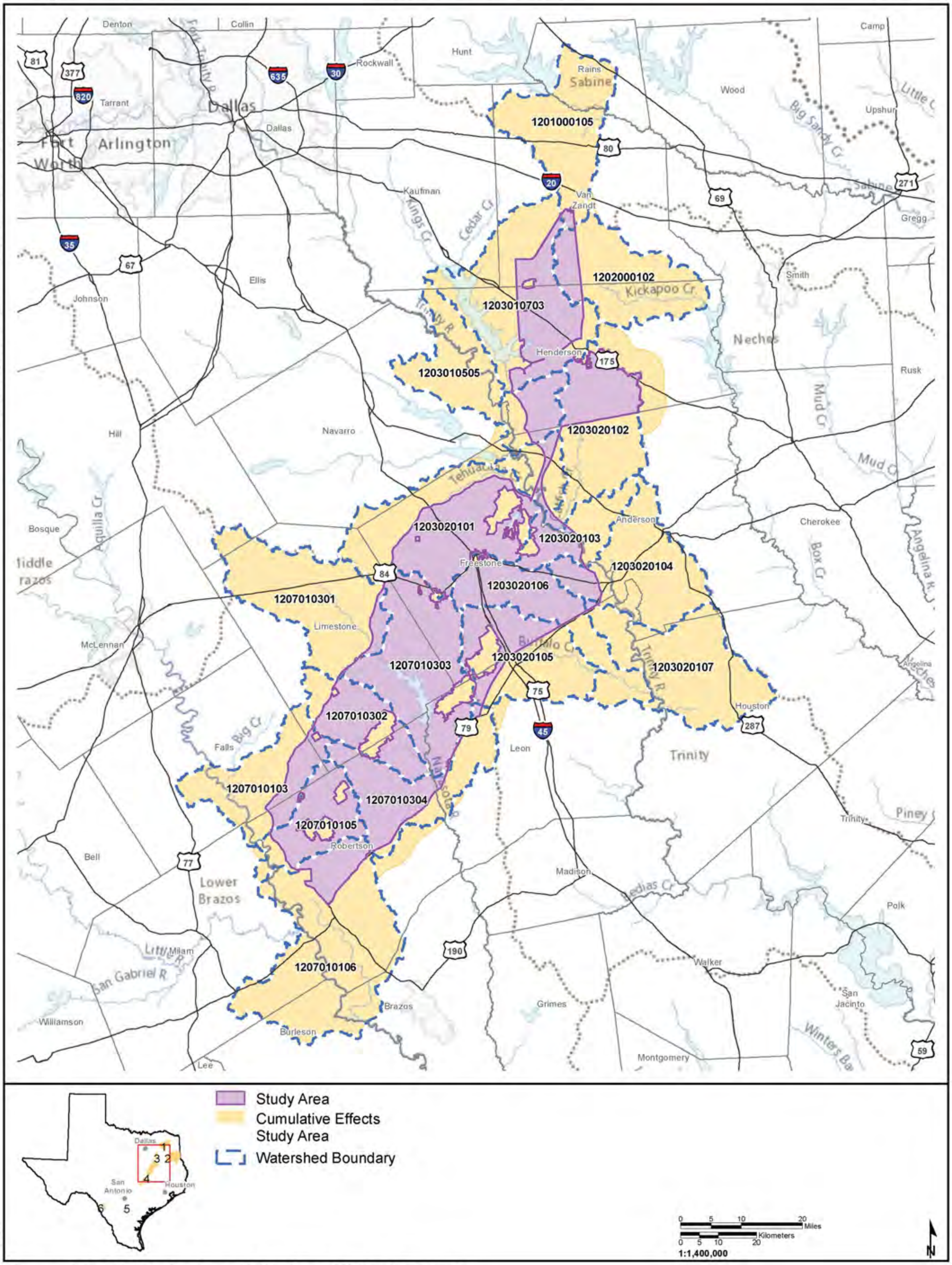


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**Figure 3.2-10 Study Area 3 Surface Water Features**

Flows indicated in **Table 3.2-15** for the Trinity River stations are affected by reservoir storage and releases. In addition, other reaches of the Sabine, Navasota, and Brazos rivers are highly regulated by impoundments. Therefore, although these flows reflect wide seasonal flow variations, they do not represent natural flow regimes. According to the NHD, approximately 411 miles of perennial stream reaches are within Study Area 3. Additionally, 1,342 miles of perennial stream reaches occur in the outlying CESA, bringing the total of perennial stream lengths within the analysis area to 1,752 miles. Approximately 4,717 miles of intermittent stream reaches are within Study Area 3. Approximately 6,891 intermittent stream miles occur in the outlying CESA, bringing the total of intermittent stream lengths within the analysis area to 11,608 miles. In the NHD, the intermittent stream category includes ephemeral streams.

Storm event magnitudes, in inches over durations of a quarter-day, half-day, or a full day, have been approximated based on the current National Weather Service reference for the area (see **Table 3.2-16**). The recurrence intervals, in years, are long-term averages that reflect the probability (based on 100 percent) of an event happening in any given year. For example, an event with an estimated 2-year recurrence interval has a 50 percent chance of occurring in any given year. Rainfall intensity is reflected in the duration. For example, for a 10-year event, approximately 5.0 inches of rain would fall in 6 hours as shown in **Table 3.2-16**.

**Table 3.2-16 Estimates of Storm Event Magnitudes for Study Area 3 (inches)**

| Storm Event Duration | Storm Event Recurrence Intervals | | | | |
|---|---|---|---|---|---|
| | 2-year | 10-year | 25-year | 50-year | 100-year |
| **6-hour** | 3.2 | 5.0 | 6.0 | 6.5 | 7.5 |
| **12-hour** | 3.7 | 6.0 | 7.0 | 8.0 | 9.0 |
| **24-hour** | 4.4 | 7.0 | 8.2 | 9.3 | 10.5 |

Source: Hershfield 1961.

Large impoundments occur in the study area and/or the larger CESA (**Figure 3.2-10**). These include Lake Limestone, Lake Mexia, Fairfield Lake, Lake Athens, and Cedar Creek Reservoir. Richland-Chambers Reservoir is immediately upstream of the central part of the analysis area near Corsicana. A large number of smaller lakes, such as Coon Creek, Catfish Creek Ranch, Murchison, Fort Parker, Teague City, Upper and Lower Club, Twin Oak, Camp Creek, Browns, and others are within the analysis area.

The Brazos River Authority owns and operates Lake Limestone for water supply and recreation. Lake Mexia is owned and operated by the Bistone Municipal Water Supply District for municipal and industrial supplies and recreation (TWDB 2014b). Fairfield Lake is owned by the Texas Power and Light Company (presently TXU Electric Company) and used for industrial purposes (thermal-electric power generation). Lake Athens is owned by the Athens Municipal Water Authority for the purposes of municipal water supply and recreation for the City of Athens. Cedar Creek Reservoir is owned and operated by the Tarrant Regional Water District for municipal water supply, flood control and recreation (TWDB 2014b). Richland-Chambers Reservoir is owned and operated by Tarrant Regional Water District for water supply, flood control, irrigation, and recreation purposes. The remaining smaller impoundments are owned and operated by smaller communities, water supply districts, or private organizations. They primarily are used for water supply and/or recreation.

*Floodplains*

Delineated floodplains, defined as FEMA Flood Hazard Zone A, have been identified along the major streams of Study Area 3 as indicated in **Figure 3.2-11**. Freestone County, and a small part of the CESA in Rains and Falls counties, do not have current floodplain delineations under the FEMA program. However, floodplains do occur along major streams and their tributaries in those counties, similar to the floodplains in the other counties.

Within Study Area 3, major streams bordered by relatively broad floodplains include the Trinity, Navasota, and Brazos rivers. Kickapoo, Cedar, and Buffalo creeks are major tributaries that also have fairly wide floodplains. Smaller floodplains occur as narrow, low-lying stream deposits along many of the streams and sloughs in the region. Within Study Area 3, delineated floodplains occupy approximately 218,583 acres (342 square miles). In the outlying CESA, approximately 792,992 acres (1,239 square miles) of additional delineated floodplains occur.

*Surface Water Uses and Quality*

The Trinity River is navigable through Study Area 3 and its associated CESA, and the Brazos River is navigable through the CESA (USACE 1999). No other navigable streams are recognized by the USACE within the analysis area. Several USGS water quality stations have been monitored within Study Area 3 or nearby, and have a larger number of samples over time. Data from these are summarized in **Table 3.2-17**. In addition, a large amount of surface water quality data is available from TCEQ and the Texas Clean Rivers Program, which can provide information for more detailed future analyses, if needed.

The following waterbodies are sole-source drinking water supplies (TAC 2014d):

- Trinity River above Lake Livingston
- Cedar Creek Reservoir
- Lake Mexia
- Navasota River below Lake Mexia
- Lake Limestone
- Navasota River below Lake Limestone

The following communities or facilities have surface water intakes at the indicated sources within Study Area 3 or its CESA (TCEQ 2014b):

- SLC Water Supply Corporation, Groesbeck (Study Area 3 – Lake Limestone)
- Houston County Water Control and Improvement District (Study Area 3 – Houston County Lake)
- City of Groesbeck (Study Area 3 – Navasota River)
- City of Teague (Study Area 3 – Lower Club Lake and Teague City Lake)
- Bistone Municipal Water Supply (Study Area 3 – Lake Mexia)
- City of Wortham (CESA – Wortham City Reservoir and Wortham Lake)
- City of Trinidad (CESA – Trinidad City Lake)
- City of Malakof (CESA – Cedar Creek)
- City of Star Harbor (CESA – Cedar Creek Reservoir)

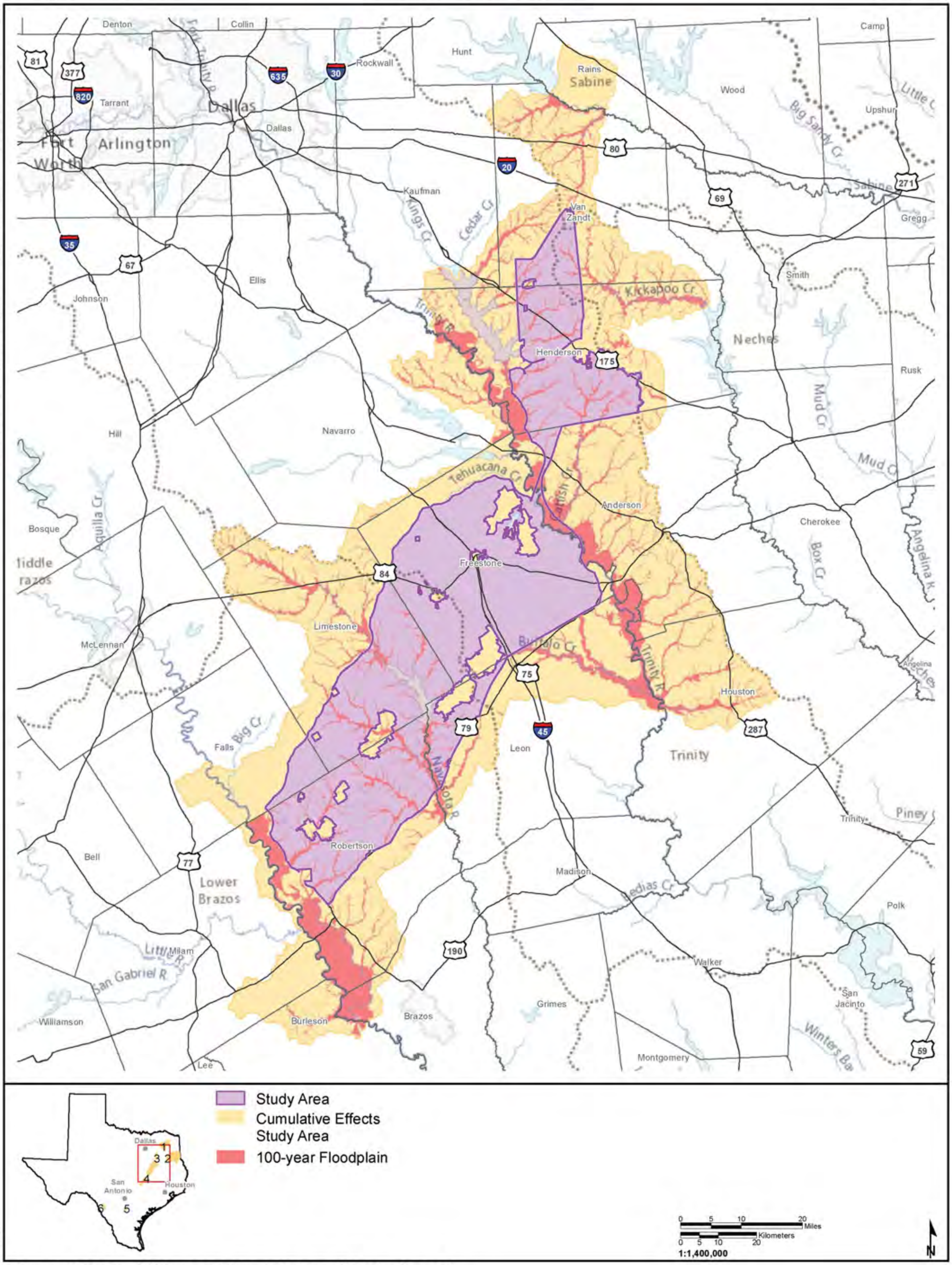


Figure 3.2-11 100-year Floodplains - Study Area 3

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**Table 3.2-17 Water Quality Overview for Streams in or near Study Area 3**

| Location | Identifier | Sampling Period | Measure | pH | TDS | Specific Conductance | Dissolved Oxygen[1] | Total Suspended Solids | Turbidity | Hardness | Calcium | Magnesium | Sodium | Bicarbonate | Chloride | Sulfate | Iron | Manganese |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Upper Keechi Creek near Oakwood | USGS 08065200 | 6/1962 to 2/1979 | Median | 6.5 | 212 | 355 | 9.5/91 | No Data | No Data | 90 | 21 | 9.5 | 28 | 22 | 45 | 72 | 90 | 330 |
| | | | Range | 4.2 to 9.1 | 59 to 368 | 87 to 611 | 5.9/74 to 12/136 | No Data | No Data | 20 to 160 | 5.8 to 38 | 2.5 to 17 | 10 to 55 | 1 to 80 | 8.8 to 93 | 18 to 134 | 40 to 150 | 300 to 450 |
| Tehuacana Creek near Streetman | USGS 08064700 | 4/2008 to 6/2014 | Median | 7.7 | 403 | 671 | 8.1/88 | 23 | 9.5 | 195 | 48.4 | 17.4 | 59.2 | 145 | 79.4 | 98 | 48.5 | 166 |
| | | | Range | 7.1 to 8.4 | 72 to 1,580 | 125 to 2,690 | 2.8/36 to 14.3/150 | 3 to 2,260 | 1.2 to 230 | 36.3 to 655 | 9.1 to 135 | 3.1 to 77.3 | 4.91 to 320 | 34.4 to 357 | 3.7 to 521 | 8.9 to 346 | 4 to 480 | 3.8 to 890 |
| Trinity River at Trinidad | USGS 08062700 | 10/1990 to 2/2001 | Median | 7.8 | 278 | 489.5 | 7.5/86 | No Data | 87 | 152 | 52 | 4.8 | 35 | 142 | 33 | 56 | 13.5 | 3 |
| | | | Range | 7.5 to 8.0 | 157 to 435 | 268 to 728 | 5.7/72 to 11.8/107 | No Data | 0.5 to 200 | 103 to 209 | 36 to 75 | 3.1 to 7.4 | 13 to 72 | 103 to 186 | 14 to 69 | 26 to 99 | 3 to 32 | 1 to 13 |
| Navasota River above Groesbeck | USGS 08110325 | 10/1978 to 5/2001 | Median | 8 | 193 | 342.5 | No Data | No Data | No Data | 131.5 | 48 | 3.45 | 13.5 | 130 | 18 | 14 | No Data | No Data |
| | | | Range | 7.3 to 9.5 | 90 to 334 | 131 to 568 | No Data | No Data | No Data | 46.5 to 260 | 16 to 97 | 1.6 to 7.6 | 5 to 54 | 46 to 250 | 4.7 to 89 | 2 to 47 | No Data | No Data |
| Navasota River near Easterly | USGS 08110500 | 2/1966 to 8/2001 | Median | 7.6 | 277 | 479.5 | No Data | No Data | No Data | 120 | 34 | 9 | 44 | 88 | 72.5 | 57.5 | No Data | No Data |
| | | | Range | 7.2 to 8.4 | 44 to 983 | 83 to 1,810 | No Data | No Data | No Data | 28 to 390 | 6.5 to 110 | 2.2 to 28 | 4.8 to 250 | 24 to 216 | 5.6 to 430 | 6 to 150 | No Data | No Data |

[1] Values reflect concentration (mg/L) and percent saturation, as available.

Note: All data in mg/L except for pH (standard units), specific conductance (microsiemens per centimeter), iron and manganese (mg/L), and turbidity (Nephelometric Turbidity Units).

Source: USGS-NWIS 2014.

- City of Athens (CESA – Lake Athens)
- Hidden Hills Harbor and Carolynn Estates (CESA – Cedar Creek Reservoir)
- Beachwood Estates and North Trinidad (CESA – Cedar Creek Reservoir)
- City of Mansfield (CESA – Cedar Creek Reservoir)
- City of Fort Worth (CESA – Cedar Creek Reservoir)
- Cherokee Shores Water Supply (CESA – Cedar Creek Reservoir)
- West Cedar Creek Municipal Utility District (Tool Plant 1-6, and Tolosa Plant) (CESA – Cedar Creek Reservoir)
- East Cedar Creek Fresh Water Supply District B.A. McKay (CESA – Cedar Creek Reservoir)
- East Cedar Creek Fresh Water Supply District Brookshire (CESA – Cedar Creek Reservoir)
- City of Mabank (CESA – Cedar Creek Reservoir)
- City of Edgewood (CESA – Edgewood City Lake)
- City of Canton (CESA – Mill Creek Lake)
- MacBee Special Utility District (CESA – Wills Point Reservoir)
- City of Wills Point (CESA – Wills Point Reservoir)

The following classified waterbody segments occur in Study Area 3 and its associated CESA:

- 0506 (Sabine River below Lake Tawakoni) in Rains and Van Zandt counties
- 0604 (Neches River below Lake Palestine) in southern Henderson and northern Anderson counties
- 0605 (Lake Palestine drainage) in eastern Henderson and southeastern Van Zandt counties
- 0606 (Neches River above Lake Palestine) in southeastern Van Zandt County
- 0804 (Trinity River above Lake Livingston) in Henderson, Navarro, Anderson, Freestone, Houston and Leon counties
- 0805 (Upper Trinity River) in Henderson and Navarro counties
- 0813 (Houston County Lake) in Houston County
- 0818 (Cedar Creek Reservoir) in Henderson, Navarro, and Kaufman counties
- 1209 (Navasota River below Lake Limestone) in Leon and Robertson counties
- 1210 (Lake Mexia) in Limestone County
- 1242 (Brazos River above Navasota River) mainly in Falls, Robertson, Milam, and Burleson counties
- 1252 (Lake Limestone) in Freestone, Limestone, Leon and Robertson counties
- 1253 (Navasota River below Lake Mexia) in Limestone County

Specific surface water quality standards for these segments primarily are oriented to their beneficial uses of PCR1, High Aquatic Life Use, Fish Consumption, General Use, and Public Supply of drinking water (TCEQ 2014a). In addition to general use criteria and standards for dissolved oxygen and temperature, other specific water quality standards apply for chloride, sulfate, total dissolved solids, pH, and indicator bacteria (TCEQ 2014a). Exceptions to these overall beneficial uses include the Neches River above Lake Palestine (Segment 0606) which has Intermediate Aquatic Life Use standards, and the Trinity River above Lake Livingston and Upper Trinity River (Segments 0804 and 0805, respectively) which do not have Public Supply or drinking water uses.

The following unclassified stream segments within the analysis area have specified Aquatic Life Uses, as indicated, and corresponding dissolved oxygen standards (TCEQ 2014a):

- Caddo Creek (along U.S. Highway 175 west of Lake Palestine, in southeastern Henderson/northeastern Anderson counties) – High
- Unnamed Caddo Creek tributary – High
- Little Duncan Branch (perennial stream northeast of Athens, Henderson County) – Intermediate
- Kickapoo Creek (tributary to Lake Palestine, northeast Henderson County) – Low (TCEQ 2012)
- Box Creek (south of Palestine in Anderson County) – Intermediate
- Keechi Creek (central Freestone County and northeastern Leon County) – High
- Bassett Creek (near the Highway 79/84 intersection, southwest of Palestine in Anderson County) – High
- Town Creek (from southwest of Palestine, draining southwest across Anderson County) – High
- Mims Creek (southeast of Fairfield, Freestone County) – Intermediate
- Walnut Creek (along the highway southwest of Athens, Henderson County) – High
- Toms Creek (south and east of Oakwood, Leon County) – High
- Unnamed Tributary - Northwest Branch (south and east of Oakwood, Leon County) – High
- One Mile Creek (north of and within Athens , Henderson County) – Intermediate

Water quality in the portion of the Sabine River Basin within Study Area 3 and its CESA generally is acceptable in terms of supporting designated beneficial uses. Minor depressed dissolved oxygen concentrations were noted in sampling (TCEQ 2012). In the Trinity River Basin, similar conditions were recorded along the Neches River below Lake Palestine. Lake Palestine and its contributing upstream drainages had water quality exceedances for several constituents, mainly involving nutrient concentrations. In Lake Palestine, manganese in sediments was noted in the middle to upper parts of the lake (TCEQ 2012). Kickapoo Creek had depressed dissolved oxygen, high pH, chlorophyll-a, and ammonia exceedances. Chlorophyll-a, nitrate and/or ammonia, orthophosphorus, and total phosphorus concentrations created screening-level water quality concerns in the Neches and Trinity River basin parts of the analysis area. Along the Trinity River near Trinidad, dioxin and PCB concentrations created non-supporting conditions for Fish Consumption (TCEQ 2012). In the Brazos River Basin, water quality standards generally were met except for bacteria counts, which reduced the suitability of waterbodies for Primary Contact Recreation.

In Study Area 3 and its CESA, waterbody segments that have water quality impairments with respect to supporting one or more of their beneficial uses include (TCEQ 2012):

- 0605A – Kickapoo Creek in Henderson County, for bacteria and depressed dissolved oxygen (Category 5);
- 0606 – Neches River above Lake Palestine, for bacteria, depressed dissolved oxygen, and pH (Category 5);
- 0804 – Trinity River above Lake Livingston, for dioxin and PCBs in edible tissue (Category 5);
- 0804H – Upper Keechi Creek, for depressed dissolved oxygen (Category 5);

- 0805 – Upper Trinity River, from the confluence with the Cedar Creek Reservoir discharge canal to locations upstream, for bacteria (Category 4) and dioxin and PCBs in edible tissue (Category 5);
- 0818 – Cedar Creek Reservoir, for pH (high) (Category 5);
- 1209 – Navasota River below Lake Limestone, for bacteria (Category 5);
- 1210A – Navasota River above Lake Mexia, for bacteria (Category 5);
- 1242I – Campbells Creek in western Robertson County, for bacteria (Category 5)
- 1242K – Mud Creek in western Robertson County, for bacteria (Category 5)
- 1242L – Pin Oak Creek in western Robertson County, for bacteria (Category 5)
- 1242M – Spring Creek in western Robertson County, for bacteria (Category 5)
- 1242O – Walnut Creek in western Robertson County, for bacteria (Category 5)
- 1242P – Big Creek in south-central Falls County, for bacteria (Category 5)

Study Area 4

*Surface Water Features and Flows*

Study Area 4 and its CESA are located mainly in the Brazos River Basin (Texas River Basin 12). However, the southern part of the analysis area is located in the Colorado River Basin (Texas River Basin 13) in Bastrop and Travis counties, and the easternmost part of the CESA is in the Navasota River Basin. Brazos River tributaries, including the Little River, San Gabriel River, Brushy Creek, and upper Yegua Creek, form other major watershed components. These features, the watersheds occurring within the study area (approximately 618 square miles), and the outlying CESA (approximately 3,496 square miles) are indicated in **Figure 3.2-12** and in **Table 3.2-18**. **Table 3.2-18** also includes small portions of some HUC 10 watersheds (i.e., Little Brazos River-Brazos River, Pond Creek, Walnut Creek-Brazos River, Old River-Brazos River, Nails Creek-Yegua Creek, Cedar Creek-Navasota River, Wickson Creek-Navasota River, Gibbons Creek-Navasota River, Big Elm Creek, Walnut Creek-Cedar Creek, and Rabbs Creek-Colorado River) in the CESA. Based on groundwater resource inputs, these additional areas represent locations where future mine-related groundwater pumping could affect groundwater levels, as well as surface water features that have a hydraulic connection to an affected aquifer, up to a few miles beyond a drainage divide.

General flow characteristics for streams with reasonably long historical periods of record are indicated in **Table 3.2-19**.

Approximately 70 miles of perennial stream reaches are within Study Area 4. An additional 574 miles of perennial stream reaches occur in the outlying CESA, bringing the total of perennial stream lengths within the analysis area to 644 miles. According to the NHD, approximately 2,808 miles of intermittent stream reaches are within Study Area 4. Approximately 7,035 intermittent stream miles occur in the outlying CESA, bringing the total of intermittent stream lengths within the analysis area to 9,843 miles. In the NHD, the intermittent stream category includes ephemeral streams.

Streamflows originate from both rainfall and runoff, as well as from groundwater contributions. The average low-flow rates in **Table 3.2-19** are more likely to reflect a combination of flow returns from upstream municipalities (e.g., Temple, Austin suburbs) and groundwater contributions on at least a seasonal basis. Flows on the Lower Colorado River are highly influenced by reservoirs upstream of Austin and municipal withdrawals and returns.

**Table 3.2-18 Watersheds, Study Area 4**

| HUC 10 Watershed Identifier | Watershed Name | Watershed Area within Study Area (acres) | Watershed Area in CESA Outside of Study Area (acres) | Total Watershed Area within Analysis Area (acres) |
|---|---|---|---|---|
| 1207010103 | Little Brazos River-Brazos River | 0 | 1,172 | 1,172 |
| 1207010104 | Pond Creek | 0 | 14,546 | 14,546 |
| 1207010105 | Walnut Creek-Brazos River | 0 | 28,791 | 28,791 |
| 1207010106 | Cedar Creek-Brazos River | 67,466 | 293,353 | 360,819 |
| 1207010107 | Old River-Brazos River | 0 | 76,319 | 76,319 |
| 1207010201 | Middle Yegua Creek | 86,099 | 196,844 | 282,943 |
| 1207010202 | East Yegua Creek | 54,760 | 128,654 | 183,414 |
| 1207010203 | Nails Creek-Yegua Creek | 0 | 5,881 | 5,881 |
| 1207010204 | Davidson Creek | 9,185 | 130,839 | 140,024 |
| 1207010305 | Cedar Creek-Navasota River | 0 | 13,634 | 13,634 |
| 1207010306 | Wickson Creek-Navasota River | 0 | 10,853 | 10,853 |
| 1207010307 | Gibbons Creek-Navasota River | 0 | 344 | 344 |
| 1207020401 | Upper Little River | 8,771 | 246,131 | 254,902 |
| 1207020402 | Big Elm Creek | 0 | 124 | 124 |
| 1207020403 | Lower Little River | 85,920 | 94,184 | 180,104 |
| 1207020504 | Turkey Creek-Brushy Creek | 32,092 | 300,561 | 332,653 |
| 1207020505 | Granger Lake-San Gabriel River | 1,151 | 202,357 | 203,508 |
| 1209030101 | Willbarger Creek-Colorado River | 4 | 234,638 | 234,642 |
| 1209030102 | Piney Creek-Colorado River | 19,895 | 103,103 | 122,997 |
| 1209030103 | Walnut Creek-Cedar Creek | 0 | 8,977 | 8,977 |
| 1209030104 | Alum Creek-Colorado River | 5 | 119,281 | 119,286 |
| 1209030105 | Rabbs Creek-Colorado River | 0 | 56,844 | 56,844 |
| **Totals** | | **365,348** | **2,267,430** | **2,632,777** |

**Table 3.2-19 General Monthly Flow Characteristics for Select Streams in Study Area 4 [1]**

| Waterbody | Monitoring Site | General Location | Drainage Area (square miles) | Period of Record | Average High Flow (cfs) | Average Low Flow (cfs) |
|---|---|---|---|---|---|---|
| Brazos River at State Highway 21 near Bryan | USGS 08108700 | On Highway 21 about 10 miles west of Bryan | 39,049 | 8/1993 to 9/2013 | 8,030 (Mar) | 2,720 (Sep) |
| East Yegua Creek near Dime Box | USGS 08109800 | At Highway 21 upstream of Somerville Lake near Dime Box | 244 | 10/1990 to 9/2013 | 127 (Feb) | 14 (Aug) |
| Middle Yegua Creek near Dime Box | USGS 08109700 | At Highway 21 upstream of Somerville Lake near Lincoln | 236 | 10/1990 to 9/2013 | 124 (Feb) | 6.6 (Aug) |
| San Gabriel River at Laneport | USGS 08105700 | Downstream of Granger Lake northeast of Taylor | 738 | 10/1990 to 9/2013 | 427 (Mar) | 116 (Oct) |
| Little River near Cameron | USGS 08106500 | At Highway 77 southeast of Cameron | 7,065 | 10/1990 to 9/2013 | 3,440 (Mar) | 1,030 (Oct) |

[1] Based on available data for a multi-year period of record.

Source: USGS-NWIS 2014.

Storm event magnitudes, in inches over durations of a quarter-day, half-day, or a full day, have been approximated based on the current National Weather Service reference for the area (see **Table 3.2-20**). The recurrence intervals, in years, are long-term averages that reflect the probability (based on 100 percent) of an event happening in any given year. For example, an event with an estimated 2-year recurrence interval has a 50 percent chance of occurring in any given year. Rainfall intensity is reflected in the duration. For example, for a 10-year event, approximately 5.0 inches of rain would fall in 6 hours as shown in **Table 3.2-20**.

**Table 3.2-20 Estimates of Storm Event Magnitudes for Study Area 4 (inches)**

| Storm Event Duration | Storm Event Recurrence Intervals | | | | |
|---|---|---|---|---|---|
| | 2-year | 10-year | 25-year | 50-year | 100-year |
| **6-hour** | 3.2 | 5.0 | 5.9 | 6.6 | 7.5 |
| **12-hour** | 3.7 | 6.0 | 6.9 | 8.0 | 9.0 |
| **24-hour** | 4.3 | 7.0 | 8.1 | 9.3 | 10.5 |

Source: Hershfield 1961.

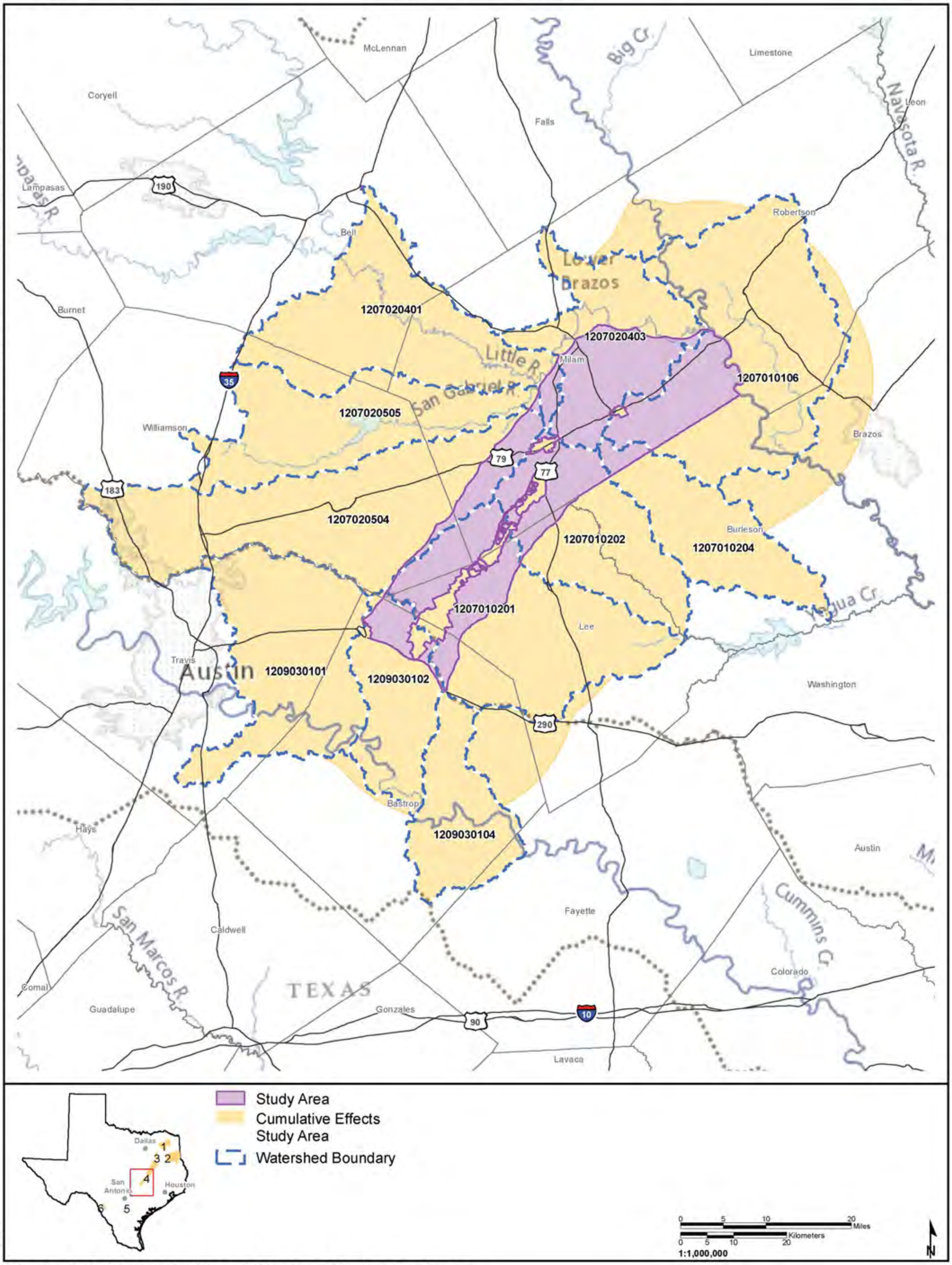


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**Figure 3.2-12 Study Area 4 Surface Water Features**

The major impoundment within Study Area 4 and its CESA is Granger Lake, a USACE reservoir operated for flood control, water supply, and recreation. It is located on the San Gabriel River in the northwest part of the CESA near Circleville in Williamson County (**Figure 3-2-12**). Lake Bastrop, Walter E. Long Lake (Decker Lake), Lake Pflugerville, Alcoa Lake, and Lake Bryan are other reservoirs within the study area or its associated CESA. Lake Bastrop is owned and operated by the Lower Colorado River Authority as a supply of cooling water to the Sim Gideon Generating Station and for recreational purposes (TWDB 2014b). Lake Pflugerville is used for municipal water supply and recreation. Walter E. Long Lake is managed by the City of Austin for power plant cooling and recreation. Alcoa Lake is owned and operated by the Aluminum Company of America for industrial and recreational purposes (TWDB 2014b). Lake Bryan (Bryan Utilities Lake) is owned by City of Bryan and operated as a cooling pond for the Dansby Power Plant (TWDB 2014b).

*Floodplains*

Delineated floodplains, defined as FEMA Flood Hazard Zone A, have been identified along the major streams in Study Area 4 as indicated in **Figure 3.2-13**. Milam County does not have current floodplain delineations under the FEMA program. However, floodplains do occur along major streams and their tributaries in Milam County, similar to the floodplains depicted in the other counties.

Within Study Area 4, major streams bordered by relatively broad floodplains include the Brazos River and the Little River. Within the associated CESA, the headwaters of Yegua Creek, the San Gabriel River, Brushy Creek, and Colorado River tributaries also have floodplains designated along their stream courses. Smaller floodplains likely occur as narrow, low-lying stream deposits along many of the streams and sloughs in the region; however, they may not be designated by FEMA.

Within Study Area 4, delineated floodplains occupy approximately 14,301 acres (22 square miles). In the outlying CESA, approximately 541,042 acres (845 square miles) of additional delineated floodplains occur.

*Surface Water Uses and Quality*

The Colorado River is navigable from the Bastrop/Fayette County line upstream to Longhorn Dam in the City of Austin (USACE 1999). This is essentially the entire length of the river through the Study Area 4 CESA. In addition, the Brazos River is navigable throughout the CESA and where it forms the northeastern boundary of Study Area 4 (**Figure 3.2-12**). There are no other identified navigable streams in Study Area 4 or its CESA (USACE 1999).

These following waterbodies provide sole-source drinking water supplies in the analysis area (TAC 2014d):

- Little River (Milam County)
- Granger Lake (Williamson County)
- Navasota River below Lake Limestone

The following communities or facilities have surface water intakes at the indicated sources within Study Area 4 or its CESA (TCEQ 2014b):

- City of Pflugerville (Lake Pflugerville)
- Brazos River Authority (Granger Lake)
- City of Cameron (Little River)

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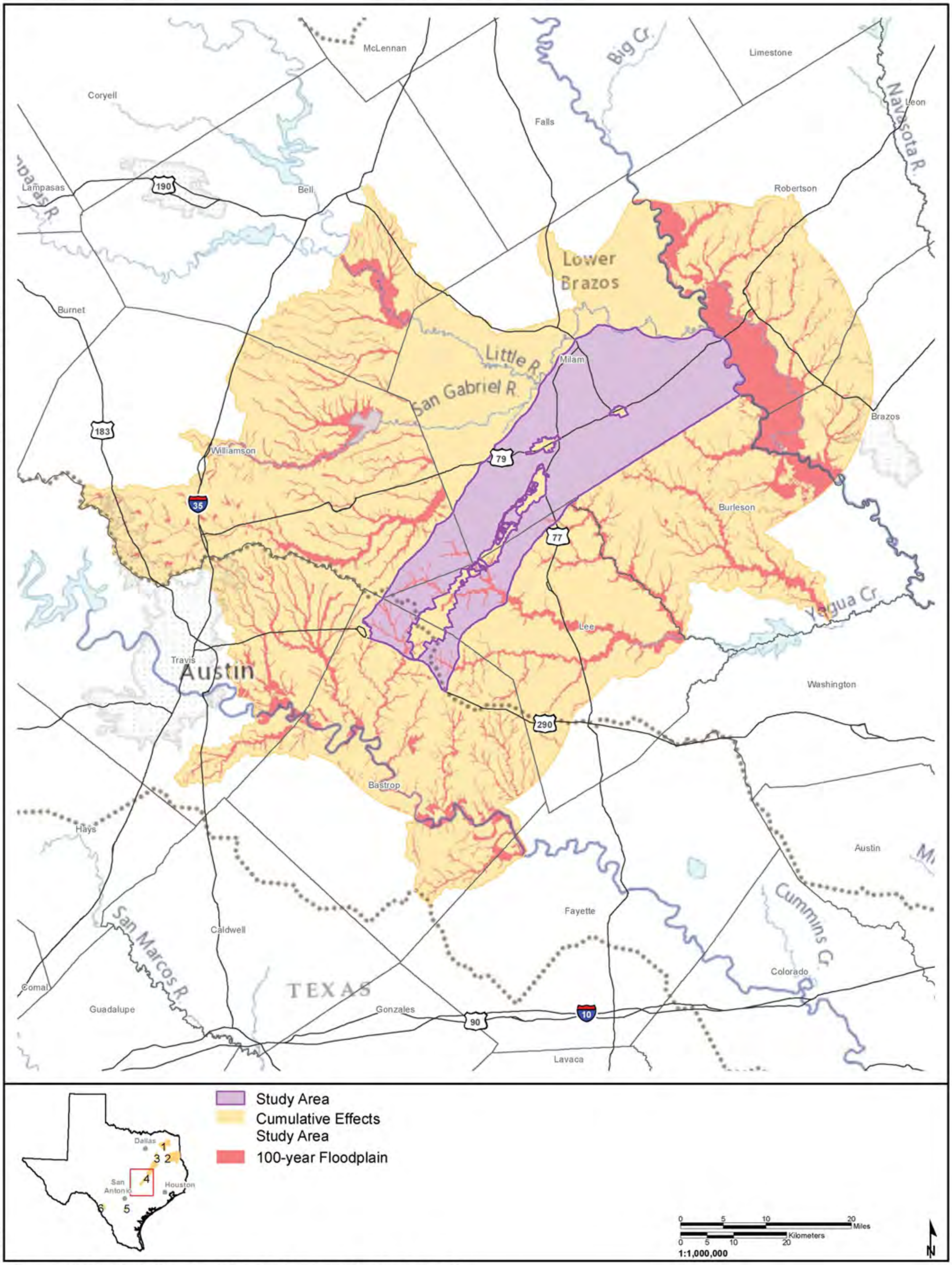


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Figure 3.2-13 100-year Floodplains – Study Area 4

Several USGS water quality stations have been monitored recently within Study Area 4 or nearby. The monitoring data are summarized in **Table 3.2-21**. In addition, a very large amount of surface water quality data is available from TCEQ and the Texas Clean Rivers Program, which can provide information for more detailed future analyses, if needed.

The following waterbody segments in Study Area 4 and its CESA are classified by TCEQ (2012) for beneficial uses and corresponding water quality standards:

- 1209 – (Navasota River below Lake Limestone) on the northeast edge of the CESA
- 1212 – (Somerville Lake upper Yegua Creek sections)
- 1213 – (Little River)
- 1214 – (San Gabriel River)
- 1242 – (Brazos River above Navasota River)
- 1244 – (Brushy Creek)
- 1247 – (Granger Lake)
- 1248 – (San Gabriel/North Fork San Gabriel River)
- 1427 – (Onion Creek) along southwestern edge of the CESA
- 1428 – (Colorado River) below Town Lake
- 1434 – (Colorado River) above LaGrange

The following unclassified stream segments with specific Aquatic Life Use water quality standards occur in Study Area 4 and its CESA (TAC 2014d):

- Davidson Creek (tributary to Yegua Creek in Burleson County) – Intermediate
- Middle Yegua Creek (tributary to Somerville Lake) – High (TCEQ 2012)
- East Yegua Creek (tributary to Somerville Lake) – High (TCEQ 2012)
- Still Creek (part of a tributary to Thompsons Creek west of Bryan) – High
- Thompsons Creek below Still Creek (tributary to the Brazos River west of Bryan) – High
- Thompsons Creek from Still Creek to Thompsons Branch – Intermediate
- Brushy Creek (in Williamson County) – High
- Mustang Creek (tributary to Brushy Creek, Williamson County) – Intermediate
- Cluck Creek (tributary to South Brushy Creek, Williamson County) – High
- Gilleland Creek (tributary to Colorado River in the CESA, east of Austin) – High
- Harris Branch (tributary to Gilleland Creek in the CESA, east of Austin) – High
- Unnamed tributary to Harris Branch – Low
- Wilbarger Creek (tributary to the Colorado River in the CESA west of Camp Swift, Travis County) – High
- Unnamed tributary of Wilbarger Creek (in the CESA, Travis County) – High

Other unclassified streams, such as Cedar Creek, Gazley Creek, and Maha Creek, are located south of the Colorado River in the southern part of the CESA. They have High or Intermediate Aquatic Life Uses but are unlikely to have a hydrologic connection to water resources in the CESA. In addition, Carters and

Wickson creeks in and north of the City of Bryan have Intermediate and Low specified Aquatic Life Uses, respectively. Carters Creek also has ongoing Total Maximum Daily Load studies for bacteria.

In general, there were relatively few water quality standards exceedances in the sampling used for the TCEQ integrated assessment (TCEQ 2012). Most of the exceedances involved screening-level considerations for nutrients such as nitrates, phosphorus, and/or orthophosphorus. Several segments were non-supporting of recreational uses on the basis of bacteria counts. These are listed more specifically below. The San Gabriel River has excessive chloride and sulfate concentrations. Screening level concerns for biological attributes such as an impaired macroinvertebrate community, impaired fish community, or impaired habitat were noted for Middle Yegua Creek (Segment 1212A) and the Colorado River below Town Lake (Segment 1428).

More consistent water quality issues are reflected in the bi-annual list of impaired waterbodies prepared by TCEQ in accordance with Clean Water Act Section 303(d). The following impaired waters occur in Study Area 4 and its CESA (TCEQ 2012):

- Navasota River below Lake Limestone, for bacteria (Category 5)
- Middle Yegua Creek and East Yegua Creek, both for bacteria (Category 5)
- Little River, for bacteria (Category 5)
- Big Elm Creek, within the CESA north of Cameron in northern Milam County, for bacteria (Category 5)
- San Gabriel River, for bacteria, chloride, and sulfate (Category 5)
- Still Creek, for bacteria (Category 5)
- Thompsons Creek, for bacteria (Category 5)
- Campbells Creek, for bacteria (Category 5)
- Spring Creek, for bacteria (Category 5)
- Pin Oak Creek, for bacteria (Category 5)
- Mud Creek, for bacteria (Category 5)
- Brushy Creek , for bacteria (Category 5)
- Lower Mankins Branch east of Georgetown, for bacteria (Category 5)
- Willis Creek, from the north arm of Granger Lake to the CESA edge near Interstate 35, for bacteria (Category 5)
- Gilleland Creek, for bacteria (Category 5)

<u>Study Area 5</u>

*Surface Water Features and Flows*

Study Area 5 and its CESA are located mainly in the upper Nueces River Basin (Texas River Basin 21), particularly within the Atascosa River, San Miguel Creek, and Frio River tributary drainages. These features and the watersheds occurring within the study area (approximately 315 square miles) and the outlying CESA (approximately 1,326 square miles) are indicated in **Figure 3.2-14** and in **Table 3.2-22**. **Table 3.2-22** also include a small portion of one HUC 10 watershed (i.e., Rex Cabaniss Creek-Nueces River) in the CESA. Based on groundwater resource inputs, this additional area represent the location where future mine-related groundwater pumping could affect groundwater levels, as well as surface water features that have a hydraulic connection to an affected aquifer, up to a few miles beyond a drainage divide.

**Table 3.2-21 Water Quality Overview for Streams in or near Study Area 4**

| Location | Identifier | Sampling Period | Measure | pH | TDS | Specific Conductance | Dissolved Oxygen[1] | Total Suspended Solids | Turbidity | Hardness | Calcium | Magnesium | Sodium | Bicarbonate | Chloride | Sulfate | Iron | Manganese |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| San Gabriel River at Laneport | USGS 08105700 | 7/1972 to 9/2007 | Median | 7.7 | 275 | 498 | 8.2/95 | 31 | 20 | 220 | 65 | 12 | 18 | 240 | 24 | 29 | 20 | 6 |
| | | | Range | 6.5 to 8.5 | 165 to 406 | 286 to 752 | 4.9/62 to 13.4/131 | 1 to 2,460 | 3 to 350 | 123 to 280 | 39 to 89 | 3.8 to 17 | 8.4 to 44 | 150 to 304 | 11 to 75 | 9 to 86 | 0 to 200 | 0 to 60 |
| Davidson Creek at SH 21 near Caldwell | USGS 08110075 | 5/2003 to 9/2004 | Median | 7.1 | 400 | No Data | 5.1 | 37 | No Data | No Data | No Data | No Data | No Data | No Data | 72 | 85 | No Data | No Data |
| | | | Range | 6.9 to 7.3 | 160 to 494 | No Data | 0.4 to 6.5 | 9 to 129 | No Data | No Data | No Data | No Data | No Data | No Data | 6 to 94 | 32 to 118 | No Data | No Data |
| East Yegua Creek near Dime Box | USGS 08109800 | 6/1966 to 4/2001 | Median | 7.55 | 767.5 | 1,060 | 7.6/79.5 | 35.5 | 20 | 410 | 110 | 32.5 | 86 | No Data | 150 | 300 | 40 | 210 |
| | | | Range | 6.9 to 8.4 | 185 to 1,450 | 182 to 2,060 | 3.3/39 to 14.5/138 | 1 to 400 | 1.2to 1,900 | 91.7 to 784 | 25 to 210 | 7.1 to 64 | 20 to 160 | No Data | 30 to 240 | 34 to 710 | 5 to 490 | 50 to 860 |
| Little River near Cameron | USGS 08106500 | 10/1970 to 9/2001 | Median | 7.8 | 312 | 556 | 8.7/94 | No Data | 55.5 | 210 | 62 | 13 | 32 | 223.5 | 42 | 37 | 10 | 3 |
| | | | Range | 6.9 to 8.7 | 142 to 471 | 240 to 870 | 5.1/65 to 13.5/161 | No Data | 0.5 to 950 | 100 to 300 | 35 to 92 | 2.7 to 20 | 7.2 to 93 | 84 to 330 | 7.4 to 87 | 5 to 84 | 3 to 200 | 1 to 120 |

[1] Values reflect concentration (mg/L) and percent saturation, where available.

Note: All data in mg/L except for pH (standard units), specific conductance (microsiemens per centimeter), iron and manganese (mg/L), and turbidity (Nephelometric Turbidity Units or Jackson Turbidity Units).

Source: USGS-NWIS 2014.

**Table 3.2-22 Watersheds, Study Area 5**

| HUC 10 Watershed Identifier | Watershed Name | Watershed Area within Study Area (acres) | Watershed Area in CESA Outside of Study Area (acres) | Total Watershed Area within Analysis Area (acres) |
|---|---|---|---|---|
| 1211010512 | Rex Cabaniss Creek-Nueces River | 0 | 312 | 312 |
| 1211010804 | Esperanza Creek-Frio River | 33,461 | 203,248 | 236,708 |
| 1211010805 | San Miguel Creek-Frio River | 18,386 | 114,609 | 132,995 |
| 1211010905 | La Jarita Creek-San Miguel Creek | 52,003 | 20,083 | 72,085 |
| 1211011003 | Borrego Creek-Atascosa River | 11,553 | 222,598 | 234,151 |
| 1211011004 | La Parita Creek-Atascosa River | 61,930 | 138,543 | 200,473 |
| 1211011005 | Lower Atascosa River | 3,509 | 169,464 | 172,973 |
| **Totals** | | **180,841** | **868,857** | **1,049,698** |

General flow characteristics for streams with reasonably long historical periods of record are indicated in **Table 3.2-23**.

According to the NHD, approximately 27 miles of perennial stream reaches are within Study Area 5. An additional 78 miles of perennial stream reaches occur in the outlying CESA, bringing the total of perennial stream lengths within the analysis area to 105 miles. Approximately 853 miles of intermittent stream reaches are within Study Area 5. Approximately 2,739 intermittent stream miles occur in the outlying CESA, bringing the total of intermittent stream lengths within the assessment area to 3,592 miles. In the NHD, the intermittent stream category includes ephemeral streams. Streamflows originate from both rainfall and runoff, as well as from groundwater contributions (baseflow). Average low-flow rates in **Table 3.2-23** are more likely to reflect baseflow.

Storm event magnitudes, in inches over durations of a quarter-day, half-day, or a full day, have been approximated based on the current National Weather Service reference for the area (see **Table 3.2-24**). The recurrence intervals, in years, are long-term averages that reflect the probability (based on 100 percent) of an event happening in any given year. For example, an event with an estimated 2-year recurrence interval has a 50 percent chance of occurring in any given year. Rainfall intensity is reflected in the duration. For example, for a 10-year event, approximately 4.9 inches of rain would fall in 6 hours as shown in **Table 3.2-24**.

**Table 3.2-23 General Monthly Flow Characteristics for Select Streams in Study Area 5[1]**

| Waterbody | Monitoring Site | General Location | Drainage Area (square miles) | Period of Record | Average High Flow (cfs) | Average Low Flow (cfs) |
|---|---|---|---|---|---|---|
| Atascosa River near McCoy | USGS 08207500 | East-central Atascosa County | 530 | 9/2002 to 3/2014 | 107 (Jul) | 8.4 (Dec) |
| Atascosa River at Whitsett | USGS 08208000 | Live Oak County, about 7 miles north of Choke Canyon Reservoir | 1,171 | 9/2002 to 3/2014 | 207 (Sep) | 34 (Dec) |
| San Miguel Creek near Tilden | USGS 08206700 | McMullen County on Highway 16 northwest of Choke Canyon Reservoir | 783 | 10/1990 to 7/2014 | 100 (Sep) | 10 (Jan) |
| Frio River at Tilden | USGS 08206600 | McMullen County on Highway 16 west of Choke Canyon Reservoir | 4,493 | 10/1990 to 10/2013 | 705 (Jul) | 84 (Jan) |

1 Based on available data for a multi-year period of record.

Source: USGS-NWIS 2014.

**Table 3.2-24 Estimates of Storm Event Magnitudes for Study Area 5 (inches)**

| Storm Event Duration | Storm Event Recurrence Intervals | | | | |
|---|---|---|---|---|---|
| | 2-year | 10-year | 25-year | 50-year | 100-year |
| **6-hour** | 3.1 | 4.9 | 5.9 | 6.5 | 7.3 |
| **12-hour** | 3.5 | 5.8 | 6.9 | 7.9 | 8.9 |
| **24-hour** | 4.1 | 6.8 | 8.0 | 9.0 | 10.3 |

Source: Hershfield 1961.

*Floodplains*

Delineated floodplains, defined as FEMA Flood Hazard Zone A, have been identified along the major streams of Study Area 5 as indicated in **Figure 3.2-15**. McMullen and La Salle counties do not have current floodplain delineations under the FEMA program. However, floodplains do occur along major streams and their tributaries in these counties, similar to the floodplains depicted in Atascosa, Wilson, Karnes, and Live Oak counties.

Within Study Area 5 and the associated CESA, major streams bordered by relatively broad floodplains include the Atascosa and Frio rivers and San Miguel Creek. Smaller floodplains likely occur as narrow, low-lying stream deposits along some of the other streams in the region; however, they may not be delineated by FEMA. Within Study Area 5, delineated floodplains occupy approximately 44,080 acres (69 square miles). In the outlying CESA, approximately 114,041 acres (178 square miles) of additional delineated floodplains occur.

The major impoundment within Study Area 5 and its CESA is Choke Canyon Reservoir. It is located on the Frio River at Calliham, upstream from the confluence of the Nueces River with its major tributaries (**Figure 3.2-14**). The reservoir was built by the Bureau of Reclamation. It is owned and operated by the City of Corpus Christi and the Nueces River Authority for municipal water supply and recreational purposes (TWDB 2014b).

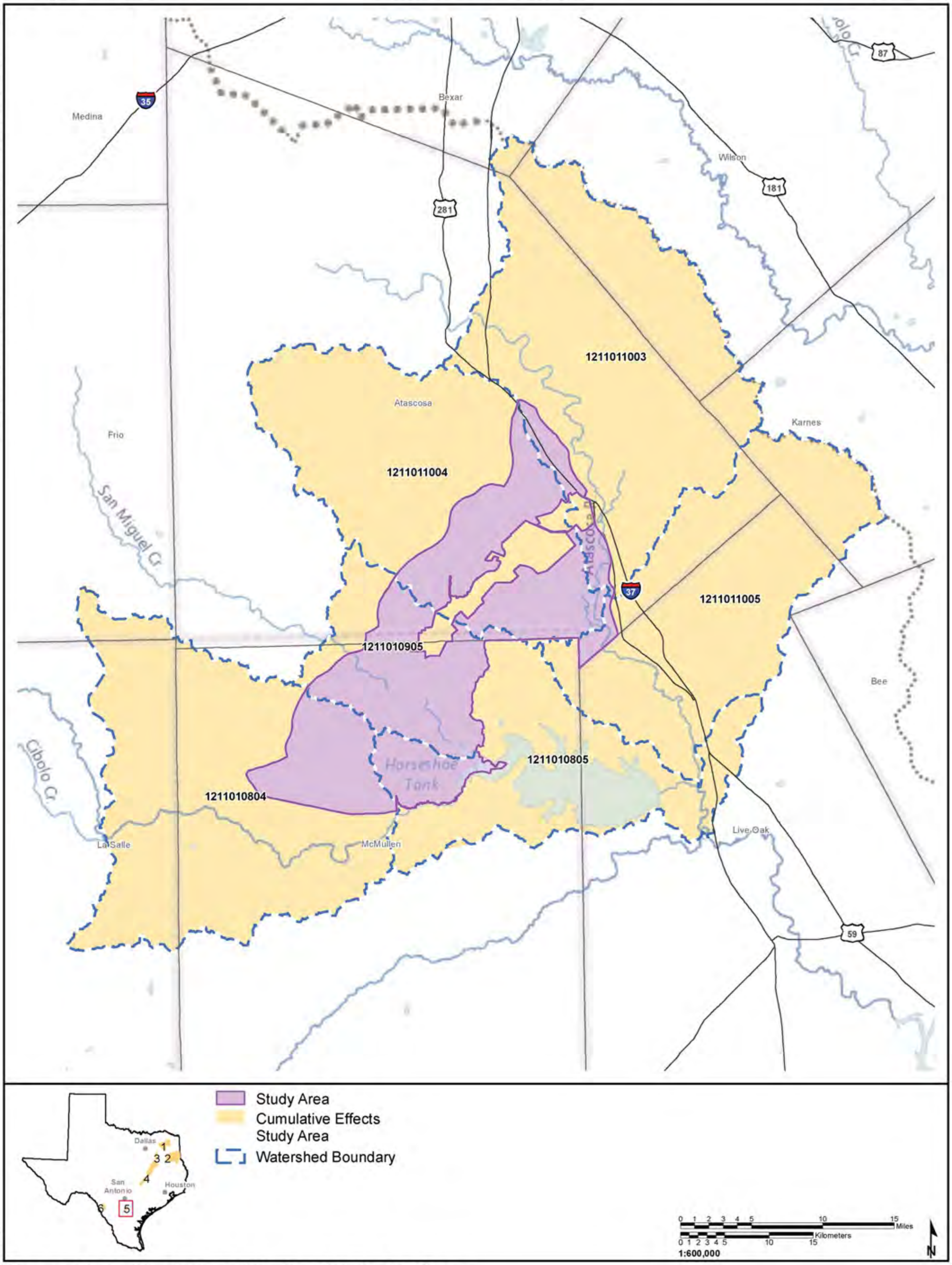




**Figure 3.2-14 Study Area 5 Surface Water Features**

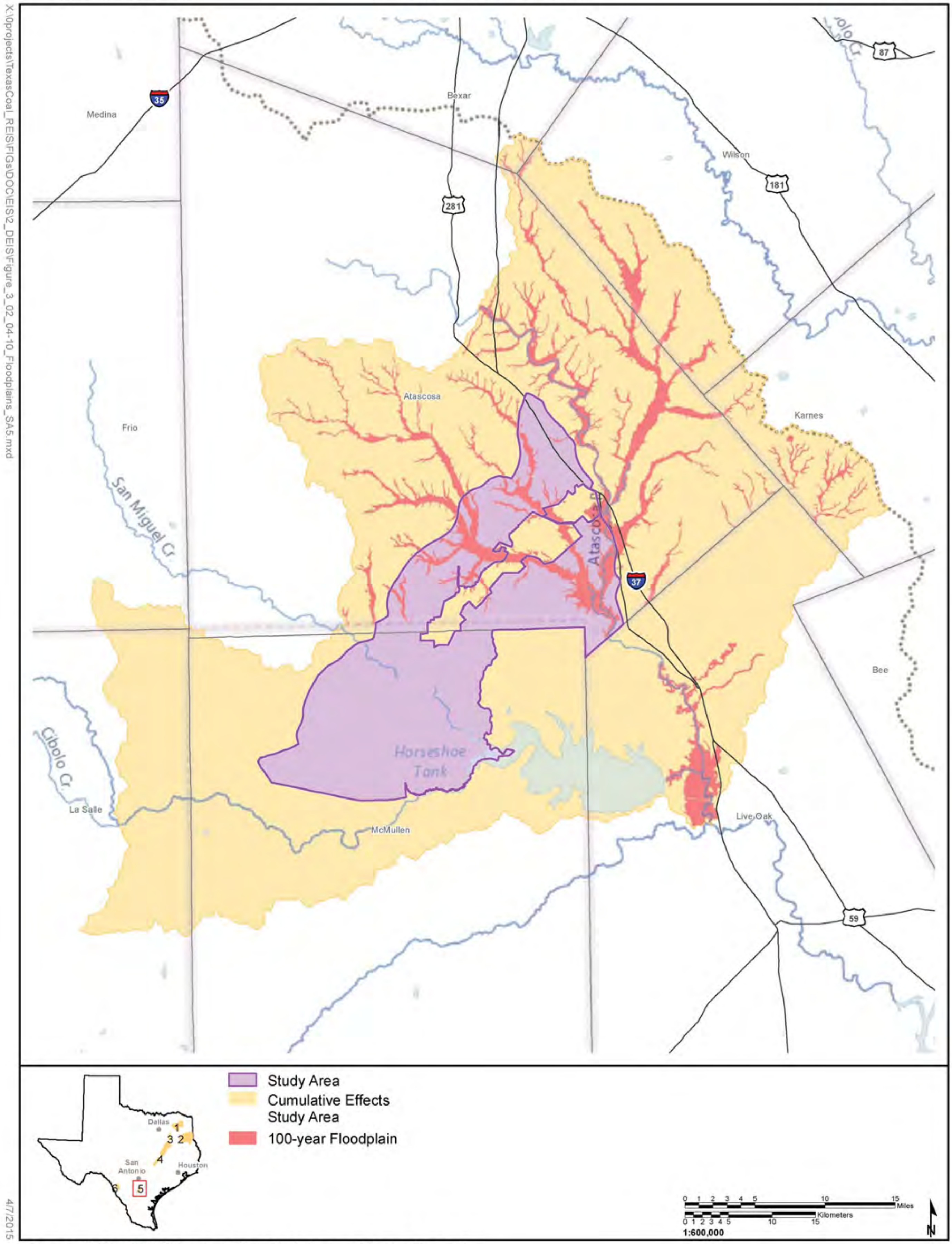


Figure 3.2-15 100-year Floodplains – Study Area 5

*Surface Water Uses and Quality*

Within Study Area 5 and its associated CESA, there are no navigable streams (USACE 1999) or waterbodies that provide sole-source drinking water supplies (TAC 2014d).

The following communities or facilities have surface water intakes at the indicated sources within Study Area 5 or its CESA (TCEQ 2014b):

- City of Three Rivers (Frio River and Choke Canyon Reservoir)
- Choke Canyon State Park (Calliham Reservoir North, Calliham Reservoir South, and Choke Canyon Reservoir)

Several USGS water quality stations have been monitored within Study Area 5 or nearby. The monitoring data are summarized in **Table 3.2-25**. In addition, some additional surface water quality data are available from TCEQ and the Texas Clean Rivers Program, which can provide information for more detailed future analyses, if needed.

The following waterbody segments within Study Area 5 and its CESA are classified by TCEQ for beneficial uses and corresponding water quality standards (TCEQ 2012):

- 2106 (Nueces River/Lower Frio River) immediately downstream of Choke Canyon Reservoir in Live Oak County
- 2107 (Atascosa River) paralleling the northeast study area boundary in Atascosa and Live Oak counties
- 2108 (San Miguel Creek) through the central part of the analysis area in McMullen County
- 2116 (Choke Canyon Reservoir) in the southeastern part of the CESA on the McMullen/Live Oak County line
- 2117 (Frio River above Choke Canyon Reservoir) in the southern part of the CESA, northern McMullen and northeastern La Salle counties

In addition to General Uses, designated beneficial uses for these segments include Primary Contact Recreation 1, High Aquatic Life Use, and Public Supply of drinking water (TAC 2014d). The Frio River above Choke Canyon Reservoir also has a designated Aquifer Protection use. Different specific criteria for chloride, sulfate, total dissolved solids, pH, dissolved oxygen, and temperature are associated with these segments (TAC 2014d).

The following unclassified stream segment with specific Aquatic Life Use water quality standards occurs in the analysis area (TAC 2014d):

- Atascosa River (Segment 2118), intermittent stream on the edge of the CESA from just east of Pleasanton and upstream – Intermediate

Along its lower reach from its confluence with the Frio River to Borrego Creek (just north of Campbellton), the Atascosa River supported its beneficial uses with the exception of Recreation, due to bacteria counts. It also had a screening level concern with respect to exceedances of chlorophyll-a (TCEQ 2012). Further upstream within the analysis area, to Galvan Creek at Pleasanton and beyond, the Atascosa River is non-supporting of its High Aquatic Uses due to habitat, macrobenthic, and fish community impairments (TCEQ 2012). Depressed dissolved oxygen and excessive chlorophyll-a concentrations were also noted along the upper reach, and Recreation use was not supported due to bacteria.

The Frio River below Choke Canyon Dam was non-supporting of General Uses based on elevated total dissolved solids concentrations (TCEQ 2012). Nitrates and bacteria counts were also noted water quality concerns (TCEQ 2012). Choke Canyon reservoir supported its designated uses; some exceedances of chloropyll-a were noted at the western end.

More consistent water quality issues are reflected in the bi-annual list of impaired waterbodies prepared by TCEQ in accordance with CWA Section 303(d). Impaired waters in Study Area 5 and its CESA include (TCEQ 2012):

- Frio River from the Nueces confluence to Choke Canyon Dam, for total dissolved solids (Category 5);
- Atascosa River, for bacteria, depressed dissolved oxygen, impaired fish community, and impaired macrobenthic community (all Category 5);
- San Miguel Creek, for bacteria (Category 5); and
- Frio River above Choke Canyon Reservoir, for bacteria (Category 5).

Study Area 6

*Surface Water Features and Flows*

Study Area 6 and its CESA are located in both the upper Nueces and Rio Grande river basins (Texas River Basin 21 and 23, respectively). Most of the analysis area is within the Nueces River basin (**Figure 3.2-16**). Major features include Elm Creek, which drains southwest to the Rio Grande north of the City of Eagle Pass, King Tank (an impoundment on a tributary to Elm Creek), and Farias Lake southeast of Eagle Pass on the Maverick County line approximately halfway to Carrizo Springs. Comanche Lake, Comanche Creek, and its tributaries drain southeastward to the Nueces River. Other Nueces River tributaries such as Turkey Creek, Capota Creek, and Picosa, Pendencia, and Palo Blanco creeks also drain generally eastward. Another Elm Creek drains to Chacon Creek and then to the Nueces River through other tributaries named above. Numerous smaller impoundments are scattered throughout Study Area 6 and its CESA.

Watersheds occurring within the study area (approximately 484 square miles), and the outlying CESA (approximately 1,412 square miles) are indicated in **Figure 3.2-16** and **Table 3.2-26**. **Table 3.2-26** also includes a small portion of one HUC 10 watershed (i.e., Rex Quemado Creek-Rio Grande) in the CESA. Based on groundwater resource inputs, this additional area represent the location where future mine-related groundwater pumping could affect groundwater levels, as well as surface water features that have a hydraulic connection to an affected aquifer, up to a few miles beyond a drainage divide.

General flow characteristics for streams with reasonably long historical periods of record are indicated in **Table 3.2-27**.

Streamflow monitoring is rare in Study Area 6 and its CESA, and data from USGS or Texas State sources are not readily available. Some information is available within the study area from the International Boundary Waters Commission (IBWC), and a few data for generally similar streams are available regionally. Data from these sources are reflected in **Table 3.2-28**.

It should be noted that extreme weather, in the form of both flash floods and drought, are common in the past 25 years of record (and more) in the region. For example, monthly flow averages in the USGS record for the West Nueces River near Brackettville are heavily influenced by comparatively extreme flow months during 1997 and again in 2007. In contrast, a number of zero-flow months are noticeable since the 2008. In addition, flash floods have been noted at Eagle Pass in June 2013, April 2004, from Hurricane Alice in 1954, and in 1948. Based on the USGS record near Asherton, high flow events also occurred during July 2002 and June 1997.

**Table 3.2-25 Water Quality Overview for Streams in or near Study Area 5**

| Location | Identifier | Sampling Period | Measure | pH | TDS | Specific Conductance | Dissolved Oxygen[1] | Total Suspended Solids | Turbidity | Hardness | Calcium | Magnesium | Sodium | Bicarbonate | Chloride | Sulfate | Iron | Manganese |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Frio River at Tilden | USGS 08206600 | 7/1978 to 1/2010 | Median | 8.1 | 1,030 | 1,700 | 7.1/84 | 55 | 32 | 450 | 128 | 31 | 160 | 240 | 280 | 220 | 12.7 | 4.0 |
| | | | Range | 7.4 to 8.6 | 127 to 5,610 | 219 to 8,940 | 3/39 to 12.3/116 | 1 to 568 | 5 to 160 | 25 to 2,140 | 6.7 to 461 | 1.9 to 240 | 7.9 to 1,140 | 78 to 430 | 8.1 to 2,180 | 10.7 to 1,410 | 0 to 350 | 0.4 to 30 |
| San Miguel Creek near Tilden | USGS 08206700 | 12/1965 to 10/1983 | Median | 7.9 | 1,050 | 1,610 | 7.3/80 | 21 | 10 | 470 | 144 | 30.5 | 180 | 270 | 240 | 270 | 25 | 65 |
| | | | Range | 7.3 to 8.2 | 116 to 1,990 | 189 to 3,050 | 4.6/55 | 4 to 344 | 2.6 to 240 | 60.6 to 860 | 20 to 230 | 2.6 to 70 | 12 to 390 | 79 to 410 | 7.6 to 570 | 24 to 610 | 10 to 40 | 10 to 270 |
| Atascosa River at Whitsett | USGS 08208000 | 1/1964 to 5/1980 | Median | 7.4 | 710 | 1,170 | No Data | No Data | No Data | 110 | 34 | 6.8 | 157 | 274 | 144 | 74 | No Data | No Data |
| | | | Range | 6 to 8.4 | 80 to 1,480 | 112 to 2,490 | No Data | No Data | No Data | 38 to 400 | 12 to123 | 2 to 22 | 4.8 to 463 | 41 to 592 | 3.8 to 395 | 11 to 225 | No Data | No Data |

[1] Values reflect concentration (mg/L) and percent saturation, where available.

Note: All data in mg/L except for pH (standard units), specific conductance (microsiemens per centimeter), iron and manganese (mg/L), and turbidity (Nephelometric Turbidity Units or Jackson Turbidity Units).

Source: USGS-NWIS 2014.

**Table 3.2-26 Watersheds, Study Area 6**

| HUC 10 Watershed Identifier | Watershed Name | Watershed Area within Study Area (acres) | Watershed Area in CESA Outside of Study Area (acres) | Total Watershed Area within Analysis Area (acres) |
|---|---|---|---|---|
| 1211010401 | Elm Creek | 25,432 | 190,454 | 215,887 |
| 1211010402 | Headwaters Palo Blanco Creek | 88,169 | 28,700 | 116,869 |
| 1211010403 | Palo Blanco Creek-Comanche Creek | 102,248 | 151,037 | 253,285 |
| 1211010405 | Chaparrosa Creek | 17,401 | 113,787 | 131,187 |
| 1211010406 | Lower Turkey Creek | 466 | 147,238 | 147,704 |
| 1308000107 | Elm Creek | 16,408 | 126,861 | 143,269 |
| 1308000108 | Quemado Creek-Rio Grande | 0 | 3,337 | 3,337 |
| 1308000201 | Rosita Creek-Rio Grande | 2,201 | 199,405 | 201,606 |
| **Totals** | | **252,326** | **960,818** | **1,213,144** |

**Table 3.2-27 General Monthly Flow Characteristics for Select Streams in or near Study Area 6[1]**

| Waterbody | Monitoring Site | General Location | Drainage Area (square miles) | Period of Record | Average High Flow (cfs) | Average Low Flow (cfs) |
|---|---|---|---|---|---|---|
| Rio Grande at Eagle Pass | IBWC 08-4580.00 | Eagle Pass below International Amistad Reservoir and Maverick Dam | Unknown | 2006 | 2,645 (May) | 1,026 (Nov) |
| West Nueces River near Brackettville | USGS 08190500 | Northwest of Uvalde outside the assessment area | 694 | 10/1991 to 8/2014 | 58 (Jun) | 2.7 (Jan) |
| Nueces River near Asherton | USGS 08193000 | East of the CESA in northeastern Dimmit County | 4,082 | 10/1991 to 7/2014 | 309 (Jul) | 68 (Feb) |

[1] Based on available data for a multi-year period of record.

Source: International Boundary Waters Commission (IBWC) 2006; USGS-NWIS 2014.

**Table 3.2-28 Estimates of Storm Even Magnitudes for Study Area 6 (inches)**

| Storm Event Duration | Storm Event Recurrence Intervals | | | | |
|---|---|---|---|---|---|
| | 2-year | 10-year | 25-year | 50-year | 100-year |
| **6-hour** | 2.7 | 4.4 | 5.2 | 5.9 | 6.7 |
| **12-hour** | 3.2 | 5.3 | 6.2 | 7.0 | 7.9 |
| **24-hour** | 3.7 | 6.0 | 7.3 | 8.2 | 9.3 |

Source: Hershfield 1961.

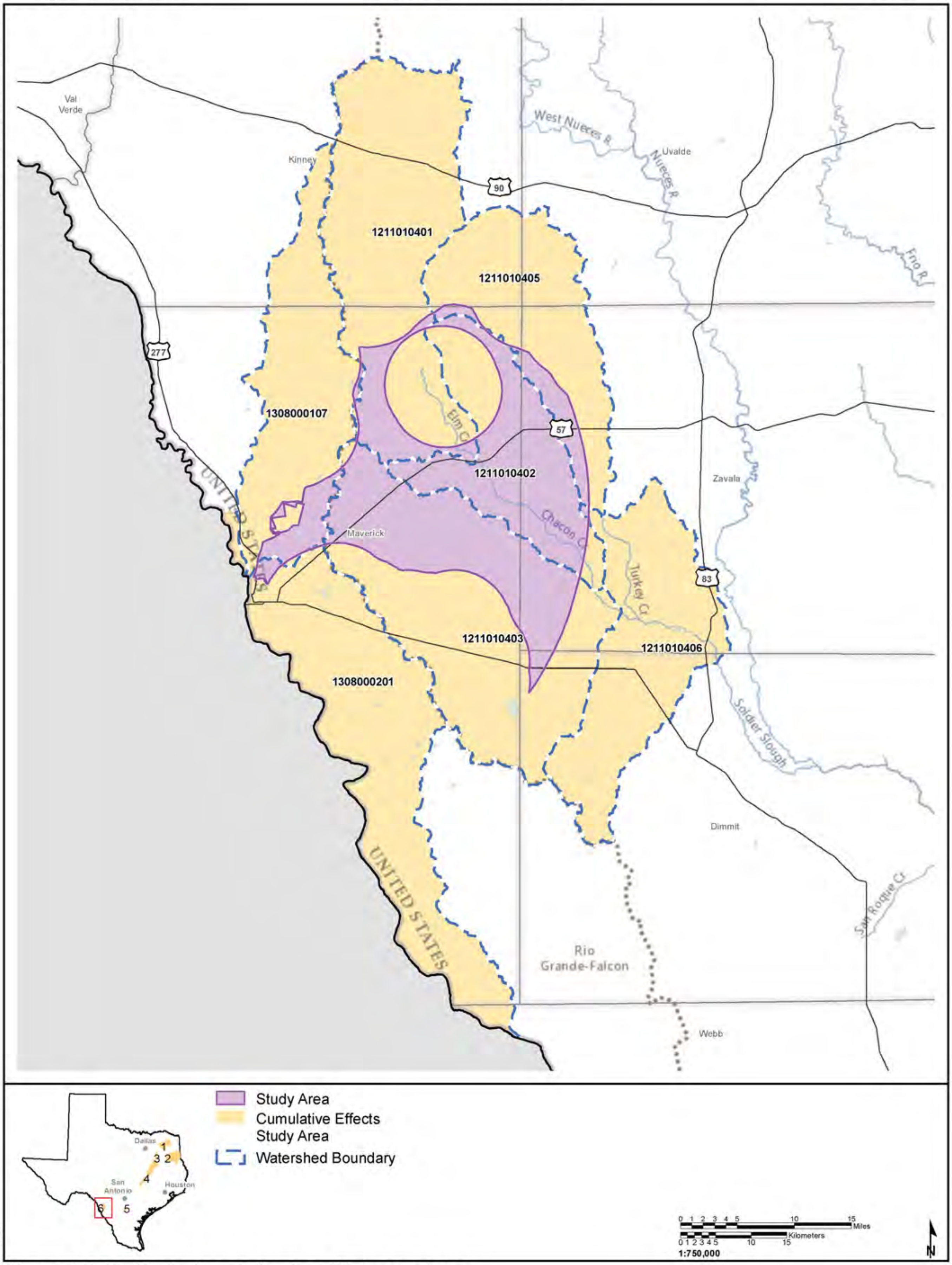




**Figure 3.2-16 Study Area 6 Surface Water Features**

According to the NHD, approximately 4 miles of perennial stream reaches are within Study Area 6. An additional 11 miles of perennial stream reaches occur in the outlying CESA, bringing the total of perennial stream lengths within the analysis area to approximately 15 miles. Approximately 1,019 miles of intermittent stream reaches are within Study Area 6. Approximately 2,741 intermittent stream miles also occur in the outlying CESA, bringing the total of intermittent stream lengths within the analysis area to about 3,760 miles. In the NHD, the intermittent stream category includes ephemeral streams.

Storm event magnitudes, in inches over durations of a quarter-day, half-day, or a full day, have been estimated based on the current National Weather Service reference for the area (see **Table 3.2-28**). The recurrence intervals, in years, are long-term averages that reflect the probability (based on 100 percent) of an event happening in any given year. For example, an event with an estimated 2-year recurrence interval has a 50 percent chance of occurring in any given year. Rainfall intensity is reflected in the duration. For example, for a 10-year event, approximately 4.4 inches of rain would fall in 6 hours as shown in **Table 3.2-28**.

*Floodplains*

Delineated floodplains, defined as FEMA Flood Hazard Zone A, have been identified along the major streams of the study area as indicated in **Figure 3.2-17**. Kinney, Zavala, and Dimmit counties do not have current floodplain delineations under the FEMA program. However, floodplains do occur along major streams and their tributaries in these counties, similar to the floodplains depicted in Maverick County.

Within Study Area 6 and the associated CESA, streams bordered by relatively broad floodplains include Elm Creek and major tributaries of the Nueces River. Smaller floodplains likely occur as narrow, low-lying stream deposits along some of the other streams in the region; however, they may not be delineated by FEMA. Within Study Area 6, delineated floodplains occupy approximately 80,271 acres (125 square miles). In the outlying CESA, approximately 124,508 acres (194 square miles) of additional delineated floodplains occur.

*Surface Water Uses and Quality*

The Rio Grande River is the only navigable stream in Study Area 6 or its associated CESA (USACE 1999). The Rio Grande also provides sole-source drinking water supplies, and it is listed as a sole source all along its length within the analysis area (TAC 2014d). The City of Eagle Pass is the only community within Study Area 6 or its CESA with intakes on this river (TCEQ 2014b).

Two USGS water quality stations were monitored within Study Area 6 or nearby during the 1960s. The monitoring data are summarized in **Table 3.2-29**. Additional surface water quality data are available from TCEQ along the Rio Grande River downstream of Eagle Pass (National Water Quality Council 2014). A water quality sample was also taken by the USEPA during an aquatic survey at Farias Lake; however, the sample data conflict between splits for various constituents. USGS and TCEQ data are summarized in **Table 3.2-29**.

The sole classified waterbody segment that occurs in Study Area 6 and its CESA is 2304 (Rio Grande River) below Amistad Reservoir, in Maverick County (TCEQ 2012). This forms the western boundary of the analysis area and the international boundary with Mexico. Much of the eastern part of the study area and CESA also drains, through tributaries, to TCEQ Segment 2105 (Nueces River above Holland Dam). In addition to General Uses, designated beneficial uses for both segments include Primary Contact Recreation 1, High Aquatic Life Use, and Public Supply of drinking water (TAC 2014d). Specific criteria for chloride, sulfate, total dissolved solids, pH, dissolved oxygen, and temperature are associated with the segments (TAC 2014d). There are no unclassified stream segments with specific Aquatic Life Use water quality standards in the analysis area (TAC 2014d).

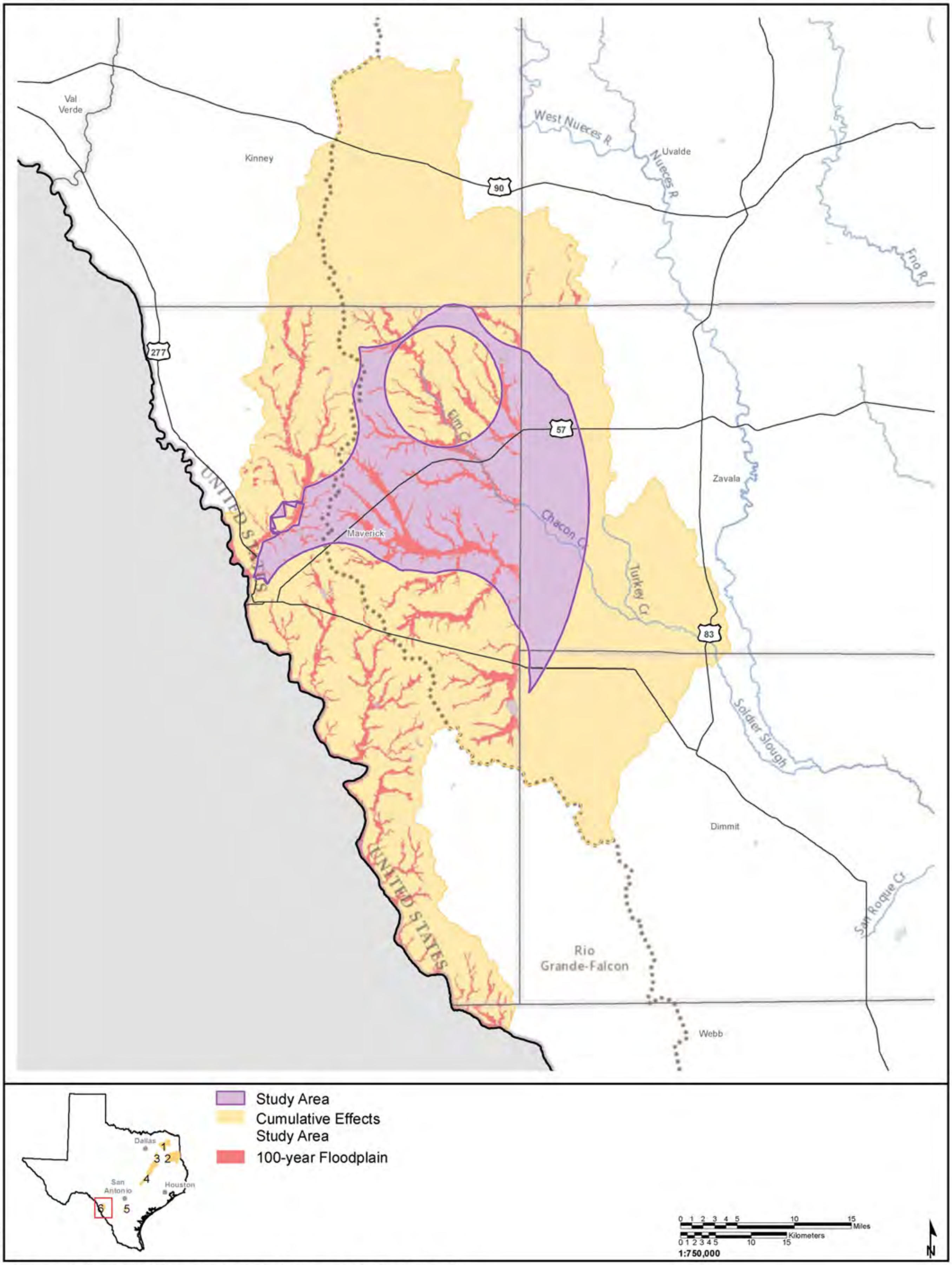


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Figure 3.2-17 100-year Floodplains – Study Area 6

**Table 3.2-29 Water Quality Overview for Streams in or near Study Area 6**

| Location | Identifier | Sampling Period | Measure | pH | TDS | Specific Conductance | Dissolved Oxygen | Total Suspended Solids | Turbidity | Hardness | Calcium | Magnesium | Sodium | Bicarbonate | Chloride | Sulfate | Iron | Manganese |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nueces River near Asherton | USGS 08193000 | 11/1964 to 5/1968 | Median | 7.5 | 177.5 | 300 | No Data | No Data | No Data | 130 | 47.5 | 3.4 | 11 | 139 | 6 | 14.5 | No Data | No Data |
| | | | Range | 6.7 to 8.7 | 129 to 1,090 | 207 to 1,740 | No Data | No Data | No Data | 92 to 630 | 33 to 189 | 1.8 to 39 | 4.7 to 149 | 100 to 384 | 3 to 290 | 8 to 222 | No Data | No Data |
| Pinto Creek near Del Rio | USGS 08455000 | 1/1967 to 5/1968 | Median | 7.1 | 705.5 | 1,240 | No Data | No Data | No Data | 420 | 153.5 | 9.4 | 74.5 | 127 | 255 | 113 | No Data | No Data |
| | | | Range | 6.9 to 7.4 | 481 to 924 | 118 to 1,600 | No Data | No Data | No Data | 290 to 530 | 106 to 190 | 6.8 to 14 | 47 to 108 | 86 to 151 | 165 to 390 | 67 to 144 | No Data | No Data |
| Rio Grande at IBWC Weir Dam, Eagle Pass | TCEQ 15274 | 10/20006 | Value | 8.5 | 584 | 946 | 7.8 | 10 | No Data | No Data | No Data | No Data | No Data | No Data | 104 | 159 | No Data | No Data |
| Rio Grande at Kickapoo Casino | TCEQ 18792 | 10/2006 | Value | 8.1 | 592 | 942 | 6.6 | 23 | No Data | No Data | No Data | No Data | No Data | No Data | 100 | 152 | No Data | No Data |

[1] Values reflect concentration (mg/L) and percent saturation, where available.

Note: All data in milligrams per liter except for pH (standard units), specific conductance (microsiemens per centimeter), iron and manganese (mg/L), and turbidity (Nephelometric Turbidity Units or Jackson Turbidity Units).

Source: National Water Quality Council Data Portal 2014; USGS-NWIS 2014.

Along the Rio Grande, industrial and municipal expansion during the past several decades has reduced water quality and created associated drinking water concerns (International Boundary Water Commission 1994). Water quality concerns from pathogens, toxins, and other oxygen-demanding substances in sewage have been investigated in ongoing international programs. In addition, the potential for pesticide contamination from farming around Eagle Pass and toxic chemical contamination from industrial plants are water quality concerns in the region (International Boundary Water Commission 1994).

Antimony and thallium concentrations were found to exceed human health criteria in one tributary to the Rio Grande River near Eagle Pass. Substantial adverse effects were identified in the toxicity tests; however, the effects were attributed to elevated total dissolved solids concentrations, as antimony and thallium concentrations were far below aquatic life criteria (International Boundary Water Commission 1994). Reduced water quality from the tributary (Manadas Creek) did not noticeably affect the Rio Grande mainstem. In addition, arsenic was found to exceed both human health criteria (consumption of fish and water, consumption of fish only) in the Eagle Pass/Piedras Negras area investigated by the International Boundary Waters Commission (Kolbe and Harrison 1996). However, similar exceedances occurred at a number of other sites along the river downstream of El Paso/Cuidad Juarez (Kolbe and Harrison 1996).

For the Nueces River tributaries, Segment 2105-03 represents most of the drainage area within the analysis area. Water quality in the Nueces River along this portion of the drainage fully supported its uses, and there were no standards exceedances identified by TCEQ in its assessment (TCEQ 2012).

For the portion of the lower Rio Grande within the CESA (Segment 2304-06, Rio Grande from the Columbia Bridge upstream to El Indio), beneficial uses were either fully supported or had standards exceedances that were not of concern (TCEQ 2012). For General Use, there were several exceedances of nitrates, total phosphorus, and orthophosphorus. Numerous exceedances for chlorophyll-a were reported (TCEQ 2012). Upstream beyond Eagle Pass, water quality conditions were generally similar, but varied in the number of nutrient and chlororphyll-a exceedances. PCR1 use in the river reach at Eagle Pass was not supported.

The following stream segment in Study Area 6 and its CESA has impaired water quality (TCEQ 2012):

- 2304-07 Rio Grande from El Indio upstream to downstream of U.S. Highway 277 (Eagle Pass), for bacteria (Category 5)

#### 3.2.4.2 Surface Water Environmental Consequences (Study Areas 1 – 6)

Surface water resource issues in the study areas include potential direct, indirect, and cumulative impacts to surface water quantity and quality associated with potential future coal or lignite mine-related surface disturbance or mine-related groundwater drawdown. Additional potential issues are associated with landowners' water rights, disruption of the hydrologic cycle, and increased flooding along rivers and drainages.

Water quality degradation also could result from contamination from spills or releases of hazardous materials. Potential impacts due to contamination are discussed in Section 3.12, Hazardous Materials and Solid Waste.

<u>Proposed Action</u>

*Effects Common to All Study Areas*

Surface coal mining activities across the study region have the potential to create generally similar classes of impacts to surface water resources. Water quantity and surface water quality are the overall resource attributes that may be affected. The types of activities that could affect surface water during the mining and reclamation phases are described in Chapter 2.0. Mining impacts may involve modification of surface water runoff and streamflow, diversion of streams, removal and creation of small impoundments, localized increases in evaporation, geomorphic changes along streams and floodplains, and reduction or improvement of water quality in storm runoff. Surface water quality may be adversely affected by the weathering of acid or toxic materials, and transport of weathering products in either runoff or groundwater seepage. The occurrence and magnitude of these several effects would vary with the phases of mining and reclamation, with site-specific water management and reclamation practices employed by mine operators, with post-reclamation landowner practices, and with climate and watershed characteristics.

Similar to the current regulatory setting, these impacts could occur at each study area if agency permits were approved and mining and reclamation took place. Under the Proposed Action, the USACE Fort Worth District's modified regulatory framework would be applied according to increasing levels of projected disturbance as described in Chapter 2.0. Changes in limits on disturbance in some habitat settings (forests, bogs, swamps) under the USACE Fort Worth District's proposed regulatory framework (see **Table 2-2**) in turn would reduce impacts to surface water features, quantity, and quality in those settings. Mine-specific water resources investigations would support future NEPA analyses. In general, however, the types of surface water impacts described below have the potential to occur in all of the study areas under the Proposed Action and would not change as a result of the proposed USACE Fort Worth District regulatory framework.

During mining, runoff from unvegetated surfaces typically has faster response to rainfall, greater peak flow, and larger overall volume than what would occur from undisturbed or revegetated conditions. Physically, increased runoff responses create the potential for greater streamflow velocities, flooding, erosion, and downstream sedimentation. In addition, pit pumping or intensified runoff from unreclaimed areas would reduce surface water quality. Without adequate storm water management controls, these adverse impacts could be common and severe. If that occurred, associated beneficial surface water uses (such as public drinking water or aquatic life uses) could be adversely affected. Compliance with RCT and TCEQ agency requirements to manage runoff quantity and water quality would minimize these adverse surface water impacts.

RCT regulations encourage the avoidance of perennial or intermittent stream disturbance by directing surface mining activities to maintain undisturbed 100-foot buffers along such features (TAC 2014a). Mine plans and activities that comply with this agency guidance would substantially minimize potential stream disturbance. Similarly, the USACE regulatory program mandates avoidance and minimization of impacts to waters of the U.S., with particular emphasis on higher quality resources such as wetlands, perennial streams, and intermittent streams with perennial pools. For those actions subject to review under the IP process, projects must demonstrate compliance with the Section 404(b)(1) guidelines, which require the applicant to demonstrate that the proposed project represents the least environmentally damaging practicable alternative.

Diversions of perennial or intermittent streams within a proposed surface coal or lignite mine disturbance area may be approved after an agency review, if it is found that the diversion will not adversely affect the water quantity, quality, or related resources of the stream (TAC 2014a). Without careful design, implementation of environmental protection measures and BMPs, and monitoring, construction of stream diversions has been known to generate substantial turbidity and sediment yield. The geometry of constructed diversions may modify flow depths and velocities of downstream channels, and may contribute to flooding or channel down-cutting or widening. These effects could occur within or outside a mine permit area, adversely affecting aquatic habitats or adjacent land uses. RCT and USACE regulatory programs would require review and assessment of diversion designs prior to their approval, minimizing the potential for adverse surface water impacts.

Geomorphic changes along streams or floodplains may occur from landscape changes during or after mining and reclamation. During mining, changes in stream geometry or the ability of floodplains to convey out-of-bank flows may result from constructing diversions, road crossings, excavation and fill placement, intensified runoff, or erosion and sedimentation. If they occur during mining-related activities, stream alterations may include a variety of scour and aggradation, channel deepening or widening, changes of meander plan-forms, loss of land and habitat along riparian corridors, increased risk of flooding, or damage to in-stream structures. These effects may extend both upstream and downstream of diverted stream reaches, channel crossings, or other disturbance. If they occur, such impacts would be minor to moderate, and local to extensive, depending on the extent of the stream alterations and site-specific conditions, but would be minimized by compliance with Section 404/401 permit requirements.

Stream buffer zones, enhanced conveyance structures, and protection measures such as channel and bank stabilization or energy dissipation may be employed to avoid or minimize these potential mining impacts. RCT regulations encourage the avoidance of perennial or intermittent stream disturbance by directing surface mining activities to maintain undisturbed 100-foot buffers (TAC 2014a). Although the RCT may authorize disturbance closer to or through streams after review, agency approvals require that surface water quantity and quality not be adversely affected, and state or federal water quality standards cannot be violated (TAC 2014a). In addition, proposed disturbance requires baseline characterization, permit review and approval, and mitigation (i.e., avoidance, minimization, or compensation) through the USACE regulatory program under Section 404 of the CWA. These regulatory provisions would not change under the Proposed Action.

If they occur within the mine area, small stock ponds, other impoundments, or water supplies would be removed as mining progresses, eliminating water uses from those specific locations. In addition, drainage from the mined area may reduce water quality in offsite impoundments. In some cases, mine-associated sediment ponds could be used temporarily as substitute water sources. Under the RCT Permanent Program Performance Standards, mine operators are required to replace water supplies where they have been “adversely impacted by contamination, diminution, or interruption proximately resulting from the surface mining activities” (TAC 2014a). Collection of baseline hydrologic information is required in RCT mine permit applications for purposes of documenting these resources and mitigating water supply effects.

It is not uncommon to have “end lakes” or other agency-approved permanent impoundments remaining on reclaimed landscapes. Where sizeable acreage of post-mining permanent impoundments remain, water volumes would be held back from downstream impoundments or flows, and evaporation losses would affect the local water balance. This could reduce overall surface water availability or groundwater recharge, particularly in the more arid western parts of the coal and lignite belt. The creation of permanent impoundments may increase the post-mining acreage of ponds or lakes in the immediate locale. The beneficial uses supported by such post-mining impoundments vary according to their purpose and design, but wildlife and aquatic habitat are typically restored. Other reclaimed impoundment uses may include recreation and stock watering.

Where groundwater pumping would be necessary for mining, aquifers would be affected by mine-related groundwater drawdown. In turn, this may reduce groundwater outflows contributing to springs and nearby streams within the mine-related drawdown area. Potential groundwater impacts are discussed in Section 3.2.3.

During the initial phase of ground clearing, and throughout the mining phases up to reclamation, storm water runoff from disturbed areas would have reduced surface water quality. Surface water runoff from disturbed areas would contain increased turbidity and possibly higher concentrations of other constituents such as TDS, total suspended solids, iron, manganese, chloride, sulfate, and toxic- or acid-forming materials. Where water management complies with state and federal regulations, these adverse impacts to surface water quality would be largely confined to a mine permit area. Temporary diversions and settling ponds would be employed to control sediment and manage water quality prior to discharging into receiving waters. As part of the RCT and USACE regulatory programs, the water quality of receiving waters must be maintained within standards under the TCEQ water quality antidegradation rules (promulgated through Section 401 of the CWA) and the Texas Pollutant Discharge Elimination System (TPDES) permit requirements for storm water discharges, Sector H “Coal Mines and Coal Mining Related Facilities” (TAC 2014a, TCEQ 2014a, 2011).

Individual TPDES Industrial Wastewater permits currently are required by TCEQ at each mine, and would be required to be obtained or updated for future mining projects. In accordance with 40 CFR Part 434 and other regulations, this Texas program addresses wastewater discharges to waters of the state from mine drainage, coal storage facilities, and coal preparation plants. In terms of the volume of waters discharged, this is the major water quality management program for coal mines in the state. Permit applications are reviewed by TCEQ, and approved permits require monitoring of point discharges from mine outfalls for a broad array of constituents related to effluent limitations and receiving water quality. Discharge considerations for waters listed on the Texas 303(d) list are of particular concern. Discharge monitoring, management, and reporting requirements are specified in the individual permits to manage mine discharges in compliance with state water quality standards. BMPs are specified in the permits, and are applied to schedule activities, prohibit inappropriate practices, identify maintenance procedures, and specify other management practices to prevent or reduce adverse impacts to Texas state waters. BMPs also include treatment requirements, operating procedures, and practices to control site runoff, spills or leaks, waste disposal, or drainage from raw material storage. In addition, surface water discharge and monitoring is required in accordance with each mine’s TCEQ-required Construction Stormwater General Permit TXR150000 and Industrial Stormwater General Permit TXR050000, Multi Sector H.

During mining, there may be some reduction of downstream surface water quality caused by discharges from mine sites to receiving waters, but existing uses and water quality sufficient to protect those existing uses must be maintained in compliance with state law. Authorized discharges are not allowed to lower water quality to the extent that the Texas surface water quality standards are not attained (TCEQ 2014a). The potential for acid-forming constituents or other geochemical weathering products to affect surface water quality would be avoided by compliance with RCT regulations. The regulations require the analysis of overburden and underburden materials through appropriate acid-base accounting and other tests and the implementation of selective handling plans and follow-up testing during reclamation to ensure that acid- or toxic-forming material are not placed in the upper 4 feet of the backfill profile (see Sections 2.2.4.1 and 2.2.5.3). Design storms are specified for diversions and impoundments in RCT Permanent Performance Standards for water quality and effluent limitations (TAC 2014a). Embankment and spillway criteria are also defined. In any hydrologic setting, however, it is possible that water control structures designed and constructed according to regulations may be overwhelmed by storm events exceeding the design. Typically such events are uncommon, but when they occur, poor-quality water may by-pass the control practices and adversely affect downstream water quality. Such temporary impacts may range from slight to severe, depending on the geographic extent of a severe storm, the nature of runoff and water quality contributions from watersheds outside a mine permit area, and the configuration of tributary inflows downstream. Impacts would be minimized by compliance with TPDES permit requirements and other storm water management regulations. After reclamation, surface water quality would improve substantially as a result of permanent revegetation and drainage controls. These features would be completed and monitored until reclaimed areas are deemed adequate for transfer to landowners and/or bond release. In some cases, the water quality of seasonal drainage and storm runoff would improve beyond pre-mining conditions, due to mixing of previously-erodible soil materials, revegetation and recontouring, overburden/interburden handling, and development of permanent drainage controls.

Environmental protection measures typically employed at surface coal mines are described in Chapter 2.0. To address the potential for the impacts described above, the RCT regulatory program requires protection of the hydrologic balance. The intent of the program is to accomplish this through the application of planning, water management controls, and mitigation practices that avoid or reduce these potential surface water impacts (TAC 2014a,b). A major regulatory requirement is the submittal and review of a hydrologic reclamation plan specific to local conditions. This required plan specifies practices to be conducted during and after mining, through bond release. These steps would be taken to minimize hydrologic effects within the mine permit area and adjacent areas, to prevent material damage outside the mine permit area, to meet applicable federal and state water quality requirements, and to protect water rights. In regard to the latter, alternative sources of water would be provided where necessary in accordance with regulations (TAC 2014a). These current RCT agency requirements would not change under the Proposed Action.

In general, the potential for adverse impacts to surface water would be reduced by complying with TCEQ-required permits (as discussed above) and specific RCT requirements to avoid acid or toxic drainage, to use the best available technology to prevent additional suspended solids from entering waterbodies, to provide water treatment when needed, and to control drainage (TAC 2014a). Water monitoring also would be required at locations upstream of a future mining project, at streams and impoundments that could potentially be impacted, and in receiving waters where water could be discharged from the permit area. TDS or specific conductance, pH, total settable solids, total iron, total manganese, and flow are required to be monitored (TAC 2014a), and additional constituents are often monitored in practice. The required quarterly submittal of monitoring results to RCT would track the effectiveness of water management practices, and identify any need for modification of the on-site program. These current RCT requirements would remain in effect under the Proposed Action.

RCT permit applications require an analysis of Probable Hydrologic Consequences of a surface coal or lignite mining project, which is essentially an analysis of the potential impacts and an evaluation of how the water management program would address them. In addition, a Cumulative Hydrologic Impact Assessment (CHIA) is a required part of an RCT coal-mining permit application. The CHIA addresses whether a proposed operation has been designed to prevent material damage to the hydrologic balance outside the permit area (TAC 2014a). Both completeness and technical reviews of the permit application, including the Probable Hydrologic Consequences and CHIA, would be conducted by the RCT during the permitting process, and modifications to any proposed water management programs would be made if necessary prior to permit approval.

The USACE regulatory program also evaluates other direct, indirect, and cumulative surface water impacts. Prior to rendering decisions on permit applications under Section 404 of the CWA and/or Section 10 of the RHA, the USACE regulatory program evaluates potential effects to surface water resources, and determines the least environmentally-damaging practicable alternative. Under the Proposed Action, the USACE Fort Worth District would consider comments from other federal, state. and local agencies during NWP 21, LOP, and IP evaluations as noted in **Table 2-2** and, additionally, would consider comments from interest groups and the general public during IP evaluations.

Included in the USACE Fort Worth District permit review process is the TCEQ Section 401 water quality certification, which examines potential impacts to water quality. A decision on Section 401 would be rendered by TCEQ after project review, would remain a required part of determining if mine discharges comply with water quality provisions of the CWA and Texas state water quality standards. State water quality standards specify the designated beneficial uses of a stream or lake, along with water quality constituent limits necessary to protect the designated uses and policies to ensure that existing water uses will not be degraded by discharges to receiving waters (Copeland 2011). USACE Fort Worth District permits issued for mining projects include requirements for compensatory mitigation to offset unavoidable adverse impacts to waters of the U.S. Compensatory mitigation typically includes restoring, enhancing, creating, and preserving aquatic functions and values. Detailed stream design information as described in the Restoration of Waters of the U.S., Including Wetlands, subsection under Section 2.2.4.3, Typical Closure and Reclamation, would be submitted for USACE Fort Worth District and resource agency review prior to construction of mitigation streams. Surface water management practices, monitoring, and mitigation measures would continue to be implemented. Under the Proposed Action, consideration of effects to surface water quality and designated beneficial uses would remain a major aspect of the proposed USACE Fort Worth District regulatory framework.

USACE Section 404 permit policy for floodplains is defined for NWPs according to Nationwide Permit General Condition 10, Fills Within 100-Year Floodplains: "The activity must comply with applicable FEMA-approved state or local floodplain management requirements" (Copeland 2012, Department of Defense 2012). The National Flood Insurance Program (NFIP) in Texas is administered through TWDB (Texas Floodplain Management Association 2008). Texas city and county governments were required by 2001 to adopt ordinances or orders necessary to be eligible for NFIP participation. Whether or not these were actually adopted, a number of counties (e.g., Panola and others) still do not have current or historical floodplain delineation maps. This would seem to preclude them from actually participating in the NFIP over a decade later. In addition, it is possible that based on USACE delineation criteria, parts of 100-year floodplains within the study areas may not be certifiable waters of the U.S. or wetlands. If so, they may not be subject to USACE jurisdiction.

To comply with NEPA requirements under Section 404 of the CWA, the USACE Fort Worth District would need to conduct impact analysis with respect to Executive Order 11988 "Floodplains." Because of this, additional discussions of potential floodplain impacts (and related surface water considerations) are presented in the study area-specific sections below. Under the Proposed Action, subsequent NEPA assessments may be tiered from these discussions.

The general extents of maximum disturbance associated with potential future mining are indicated for each study area in Chapter 2.0, **Table 2-3**. As can be seen in that table, less than five percent of Study Areas 1 through 4 may ultimately be disturbed by mining, and generally five to ten percent of Study Areas 5 and 6 could ultimately be disturbed. At any one time, however, active surface mining would involve much smaller percentages in any particular Study Area because, as described in Chapter 2.0, approved mining would move in phases across watersheds. Mining would be followed closely in sequence across the landscape by reclamation practices including recontouring, drainage restoration, revegetation, and monitoring. Post-mining drainage and impoundment features would accompany reclamation. Although the overall potential disturbance percentages are reflected in **Table 2-3**, smaller extents of future surface drainage disturbance would occur in the watersheds of each study area at any one time.

Study Area 1

The estimated lengths of perennial and intermittent streams in Study Area 1 are described in Section 3.2.4.1 text and tables, along with the overall acreage of the study area. Based on these values, a general estimate of stream density (miles per acre) can be derived within the overall study area. Then, based on an estimated 13,500 acres of maximum potential future mining disturbance within Study Area 1 (see **Table 2-3**), it is conceivable that approximately 11.6 miles of perennial streams and 39 miles of intermittent streams may occur within areas that could be affected by future mining activities in Study Area 1. A currently unquantifiable portion of the perennial and intermittent streams may be impacted by future mining activities if during future mine-specific permitting: 1) a waiver is granted by RCT (per Section 12.355 under the Texas Coal Mining Regulations) and 2) the proposed disturbance represents the least environmentally damaging practicable alternative in accordance with the USACE's Section 404(b)(1) guidelines.

Based on visual inspection of TCEQ stream segment maps for the Sulphur, Cyprus Creek, and Sabine river basins (TCEQ 2004), stream densities may be somewhat less in the northern part of the study area, and greater to the south in Wood County. If this is the case, then proportionally more of the estimated stream disturbance could occur in the southern part of Study Area 1 if mining took place there. Potential impacts to streams would be as described above.

Assuming that groundwater and surface water flow into remaining pit areas, it is likely that end lakes would be left as post-mining water features in Study Area 1. Depending on their volumes and locations, runoff retained in end lakes could somewhat reduce flows into adjacent streams. End lakes could slightly reduce the availability of water to other existing impoundments such as Lake Bob Sandlin, Lake Tankersley, Lake Cypress Springs, Welsh Reservoir, or Lake Fork Reservoir. However, the overall impact on surface water availability would be negligible to minor, due to the generally high rainfall rates (under normal climatic conditions), the large volumes of existing water supply impoundments, and limited removal of contributing watershed areas.

Navigable waters do not occur within Study Area 1, so no related impacts would occur from potential future mining activities under the Proposed Action.

Floodplains are generally narrow in most of Study Area 1. In those settings, potential impacts could generally be avoided by stream buffer zones or other provisions and practices oriented to stream channels and banks. Floodplains are wider in the southern part of the study area, such as those along Dry Creek, Lake Fork Creek, and Big Sandy Creek in Wood County. Without avoidance or adequate mitigation, floodplain disturbance in these settings would adversely affect flow conveyance under large runoff events. This may create additional flood damages. In addition, other floodplain values such as riparian or aquatic habitats may be adversely affected. Depending on the potential magnitude of effects to floodplains in certain areas, particularly in Camp and Franklin counties, more robust analysis of floodplain effects may be required.

Drinking water sources and communities using them within Study Area 1 are listed in Section 3.2.4.1. RCT regulations (TAC 2014a,b) require mining projects to address the potential for hydrologic consequences to surface water sources, and replace such sources if adversely impacted. In Study Area 1, all of the surface water sources except Big Sandy Creek are large lakes that would not be physically disturbed by mining activities, and compliance with related water quality regulatory provisions from RCT or TPDES permits would avoid or minimize the potential for water quality impacts to these sources. In addition, through the CWA Section 401 (Water Quality Certification) requirements, compliance with TCEQ regulations for source-water protection would reduce the potential for water quality impacts. Adherence to standards for designated site-specific uses and criteria, and their application to source-water protection zones (TCEQ 2014a), would reduce potential water quality impacts to negligible or minor levels within 2 or 3 miles of sole-source drinking water supplies.

Historically, mine permit applications have noted increased sediment concentrations in runoff during excavation and coal recovery, followed by declining sediment concentrations, often to less than baseline levels, after reclamation. This is anticipated to continue if future mining projects are permitted in Study Area 1. Similar trends have been predicted for iron and manganese concentrations in runoff. Chloride, sulfate, TDS, and other constituents would be monitored in water management programs.

Long-term water quality data from outlying undisturbed sites, as tabulated for Study Area 1 in Section 3.2.4.1, indicate that manganese concentrations typically exceed standards. Chloride, sulfate, and total dissolved solids also occasionally exceed standards. Control of these constituents in discharges from disturbed areas would be necessary to avoid further degradation of waters that already exceed water quality standards. Sediment-laden discharges would be detained for settling, and treated if necessary, to meet receiving water quality standards in accordance with RCT and TCEQ regulations and reporting requirements. Occasional water quality bypasses may occur under exceptional storm events that surpass agency design requirements. The impacts from such large storm events would be somewhat offset by more widespread high flows and reduced water quality in outlying watersheds.

Study Area 2

The estimated lengths of perennial and intermittent streams in Study Area 2 are described in Section 3.2.4.1 text and tables, along with the overall acreage of the study area. Based on a stream density approximation and an estimated 50,200 acres of maximum potential future mining disturbance within Study Area 2 (see **Table 2-3**), it is conceivable that approximately 56 miles of perennial streams and 187 miles of intermittent streams may occur within areas that could be affected by future mining activities in Study Area 2. A currently unquantifiable portion of the perennial and intermittent streams may be impacted by future mining activities if during future mine-specific permitting: 1) a waiver is granted by RCT (per Section 12.355 under the Texas Coal Mining Regulations) and 2) the proposed disturbance represents the least environmentally damaging practicable alternative in accordance with the USACE's Section 404(b)(1) guidelines. Potential impacts to streams, and management of those impacts, would be similar to those described above under "Effects Common to All Study Areas."

Assuming that groundwater and surface water flow into remaining pit areas, it is likely that end lakes would be left as post-mining water features in Study Area 2. Depending on their volumes and locations, runoff retained in end lakes could somewhat reduce flows in adjacent streams. End lakes could somewhat reduce the availability of water to other existing impoundments such as Lake Cherokee, Lake Murvaul, and Martin Creek Lake. The impact on water availability could be minor to moderate during periods where active mining disturbance was extensive near these waterbodies. After reclamation restores most contributing watershed areas, overall impacts would ultimately be negligible to minor, due to the generally high rainfall rates (under normal climatic conditions) and less runoff retention.

Floodplains are fairly broad in Study Area 2, particularly along the Sabine River. Without avoidance or adequate mitigation, floodplain disturbance in these settings would adversely affect flow conveyance under large runoff events, create extensive channel and bank erosion, or both. In addition, other floodplain values such as riparian or aquatic habitats may be adversely affected. The latter potential effects are discussed in separate respective text sections. Depending on the potential magnitude of effects to floodplains in certain areas, such as Panola and Shelby counties, more robust analysis of floodplain effects may be required.

The Sabine River is designated as navigable throughout Study Area 2 (USACE 1999); however, no shipping traffic has occurred for many years upstream of Toledo Bend Reservoir. River navigation activities in Study Area 2 mainly involve recreational boating. It is not anticipated that mining projects and associated activities would adversely affect this use in Study Area 2. If boating restrictions were to occur from ancillary activities, they would be short-term and have negligible to minor local effects.

Drinking water sources are described in Section 3.2.4.1 for Study Area 2. Potential impacts and practices to address them would be the same as described for Study Area 1.

Long-term water quality data from outlying undisturbed sites indicate that manganese concentrations typically exceed standards, and iron concentrations occasionally exceed standards. Sulfate and TDS also occasionally exceed standards. Control of these constituents in discharges from disturbed areas would be necessary to avoid further degradation of waters that already exceed water quality standards. Potential surface water quality impacts, and management programs that address them, would be similar to those described for Study Area 1.

Study Area 3

The estimated lengths of perennial and intermittent streams in Study Area 3 are described in Section 3.2.4.1 text and tables, along with the overall acreage of the study area itself. Based on a stream density approximation and an estimated 50,600 acres of maximum potential future mining disturbance within Study Area 3 (see **Table 2-3**), it is conceivable that approximately 16 miles of perennial streams and 182 miles of intermittent streams may occur within areas that could be affected by future mining activities in Study Area 3. A currently unquantifiable portion of the perennial and intermittent streams may be impacted by future mining activities if during future mine-specific permitting: 1) a waiver is granted by RCT (per Section 12.355 under the Texas Coal Mining Regulations) and 2) the proposed disturbance represents the least environmentally damaging practicable alternative in accordance with the USACE's Section 404(b)(1) guidelines. Potential impacts to streams, and management to address those impacts, would be similar to those under "Effects Common to All Study Areas."

Assuming that additional groundwater and surface water flow into remaining pit areas, it is likely that end lakes would be left as post-mining water features in Study Area 3. Impacts to surface water resources from end lakes in Study Area 3 would be similar to those described for Study Area 2. Existing water supply reservoirs that could be temporarily affected by minor impacts primarily include Lake Mexia and Lake Limestone.

Study Area 3 is largely configured to exclude the broad floodplains associated with the Trinity and Brazos rivers. Broad 100-year floodplains have been delineated by FEMA within Study Area 3 west of the Trinity River channel and elsewhere in Freestone County, but these historical (1978) delineations are not digitally available from the agency. If future mining activities occurred in floodplains, more robust analysis of floodplain effects may be required.

The Trinity River is navigable through Study Area 3. The types and frequency of vessels navigating the river are unknown. If mining-associated transport corridors are constructed over the river and on its floodplain approaches, obstruction impacts to a navigable water and floodplains could occur. These would likely be local and temporary.

Drinking water sources are described in Section 3.2.4.1 for Study Area 3. Potential impacts and practices to address them would be the same as described above for Study Area 1.

Long-term water quality data from outlying undisturbed sites, as tabulated for Study Area 3 in Section 3.2.4.1, indicate that manganese concentrations typically exceed standards on tributaries of the central Trinity River Basin; total dissolved solids and iron concentrations occasionally exceed standards, and dissolved oxygen concentrations were occasionally low. Further southwest in the Navasota River locale, existing water quality generally meets standards, with minor exceptions for TSD, high pH, chloride, and sulfate. Control of these constituents in discharges from disturbed areas would be necessary to avoid further degradation of waters that currently exceed water quality standards. Potential surface water quality impacts, and management programs that address them, would be similar to those described for Study Area 1.

<u>Study Area 4</u>

The estimated lengths of perennial and intermittent streams in Study Area 4 are described in Section 3.2.4.1 text and tables, along with the overall acreage of the study area itself. Based on a stream density approximation and an estimated 9,800 acres of maximum potential future mining disturbance within Study Area 4 (see **Table 2-3**), it is conceivable that approximately 2 miles of perennial streams and 33 miles of intermittent streams may occur within areas that could be affected by future mining activities in Study Area 4. A currently unquantifiable portion of the perennial and intermittent streams may be impacted by future mining activities if during future mine-specific permitting: 1) a waiver is granted by RCT (per Section 12.355 under the Texas Coal Mining Regulations) and 2) the proposed disturbance represents the least environmentally damaging practicable alternative in accordance with the USACE's Section 404(b)(1) guidelines. Potential impacts to streams, and management to address those impacts, would be similar to those described under "Effects Common to All Study Areas."

Assuming that additional groundwater and surface water flow into remaining pit areas, it is likely that end lakes would be left as post-mining water features in Study Area 4. Impacts to surface water resources from end lakes in Study Area 4 would be similar to those described for Study Area 2. An existing municipal water supply source that could be temporarily affected by minor impact is the Little River at Cameron. Potential public drinking water supply impacts, and the practices to address them, would be the same as described for Study Area 1.

Study Area 4 is largely configured to exclude floodplains associated with the Brazos Rivers, the Little River, San Gabriel River, and Brushy Creek. No 100-year floodplains have been delineated by FEMA within Milam County in Study Area 4 west of the Brazos River. However, such floodplains undoubtedly occur along the Brazos and Little rivers, and in the upper Yegua Creek drainage. If future mining activities occurred in floodplains, more robust analysis of floodplain effects may be required.

The Brazos River is navigable where it forms the northeastern boundary of Study Area 4 (USACE 1999). No river disturbance is anticipated from potential future mining activities, and no impacts to navigation would occur.

Long-term water quality data from outlying undisturbed sites, as tabulated for Study Area 4 in Section 3.2.4.1, indicate that historically, surface water generally met standards on the Little River and San Gabriel River. There were occasional exceedances of chloride, sulfate, and manganese. Assuming the tributary rule applies to Davidson Creek, it meets standards for Yequa Creek. Based on historical data, East Yegua Creek itself has somewhat reduced water quality. Surface water there typically exceeded standards for TDS, sulfate, and manganese, and occasionally exceeded iron and chloride standards. Control of these constituents in discharges from disturbed areas would be necessary to avoid further degradation of waters that currently exceed water quality standards. Potential surface water quality impacts, and management programs that address them, would be similar to those described for Study Area 1.

Study Area 5

The estimated lengths of perennial and intermittent streams in Study Area 5 are described in Section 3.2.4.1 text and tables, along with the overall acreage of the study area itself. Based on a stream density approximation and an estimated 9,500 acres of maximum potential future mining disturbance within Study Area 5 (see **Table 2-3**), it is conceivable that approximately 1.3 miles of perennial streams and 40 miles of intermittent streams may occur within areas that could be affected by future mining activities in Study Area 5. A currently unquantifiable portion of the perennial and intermittent streams may be impacted by future mining activities if during future mine-specific permitting: 1) a waiver is granted by RCT (per Section 12.355 under the Texas Coal Mining Regulations) and 2) the proposed disturbance represents the least environmentally damaging practicable alternative in accordance with the USACE's Section 404(b)(1) guidelines. Potential impacts to streams, and management to address those impacts, would be similar to those described under "Effects Common to All Study Areas."

End lakes may form in excavated or impounded areas if these features remain on the reclaimed surfaces of future mining projects. These could be supported by additional groundwater and surface water flow from the reclaimed areas. If end lakes form, their water levels are likely to vary seasonally and from year-to-year due to relatively high rates of evaporation. In addition, evaporation may concentrate salinity or other constituents in open waters collecting in end lake positions. If this occurred, reduced water quality would limit the post-mining recreation, aquatic and wildlife uses of these waterbodies.

FEMA delineations of 100-year floodplains in Study Area 5 occur along the Atascosa River and its tributaries in Atascosa County. FEMA maps for McMullen County indicate no 100-year floodplains. If future mining activities occurred in floodplains, more robust analysis of floodplain effects may be required.

There are no navigable streams in Study Area 5 (USACE 1999). There are no waterbodies that provide sole-source drinking water supplies within the assessment area (TAC 2014d) so there would be no impacts to such resources from potential future mining in Study Area 5. Depending on the configuration and duration of future mining disturbance, runoff to existing impoundments, notably Choke Canyon Reservoir, could be restricted and would somewhat reduce the water available to other reservoir uses, including drinking water supply. RCT regulations (TAC 2014a,b) require mining projects to address the potential for hydrologic consequences to surface water sources, and replace such sources if adversely impacted. Compliance with related water quality regulatory provisions from RCT or TPDES permits would avoid or minimize the potential for water quality impacts to these sources.

Long-term water quality data from outlying undisturbed sites are tabulated for Study Area 5 in Section 3.2.4.1. Data indicate that historically, surface water in the Atascosa River, Frio River, and San Miguel Creek met standards for uses other than public water supply. TDS concentrations commonly exceeded the public water supply standard (1,000 mg/L) in all three streams. Chloride concentrations occasionally exceeded the public supply standards in all three waterbodies. Iron and sulfate concentrations occasionally exceeded public supply standards in the Frio River. In San Miguel Creek, manganese typically exceeded the public standard historically, and sulfate occasionally exceeded its respective standard. Control of these constituents in discharges from disturbed areas would be necessary to avoid further degradation of waters that already exceed water quality standards. Protection of the Edwards Aquifer is a designated use of the Frio River segment above Choke Canyon Reservoir but the portion of the river overlying the aquifer is well north of Study Area 5 and its associated CESA, near the far northwestern corner of Atascosa County. Potential surface water quality impacts, and management programs that address them, would be similar to those described for Study Area 1.

Study Area 6

The estimated lengths of perennial and intermittent streams in Study Area 6 are described in Section 3.2.4.1 text and tables, along with the overall acreage of the study area. Based on a stream density approximation and an estimated 25,000 acres of maximum potential future mining disturbance within Study Area 6 (see **Table 2-3**), it is conceivable that approximately 0.3 mile of perennial streams and about 82 miles of intermittent streams may occur within areas that could be affected by future mining activities in Study Area 6. A currently unquantifiable portion of the perennial and intermittent streams may be impacted by future mining activities if during future mine-specific permitting: 1) a waiver is granted by RCT (per Section 12.355 under the Texas Coal Mining Regulations) and 2) the proposed disturbance represents the least environmentally damaging practicable alternative in accordance with the USACE's Section 404(b)(1) guidelines. Potential impacts to streams, and management to address those impacts, would be similar to those under "Effects Common to All Study Areas."

End lakes may form in excavated or impounded areas if these features remain on the reclaimed surfaces of future mining projects. End lakes might be supported by additional groundwater and surface water flow from the reclaimed areas. If end lakes form, their water levels are likely to vary seasonally and from year-to-year due to relatively high rates of evaporation. In addition, evaporation may concentrate salinity or other constituents in open waters collecting in end lake positions. If this occurred, reduced water quality would limit the post-mining recreation, aquatic and wildlife uses of these waterbodies.

FEMA-delineated 100-year floodplains are extensive in the Maverick County portion of Study Area 6. In addition, although not available in digital coverage, historical FEMA floodplain delineations extend into Zavala County along Chacon Creek and other streams west of La Pryor. None of these areas are known to support irrigated or sub-irrigated agriculture. Alluvial valley floor considerations would be addressed for potential mining projects on a specific basis through the RCT permitting process. If future mining activities occurred in floodplains, more robust analysis of floodplain effects may be required.

The Rio Grande is the only navigable stream in Study Area 6 (USACE 1999). No future mining activities are currently expected to potentially disturb the river or cross the international border. Based on this, no impacts to navigability on the Rio Grande are anticipated.

The Rio Grande also provides sole-source drinking water supplies, and is listed as a sole source all along its length within the study area (TAC 2014d). The City of Eagle Pass uses an intake on the river for its municipal water supply. Elm Creek drains southwest along the western edge of Study Area 6, to the Rio Grande at Eagle Pass. Potential future mining disturbance along Elm Creek, or near the Rio Grande in proximity to the water supply intake for the City of Eagle Pass, could generate adverse water quality impacts to the municipal supply. Adherence to standards for designated site-specific uses and criteria, and compliance with standards and regulations for source-water protection zones (TCEQ 2014a), would reduce potential direct or indirect water quality impacts to negligible or minor levels within 2 or 3 miles of the sole-source drinking water supply and its associated tributaries. Achieving this would be a major consideration for potential future mining activities in Study Area 6.

Existing historical water quality data for areas undisturbed by mining are sparse in Study Area 6 and nearby. Based on available data summarized for Study Area 6 in Section 3.2.4.1, receiving water quality in the Nueces River drainage generally conforms to state standards, with some exceptions for TDS, chloride, and sulfate. Streams in the Rio Grande watershed conform to standards where data are available. Historically, mine permit applications have noted increased sediment concentrations in runoff during excavation and coal recovery, followed by declining sediment concentrations, often to less than baseline levels, after reclamation. As in other study areas, this is anticipated to occur if future mining projects are permitted in Study Area 6. Similar trends have been predicted for iron and manganese concentrations in runoff: initial rises, with ultimate reductions in concentrations. Chloride, sulfate, TDS, and other constituents could reduce surface water quality and would need to be monitored and controlled through water management programs.

Severe storms and flash floods are known to occur in the region, with more recent exceptional events occurring in 1998, 2004, and 2013 (3 times in 16 years). Runoff from such events more commonly bypasses or damages mine water management systems designed according to typical RCT regulations. Under such circumstances, mine discharges would markedly reduce water quality and flooding-caused channel migration and damages to bridges or nearby structures would potentially be severe impacts from bypassed or damaged sediment ponds, diversions, or other water controls. These impacts would be temporary, and would interact with more widespread similar impacts from severe storms and high flows.

<u>No Action</u>

Under the No Action Alternative, potential surface water impacts from future mining projects would be generally similar to those described for the Proposed Action. Current RCT and TCEQ regulatory programs would continue to minimize the types of surface water impacts that could occur, and on the potential extent and severity of those impacts. Current USACE Section 404 mitigation guidelines (see Section 2.1.2) would continue to be implemented through the agency's jurisdictions under the CWA. Proposed Regional General Permit conditions, such as changes in limits on disturbance in some habitat settings (bogs and bald cypress-tupelo swamps) (see **Table 2-2**), would not be implemented, and the related reduction in impacts to surface water features, quantity, and quality in those settings would not occur. This could allow greater surface water-related impacts in parts of the coal and lignite belt. The categorical tiering aspects of the Proposed Action would not be applied, so the resource benefits from concentrating regulatory efforts and specific mitigation on future projects with greater potential for surface water impacts would not occur.

### 3.2.4.3 Cumulative Impacts

The CESAs are based on watersheds (HUC delineations) surrounding the study areas. These areas are depicted on figures in Appendix A. **Table 3.2-30** below indicates the ultimate potential mining disturbance portions of the CESAs for water resources. From the table below, it can be seen that there is a wide range in potential future disturbance between the six CESAs. The potential distribution of mining activity within an individual HUC delineation is unknown. Some individual watersheds would be disturbed more than others.

**Table 3.2-30 Area in CESAs Affected by Estimated Future Mining**

| CESA | Area of Combined Hydrologic Units by CESA (acres) | Estimated Maximum Disturbance from Potential Future Authorizations (acres) | Estimated Percent of CESA Potentially Disturbed under Potential Future Authorizations | Approximate Current Acreage of Existing Coal/Lignite Disturbance by CESA | Estimated Percent of CESA Cumulatively Disturbed by Future and Existing Coal/Lignite Mining |
|---|---|---|---|---|---|
| 1 | 1,923,711 | 13,500 | 0.70 | 35,647 | 2.6 |
| 2 | 2,912,428 | 50,200 | 1.7 | 130,954 | 6.2 |
| 3 | 3,674,481 | 50,600 | 1.4 | 81,273 | 3.6 |
| 4 | 2,632,777 | 9,800 | 0.4 | 42,526 | 2.0 |
| 5 | 1,049,698 | 9,500 | 0.9 | 24,831 | 3.3 |
| 6 | 1,213,144 | 25,000 | 2.1 | 2,701 | 2.3 |

On a general basis, however, the ultimate potential mining disturbance represents small portions of the overall land uses that affect surface water quantity and quality in the CESAs. Because active mining and reclaimed areas would proceed sequentially over the watershed areas, the estimated cumulative disturbance would not occur at any one time. Ultimately, these areas would be reclaimed in accordance with agency and landowner requirements; surface water resources would be reconstructed, and watersheds returned to beneficial post-mining land uses.

Agriculture, municipalities, reservoir construction, and associated shoreline developments comprise other major categories of watershed disturbance that affect both surface water quantity and quality due to contributions of sediment and chemical constituents in storm water runoff. Salinity and other constituent concentrations are known to increase due to irrigation diversions and returns in the southwestern U.S. In the list of current Texas stream segments that have established TMDLs, the vast majority are for bacterial concentration, which is primarily generated from municipal, domestic, or livestock uses in the watersheds. The proportions of municipal extent in the CESA watersheds are unknown, but sizeable.

While reservoirs result in beneficial uses relative to water supply and improvement of habitats for some aquatic species, they result in direct and indirect adverse effects to wetlands, streams, floodplains and their associated functions and habitats. Impacts generally represent a shift in beneficial uses from those associated with flowing streams and floodplain conditions to impoundment and inlet delta conditions. Increased reservoir evaporation and reduced downstream flows from restricted reservoir releases create downstream hydrologic impacts. Reservoir evaporation reduces water available for other uses. Releases from storage may create cooler water temperatures and change flow regimes in streams. While attenuated flood flows result from reservoir storage, in arid regions, the extended minimum releases also sustain downstream flows through dry periods. Large impoundments elevate upstream flow levels and slow stream velocities, causing sediment deposition upstream and within the reservoir. Downstream, cleaner reservoir discharges may accelerate erosion while sediment dynamics move toward equilibrium. Where they occur, associated shoreline developments create impacts from watershed disturbance, septic tank filter fields, road runoff, and boating discharges. Secondary effects to existing waterbodies and watershed hydrology (e.g., water consumption and runoff water quality) also result from commercial and residential shoreline developments. **Table 3.2-31** indicates the portions of the CESAs occupied by large reservoirs.

**Table 3.2-31 Portions of CESAs Occupied by Reservoirs**

| CESA | Area of Combined Hydrologic Units by CESA (acres) | Approximate Area of Major Existing Reservoirs (acres) | Estimated Percent of CESA Occupied by Major Reservoirs |
|---|---|---|---|
| 1 | 1,923,711 | 85,461 | 4.4 |
| 2 | 2,912,428 | 136,509 | 4.7 |
| 3 | 3,674,481 | 122,447 | 3.3 |
| 4 | 2,632,777 | 36,329 | 1.4 |
| 5 | 1,049,698 | 32,212 | 2.6 |
| 6 | 1,213,144 | none | 0.0 |

#### 3.2.4.4 Monitoring and Mitigation Measures

In accordance with each agency's respective statutory authorities, TCEQ, RCT, and USACE require monitoring measures for surface waters, sufficient to ensure compliance with all applicable federal and state regulations. Such measures typically are required as permit conditions and are evaluated at established intervals to ensure established standards and performance measures are met. No additional monitoring or mitigation measures are recommended.

#### 3.2.4.5 Residual Adverse Impacts

Residual adverse impacts would not differ between the Proposed Action and the No Action alternatives. Such impacts would generally consist of changes in watershed contributing areas due to the presence of end lakes or other permanent impoundments, as appropriate, and other changes in stream channel and floodplain configurations. Smaller ongoing adjustments in channel and floodplain conditions would be anticipated to decline over time, as the effects of mining disturbance transition to the surrounding background conditions.

### 3.2.5 Waters of the U.S. (including Wetlands)

Regulatory Background

The Federal Water Pollution Control Act Amendments of 1972 (Public Law 92-500), now known as the CWA, established the goal of restoring and maintaining the physical, chemical, and biological integrity of the nation's waters. Under Section 404 of the CWA, the Secretary of the Army, operating through the USACE, is responsible for administering a regulatory program to authorize the discharge of dredged or fill material into waters of the U.S. Waters of the U.S. are defined as surface water tributary systems, lakes, ponds, or other waterbodies on the tributary systems and adjacent wetlands (33 CFR Part 328). Included in the definition are areas that are man-made, or man-induced, and natural aquatic resources.

Streams that are part of the surface tributary systems generally are categorized as ephemeral, intermittent, or perennial. An ephemeral stream only flows during, or for a short duration after, precipitation events in a typical year. Ephemeral stream beds are located above the water table; therefore, groundwater does not provide water for stream flow. An intermittent stream has flowing water during certain times of the year, when groundwater provides water for stream flow; runoff from rainfall is a supplemental source of water for stream flow. During dry periods, intermittent streams may not have flowing water. A perennial stream has flowing water year-round during a typical year. The water table is located above the stream bed for most of the year; therefore, groundwater is the primary source of water for stream flow. Runoff from rainfall is a supplemental source of water for stream flow.

Under Section 10 of the RHA of 1899 (Chapter 425, March 3, 1899, 30 Stat. 1151), the USACE regulates all work and structures in, or affecting, the course, condition, or capacity of navigable waters of the U.S. Navigable waters are defined as waters that are presently used, or have been used in the past, or may be susceptible to use to transport interstate or foreign commerce (33 CFR Part 329). Interstate and intrastate waters whose use, degradation, or destruction could affect interstate commerce are subject to USACE regulation.

### 3.2.5.1 Affected Environment

Data Sources

Two datasets with comprehensive mapping of surface water and wetland resources in Texas were used to identify and quantify areas potentially meeting the regulatory definition of waters of the U.S., including wetlands, within the analysis area. These datasets include the National Wetlands Inventory (NWI) (USFWS 2014a) and the NHD (USGS 2014b). Both datasets provide mapped data for the analysis area in geo-referenced electronic formats.

The mapped NWI data were used to determine the location of wetland resources, as classified by the Cowardin wetland classification system (Cowardin et al. 1979), within the analysis area. The NWI data include a variety of wetland types (e.g., lakes, rivers, ponds, and marshes), with additional descriptive information (e.g., perennial, intermittent, unconsolidated bottom, forested, and emergent) provided. Although many of the mapped wetlands appear to follow streams, creeks, or rivers, the NWI mapping does not include the flow lines of the surface drainage features (i.e., water courses).

The NHD dataset primarily was used to identify the mapped flow lines of surface drainage features in the analysis area. These flow lines represent the linear length and configuration of drainage features.

To present a more complete identification of wetlands and water courses within the analysis area, the mapped wetlands from the NWI dataset were combined with the flow lines from the NHD dataset. Where the two datasets overlapped, the portions of the NHD flow lines that occurred within the boundaries of mapped NWI wetlands were removed to avoid double counting. Also, a minor adjustment to the combined datasets was necessary to present the data in a consistent manner. In a small number of instances, the NWI dataset includes wetlands that have been expanded to a fixed width along the entirety of a flow line to create a polygon (footprint) of the wetland resource. Because the NWI data in these instances were based on the NHD-mapped flow lines, the fixed-width polygon of the NWI dataset was not used. Instead, only the linear footage of the underlying NHD flow line was used to be consistent with the presentation and calculation of other flow line data mapped for the analysis area.

GIS comparison of the NWI and NHD datasets revealed that the locations and shapes of the majority of the waterbodies in the two datasets were consistent. In these instances, the NWI data were used. The comparison also revealed that there were mapped waterbodies in the NHD dataset that were not included in the NWI dataset. In these instances the NHD data were used since the NHD waterbodies may have been identified from mapping sources that are more recent than those used for mapping NWI waterbodies.

The resources identified in the NWI and NHD datasets were classified using separate naming conventions. Since the resources identified in the NHD data could not confidently be placed in a corresponding NWI classification (Cowardin et al. 1979), the NHD naming convention was retained for the surface drainage features and select waterbodies obtained from the NHD dataset.

Regional Summary

Categorizing the combined wetland resources within the analysis area required a consolidation of the naming conventions to simplify the presentation and interpretation of wetland types. For the consolidation, NWI wetlands generally were categorized only to the system and subsystem levels (e.g., Lacustrine Littoral, Riverine Lower Perennial), with palustrine wetlands categorized to the system and class levels (e.g., Palustrine Emergent, Palustrine Forested). NHD waterbodies similarly were consolidated to two levels (e.g., Lake/Pond Perennial, Reservoir - Water Storage). The consolidated naming resulted in 16 categories of wetland types for the analysis area, as listed below.

| | |
|---|---|
| Lacustrine | Palustrine Emergent |
| Lacustrine Limnetic | Palustrine Forested |
| Lacustrine Littoral | Palustrine Scrub-Shrub |
| Lake/Pond – Perennial | Palustrine Unconsolidated Bottom |
| Lake/Pond – Intermittent | Palustrine Unconsolidated Shore |
| Reservoir – Water Storage | Swamp/Marsh |
| Reservoir – Treatment/Other Uses | Riverine Lower Perennial |
| Palustrine Aquatic Bed | Riverine Intermittent |

The Lacustrine System represents permanently flooded and intermittent lakes and reservoirs that typically have extensive areas of deep water. The Limnetic Subsystem includes the deep water habitats of the Lacustrine System, while the Littoral Subsystem includes the wetland habitats in the shore and near shore environments. Perennial and intermittent lakes/ponds and the reservoir waterbodies mapped in the NHD dataset are similar to lacustrine aquatic resources.

The Palustrine System represents vegetated wetlands and small, shallow, intermittent, or permanent waterbodies. The classes within the Palustrine System further describe the dominant vegetation or substrate. Swamp/marsh wetlands mapped in the NHD dataset are similar to palustrine aquatic resources.

The Riverine System represents all wetlands and deepwater habitats contained within a channel, but excludes wetlands that otherwise would be defined within the Palustrine System. Riverine wetlands can be natural or artificially created channels, typically having flowing water. The Lower Perennial Subsystem includes low-gradient channels with slow water velocities, a well-developed floodplain, and substrates primarily of mud and sand. The Intermittent Subsystem has flowing water only for portions of the year. During periods when water is not flowing, surface water may be absent or may be retained in isolated pools. The acreage of each wetland type and linear feet of water courses or drainage features within each of the study areas (as determined based on GIS analysis) are presented in **Table 3.2-32**. The acreage of each wetland type and linear feet of water courses or drainage features within each of the CESAs are presented in **Table 3.2-33**.

As discussed in the Climate subsections in Section 3.7, Air Quality, monthly precipitation rates in eastern Texas are higher than in western Texas. Correspondingly, the acreage of wetlands is greater in the eastern portion of the state as compared to the western portion of the state. The occurrence of wetlands within the study areas and CESAs is presented in **Tables 3.2-34** and **3.2-35**, respectively.

Study Area Descriptions

Similar wetland types were grouped into more general categories to provide a means of broadly assessing the resource within each study area. These groupings generally follow the Cowardin system-level categories of Lacustrine, Palustrine, and Riverine systems. The 16 wetland categories identified above were grouped into the three general categories as follows:

- Lacustrine-type Wetlands: Lacustrine, Lacustrine Limnetic, Lacustrine Littoral, Lake/Pond Intermittent, Lake/Pond Perennial, Reservoir-Water Storage, and Reservoir-Treatment/Other Uses
- Palustrine-type Wetlands: Palustrine Aquatic Bed, Palustrine Emergent, Palustrine Forested, Palustrine Scrub-Shrub, Palustrine Unconsolidated Bottom, Palustrine Unconsolidated Shore, and Swamp/Marsh
- Riverine-type Wetlands: Riverine Lower Perennial and Riverine Intermittent

Acreages for the individual wetland types and the three general wetland categories were used to describe the wetlands occurring within the six study areas. Collectively considering the acreages for the 16 wetland types in all 6 of the study areas (see **Table 3.2-32**), the five most abundant wetland types are palustrine forested wetlands, lacustrine limnetic wetlands, palustrine unconsolidated bottom wetlands, palustrine emergent wetlands, and palustrine scrub-shrub wetlands. Based on the grouping of wetland types into the three general categories, the palustrine-type wetlands (191,512 acres) comprise approximately 74 percent of all mapped wetlands in the six study areas, with the lacustrine-type wetlands (64,411 acres) comprising approximately 25 percent and the riverine-type wetlands (3,051 acres) comprising approximately 1 percent.

*Study Area 1*

Study Area 1 encompasses 912,497 acres, of which approximately 75,600 acres (8 percent) are occupied by wetlands. Additionally, there are approximately 15,809,578 linear feet (2,994 miles) of water courses or drainage features in the study area. As shown in **Table 3.2-32**, the most abundant wetland type in Study Area 1 is Palustrine Forested at 38,562 acres. The next most abundant wetland type is the Lacustrine Limnetic (open waters of lakes and reservoirs) at 19,353 acres.

Based on the grouping of wetland types into the three general categories, the majority of the wetlands within the study area are palustrine-type wetlands, comprising 70 percent; followed by lacustrine-type wetlands, comprising 29 percent, with riverine-type wetlands comprising less than 1 percent of the total wetland acreage (**Table 3.2-36**).

*Study Area 2*

Study Area 2 encompasses 1,449,322 acres, of which approximately 105,506 acres (7 percent) are occupied by wetlands. There are also approximately 32,836,737 linear feet (6,219 miles) of water courses or drainage features in the study area. As shown in **Table 3.2-32**, the most abundant wetland type is Palustrine Forested at 69,292 acres. The next most abundant wetland type is Lacustrine Limnetic (open waters of lakes and reservoirs) at 14,585 acres.

Based on the grouping of wetland types by the three general categories, the majority of the wetlands within the study area are palustrine-type wetlands, comprising 82 percent; followed by lacustrine-type wetlands, comprising 16 percent; with riverine-type wetlands comprising 2 percent of the total wetland acreage (**Table 3.2-37**).

**Table 3.2-32 Wetlands and Water Courses or Drainage Features within the Study Areas**

| Study Area | Wetland Type[1] (acres) | | | | | | | | | | | | | | | | Water Courses or Drainage Features[2] (linear feet) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Lacustrine | Lacustrine Limnetic | Lacustrine Littoral | Lake/Pond-Intermittent | Lake/Pond-Perennial | Reservoir-Treatment/ Other Uses | Reservoir-Water Storage | Palustrine Aquatic Bed | Palustrine Emergent | Palustrine Forested | Palustrine Scrub-Shrub | Palustrine Unconsolidated Bottom | Palustrine Unconsolidated Shore | Swamp/ Marsh | Riverine Lower Perennial | Riverine Intermittent | |
| 1 | 77 | 19,353 | 340 | 97 | 2,034 | 3 | 107 | 193 | 3,426 | 38,562 | 2,598 | 5,310 | 3,129 | 45 | 317 | 8 | 15,809,578 (2,994 miles) |
| 2 | 0 | 14,585 | 363 | 149 | 2,021 | 6 | 76 | 292 | 4,078 | 69,292 | 5,592 | 6,226 | 969 | 83 | 1,763 | 10 | 32,836,737 (6,219 miles) |
| 3 | 0 | 18,825 | 449 | 154 | 2,118 | 0 | 85 | 220 | 7,167 | 26,090 | 2,380 | 8,893 | 30 | 61 | 458 | 2 | 22,662,588 (4,292 miles) |
| 4 | 0 | 1,178 | 0 | 66 | 701 | 29 | 10 | 4 | 497 | 1,544 | 104 | 2,626 | 1 | 6 | 477 | 0 | 6,817,732 (1,291 miles) |
| 5 | 218 | 888 | 0 | 7 | 10 | 0 | 0 | 0 | 35 | 0 | 2 | 913 | 23 | 0 | 8 | 0 | 4,230,813 (801 miles) |
| 6 | 0 | 119 | 268 | 36 | 38 | 0 | 0 | 0 | 2 | 2 | 6 | 1,110 | 0 | 0 | 0 | 7 | 4,582,847 (868 miles) |

[1] Based on NWI (USFWS 2014) and NHD (USGS 2014) mapped data.

[2] Based on NHD (USGS 2014) mapped data.

**Table 3.2-33 Wetlands and Water Courses or Drainage Features within the Cumulative Effects Study Areas**

| Cumulative Effects Study Area | Wetland Type[1] (acres) | | | | | | | | | | | | | | | | Water Courses or Drainage Features[2] (linear feet) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Lacustrine | Lacustrine Limnetic | Lacustrine Littoral | Lake/Pond-Intermittent | Lake/Pond-Perennial | Reservoir-Treatment/ Other Uses | Reservoir-Water Storage | Palustrine Aquatic Bed | Palustrine Emergent | Palustrine Forested | Palustrine Scrub-Shrub | Palustrine Unconsolidated Bottom | Palustrine Unconsolidated Shore | Swamp/ Marsh | Riverine Lower Perennial | Riverine Intermittent | |
| 1 | 77 | 21,302 | 446 | 113 | 2,774 | 4 | 150 | 235 | 4,120 | 56,555 | 3,059 | 6,220 | 3,592 | 55 | 493 | 18 | 18,193,816 (3,446 miles) |
| 2 | 0 | 15,237 | 370 | 196 | 3,168 | 11 | 206 | 326 | 4,711 | 85,610 | 6,482 | 8,087 | 1,151 | 90 | 1,933 | 10 | 39,814,567 (7,541 miles) |
| 3 | 0 | 29,372 | 1,336 | 234 | 3,924 | 10 | 156 | 442 | 19,010 | 62,890 | 5,055 | 14,024 | 246 | 94 | 2,616 | 2 | 34,036,106 (6,446 miles) |
| 4 | 0 | 3,734 | 43 | 229 | 2,983 | 38 | 41 | 70 | 2,942 | 6,384 | 806 | 10,521 | 24 | 243 | 5,262 | 0 | 26,296,550 (4,980 miles) |
| 5 | 514 | 6,383 | 0 | 26 | 69 | 0 | 1 | 0 | 165 | 29 | 24 | 1,614 | 51 | 3 | 8 | 2 | 6,919,139 (1,310 miles) |
| 6 | 0 | 119 | 437 | 44 | 46 | 0 | 1 | 0 | 2 | 6 | 8 | 1,346 | 0 | 0 | 0 | 18 | 5,657,582 (1,072 miles) |

[1] Based on NWI (USFWS 2014) and NHD (USGS 2014) mapped data.

[2] Based on NHD (USGS 2014) mapped data.

**Table 3.2-34 Wetlands Summary by Study Area**

| Study Area | Total Acreage of Study Area | Total Acreage of Wetlands | Approximate Percent of Study Area Occupied by Wetlands |
|---|---|---|---|
| 1 | 912,497 | 75,600 | 8 |
| 2 | 1,449,322 | 105,506 | 7 |
| 3 | 1,219,146 | 66,931 | 6 |
| 4 | 365,348 | 7,243 | 2 |
| 5 | 180,841 | 2,106 | 1 |
| 6 | 252,327 | 1,588 | <1 |

**Table 3.2-35 Wetlands Summary by CESA**

| CESA | Total Acreage of CESA | Total Acreage of Wetlands | Approximate Percent of CESA Occupied by Wetlands |
|---|---|---|---|
| 1 | 1,066,270 | 99,214 | 9 |
| 2 | 1,780,270 | 127,649 | 7 |
| 3 | 1,950,726 | 139,410 | 7 |
| 4 | 1,481,527 | 33,319 | 2 |
| 5 | 326,891 | 8,889 | 3 |
| 6 | 323,186 | 2,027 | <1 |

**Table 3.2-36 Wetlands by General Category within Study Area 1**

| General Wetland Type | Acres | Total Acreage of Wetlands within the Study Area | Percent of Total Wetland Acreage within the Study Area |
|---|---|---|---|
| Lacustrine | 22,011 | 75,600 | 29 |
| Palustrine | 53,263 | 75,600 | 70 |
| Riverine | 326 | 75,600 | <1 |

**Table 3.2-37 Wetlands by General Category within Study Area 2**

| General Wetland Type | Acres | Total Acreage of Wetlands within the Study Area | Percent of Total Wetland Acreage within the Study Area |
|---|---|---|---|
| Lacustrine | 17,200 | 105,506 | 16 |
| Palustrine | 86,532 | 105,506 | 82 |
| Riverine | 1,774 | 105,506 | 2 |

*Study Area 3*

Study Area 3 encompasses 1,219,146 acres, of which approximately 66,931 acres (6 percent) are occupied by wetlands. Additionally, there are approximately 22,662,588 linear feet (4,292 miles) of water courses or drainage features in the study area. As shown in **Table 3.2-32**, the most abundant wetland type is Palustrine Forested at 26,090 acres. The next most abundant wetland type is the Lacustrine Limnetic (open waters of lakes and reservoirs) at 18,825 acres.

Based on the grouping of wetland types into the three general categories, the majority of the wetlands within the study area are palustrine-type wetlands, comprising 67 percent; followed by lacustrine-type wetlands, comprising 32 percent; with riverine-type wetlands comprising 1 percent of the total wetland acreage (**Table 3.2-38**).

**Table 3.2-38 Wetlands by General Category within Study Area 3**

| General Wetland Type | Acres | Total Acreage of Wetlands within the Study Area | Percent of Total Wetland Acreage within the Study Area |
|---|---|---|---|
| Lacustrine | 21,631 | 66,931 | 32 |
| Palustrine | 44,840 | 66,931 | 67 |
| Riverine | 460 | 66,931 | 1 |

*Study Area 4*

Study Area 4 encompasses 365,348 acres, of which approximately 7,243 acres (2 percent) are occupied by wetlands. There are also approximately 6,817,732 linear feet (1,291 miles) of water courses or drainage features within the study area. As shown in **Table 3.2-32**, the most abundant wetland type is Palustrine Unconsolidated Bottom (2,626 acres). The next most abundant wetland types are Palustrine Forested (1,544 acres) and Lacustrine Limnetic (1,178).

Based on the grouping of wetland types by the three general categories, the majority of the wetlands within the study area are palustrine-type wetlands, comprising 66 percent; followed by lacustrine-type wetlands, comprising 27 percent; with riverine-type wetlands comprising 7 percent of the total wetland acreage (**Table 3.2-39**).

**Table 3.2-39 Wetlands by General Category within Study Area 4**

| General Wetland Type | Acres | Total Acreage of Wetlands within the Study Area | Percent of Total Wetland Acreage within the Study Area |
|---|---|---|---|
| Lacustrine | 1,984 | 7,243 | 27 |
| Palustrine | 4,783 | 7,243 | 66 |
| Riverine | 477 | 7,243 | 7 |

*Study Area 5*

Study Area 5 encompasses 180,841 acres, of which approximately 2,106 acres (1 percent) are occupied by wetlands. Additionally, there are approximately 4,230,813 linear feet (801 miles) of water courses or drainage features in the study area. As shown in **Table 3.2-32**, the most abundant wetland types are Palustrine Unconsolidated Bottom (913 acres) and Lacustrine Limnetic (open waters of lakes and reservoirs) (888 acres.

Based on the grouping of wetland types by the three general categories, the majority of the wetlands within the study area are lacustrine-type wetlands; comprising 53 percent; followed by palustrine-type wetlands, comprising 46 percent; with riverine-type wetlands comprising less than 1 percent of the total wetland acreage (**Table 3.2-40**).

**Table 3.2-40 Wetlands by General Category within Study Area 5**

| General Wetland Type | Acres | Total Acreage of Wetlands within the Study Area | Percent of Total Wetland Acreage within the Study Area |
|---|---|---|---|
| Lacustrine | 1,124 | 2,106 | 53 |
| Palustrine | 974 | 2,106 | 46 |
| Riverine | 8 | 2,106 | <1 |

*Study Area 6*

Study Area 6 encompasses 252,327 acres, of which approximately 1,588 acres (0.6 percent) are occupied by wetlands. There are also approximately 4,582,847 linear feet (868 miles) of water courses or drainage features in the study area. As shown in **Table 3.2-32**, the most abundant wetland type is Palustrine Unconsolidated Bottom at 1,110 acres. The next most abundant wetland type is the Lacustrine Littoral (associated with shores of lakes and reservoirs) at 268 acres.

Based on the grouping of wetland types by the three general categories, the majority of the wetlands within the study area are palustrine-type wetlands, comprising 71 percent; followed by lacustrine-type wetlands, comprising 29 percent; with riverine-type wetlands comprising less than 1 percent of the total wetland acreage (**Table 3.2-41**).

**Table 3.2-41 Wetlands by General Category within the Study Area 6**

| General Wetland Category | Acres | Total Acreage of Wetlands within the Study Area | Percent of Total Wetland Acreage within the Study Area |
|---|---|---|---|
| Lacustrine | 461 | 1,588 | 29 |
| Palustrine | 1,120 | 1,588 | 71 |
| Riverine | 7 | 1,588 | <1 |

### 3.2.5.2 Environmental Consequences (Study Areas 1 – 6)

Potential impacts to wetlands and waters of the U.S. from potential future mining-related development would result from surface disturbing activities that cannot avoid the discharge of dredged or fill materials into streams, waterbodies, or wetlands meeting the regulatory definitions enforced by the USACE and the USEPA and briefly described in Section 3.2.5. Not all streams, wetlands, and waterbodies within each study area are regulated by these federal agencies. Potential impacts to waters of the U.S., including wetlands, could occur as a result of direct or indirect effects associated with earth disturbing activities, or as a result of indirect effects associated with aquifer dewatering/depressurization that could result in the dewatering of shallow groundwater-fed wetlands and streams.

During the permitting process for future mine expansion areas or satellite mines, identification and delineation of waters of the U.S. would be performed within future proposed mine disturbance areas. Coordination with the USACE Fort Worth District through preparation of a Jurisdictional Determination would determine the location and extent of any waters of the U.S. affected by future mining-related activities. A conditional or functional assessment of the identified waters of the U.S. would be prepared to characterize the functions and quality of the waters of the U.S. to be used as an ecological baseline for evaluation of a Section 404 permit application, planning for mine reclamation, and USACE Fort Worth District compensatory mitigation.

Under both the Proposed Action and the No Action alternatives, future applications for Section 404 permits for mine expansion areas or satellite mines within each of the six study areas are expected to be received by the USACE Fort Worth District for review and evaluation. **Table 2-3** presents the maximum acreage for each study area estimated to be disturbed by future mine authorization requests.

The size and location of potential future mine expansions or satellite mines within the study areas are not currently known, so the actual amount of wetlands and waters of the U.S. cannot be accurately quantified. However, for analysis purposes, it is assumed that the percentage of wetlands projected to be impacted would be the same as the percentage of each general category of wetlands within each study area. Until delineations of waters of the U.S. are performed for specific mine permits, the potential impacts to waters of the U.S. can only be assumed to be similar to the impacts described for surface water in Section 3.2.4.2.

Proposed Action

During the planning stages of future mines within the six study areas, an identification and delineation of waters of the United States, including wetlands, would be conducted within future proposed mine disturbance areas. Based on the USACE Fort Worth District's proposed regulatory framework described in Section 2.2.1, the USACE Fort Worth District would determine which permit type would be required using the thresholds applicable to each future mine expansion area or satellite mine and begin the necessary agency coordination. Part of the USACE Fort Worth District's initial evaluation would identify the category for future NEPA tiering or supplementation as would be required for each Section 404/10 permit evaluation, as described in Section 2.2.2. The USACE Fort Worth District's process regarding compensatory mitigation would still apply as appropriate to minimize adverse impacts. Submittal of detailed stream design information for USACE Fort Worth District and resource agency review prior to construction of mitigation streams would be required. The information would include but not be limited to plan, profile, and dimension measurements based on appropriate regional hydrographic and geomorphological data and successful as-built streams/systems on and/or near the respective mitigation site.

The USACE Fort Worth District's proposed regulatory framework is intended to improve the process of permit review and evaluation for future mine authorization requests. Therefore, the timeframe for the USACE Fort Worth District's review of environmental documentation and evaluation of future mine Section 404 permit applications may be shortened compared to the current case-by-case permit review and agency concurrence process that would apply under the No Action Alternative.

*Study Area 1*

The estimated maximum acreage of disturbance associated with potential requests for future surface lignite mining authorizations in Study Area 1 is approximately 13,500 acres, which represents approximately 1.5 percent of the total area. Wetlands within Study Area 1 comprise approximately 8 percent of the total study area; therefore, approximately 1,118 acres of wetlands are projected to be impacted by potential future mining. **Table 3.2-42** presents the estimated acreage of the three general wetland categories projected to occur within the potential future mine areas.

**Table 3.2-42 Wetland Types within Study Area 1 Projected to be Impacted by Future Mining**

| General Wetland Type | Percent of Wetland Type in Study Area | Acreage of Wetlands Projected to be Impacted by Future Mining |
|---|---|---|
| Lacustrine | 29 | 325 |
| Palustrine | 70 | 788 |
| Riverine | <1 | 5 |

Palustrine-type wetlands, specifically palustrine forested wetlands, are the most likely to be affected because they cover the largest acreage. However, forested wetlands are typically among the highest quality wetlands present on the landscape. Consequently, irrespective of potential permit evaluation mechanism, the USACE Fort Worth District would likely direct efforts toward ensuring avoidance and minimization of adverse impacts in such areas. It is likely that future mining activities would avoid large bodies of open water and larger river-like areas in favor of landscape positions that would not be permanently inundated. Therefore, palustrine wetlands are projected to be impacted to a greater extent than the other wetland types.

*Study Area 2*

The estimated maximum acreage of disturbance associated with potential requests for future surface lignite mining authorizations in Study Area 2 is approximately 50,200 acres, which represents approximately 3.5 percent of the total area. Wetlands within Study Area 2 comprise approximately 7 percent of the total study area; therefore, approximately 3,655 acres of wetlands are projected to be impacted by potential future mining. **Table 3.2-43** presents the estimated acreage of the three general wetland categories projected to occur within potential future mine areas.

**Table 3.2-43 Wetland Types within Study Area 2 Projected to be Impacted by Future Mining**

| General Wetland Type | Percent of Wetland Type in Study Area | Acreage of Wetlands Projected to be Impacted by Future Mining |
|---|---|---|
| Lacustrine | 16 | 596 |
| Palustrine | 82 | 2,998 |
| Riverine | 2 | 61 |

*Study Area 3*

The estimated maximum acreage of disturbance associated with potential requests for future surface lignite mining authorizations in Study Area 3 is approximately 50,600 acres, which represents approximately 4 percent of the total area. Wetlands within Study Area 3 comprise approximately 5.5 percent of the total study area; therefore, approximately 2,778 acres of wetlands are projected to be impacted by potential future mining. **Table 3.2-44** presents the estimated acreage of the three general wetland categories projected to occur within potential future mine areas.

**Table 3.2-44 Wetland Types within Study Area 3 Projected to be Impacted by Future Mining**

| General Wetland Type | Percent of Wetland Type in Study Area | Acreage of Wetlands Projected to be Impacted by Future Mining |
|---|---|---|
| Lacustrine | 32 | 898 |
| Palustrine | 67 | 1,861 |
| Riverine | 1 | 19 |

As in Study Area 1, palustrine-type wetlands are projected to be impacted to a greater extent than the other wetland types.

As in Study Area 1, palustrine-type wetlands are projected to be impacted to a greater extent than the other wetland types.

*Study Area 4*

The estimated maximum acreage of disturbance associated with potential requests for future surface lignite mining authorizations in Study Area 4 is approximately 9,800 acres, which represents approximately 3 percent of the total area. Wetlands within Study Area 4 comprise approximately 2 percent of the total study area; therefore, approximately 194 acres of wetlands are projected to be impacted by potential future mining. **Table 3.2-45** presents the estimated acreage of the three general wetland categories projected to occur within potential future mine areas.

**Table 3.2-45 Wetland Types within Study Area 4 Projected to be Impacted by Future Mining**

| General Wetland Type | Percent of Wetland Type in Study Area | Acreage of Wetlands Projected to be Impacted by Future Mining |
|---|---|---|
| Lacustrine | 27 | 53 |
| Palustrine | 66 | 128 |
| Riverine | 7 | 13 |

As in Study Area 1, palustrine-type wetlands are projected to be impacted to a greater extent than the other wetland types.

*Study Area 5*

The estimated maximum acreage of disturbance associated with potential requests for future surface coal and lignite mining authorizations in Study Area 5 is approximately 9,500 acres, which represents approximately 5 percent of the total area. Wetlands within Study Area 5 comprise approximately 1 percent of the total study area; therefore, approximately 110 acres of wetlands are projected to be impacted by potential future mining. **Table 3.2-46** presents the estimated acreage of the three general wetland categories projected to occur within potential future mine areas.

As in Study Area 1, palustrine-type wetlands are projected to be impacted to a greater extent than the other wetland types.

**Table 3.2-46 Wetland Types within Study Area 5 Projected to be Impacted by Future Mining**

| General Wetland Type | Percent of Wetland Type in Study Area | Acreage of Wetlands Projected to be Impacted by Future Mining |
|---|---|---|
| Lacustrine | 53 | 59 |
| Palustrine | 46 | 51 |
| Riverine | <1 | <1 |

*Study Area 6*

The estimated maximum acreage of disturbance associated with potential requests for future surface coal and lignite mining authorizations in Study Area 6 is approximately 25,000 acres, which represents approximately 10 percent of the total area. Wetlands within Study Area 6 comprise less than 1 percent of the total study area; therefore, approximately 158 acres of wetlands are projected to be impacted by potential future mining. **Table 3.2-47** presents the estimated acreage of the three general wetland categories projected to occur within potential future mine areas.

As in Study Area 1, palustrine-type wetlands are projected to be impacted to a greater extent than the other wetland types.

**Table 3.2-47 Wetland Types within Study Area 6 Projected to be Impacted by Future Mining**

| General Wetland Type | Percent of Wetland Type in Study Area | Acreage of Wetlands Projected to be Impacted by Future Mining |
|---|---|---|
| Lacustrine | 29 | 46 |
| Palustrine | 71 | 111 |
| Riverine | <1 | 1 |

No Action Alternative

The No Action alternative would maintain the existing USACE Fort Worth District regulatory framework, whereby requests for future surface coal and lignite mine expansions or satellite mines within the six study areas would comply with the regulatory requirements of NEPA, and impacts to waters of the U.S. including wetlands would be subject to the current Section 404/10 permit review and evaluation guidelines and assessment of post-project conditions in meeting policies, including the USACE Fort Worth District's process regarding compensatory mitigation requirements. The proposed changes to the USACE Fort Worth District regulatory framework as discussed in Section 2.2.1 would not be implemented; therefore, the timeframe for USACE Fort Worth District review and evaluation of future mine Section 404//10 permit applications may be longer than under the Proposed Action. Under the No Action Alternative, future mine-related impacts to waters of the U.S., including wetlands, would be the same as described for the Proposed Action.

### 3.2.5.3 Cumulative Impacts

The past and present actions and RFFAs identified in Section 2.4 include all known and foreseeable surface-disturbing activities that affect the type and extent of vegetation. Most of this surface disturbance can be categorized as long-term disturbance with the possible exception of pipelines and Section 404 permits, which are likely to have been reclaimed following completion of construction. The CESA boundaries for waters of the U.S. include the area encompassed by the outer boundaries of the study areas and the riparian or wetland vegetation within the study area-specific 5-foot groundwater drawdown area described in Section 3.2.3.3, Groundwater. **Table 3.2-48** summarizes the acreage of past and present actions within each CESA that affected waters of the U.S. through surface-disturbing activities such as mining, reservoirs, road construction, urban development, power generation, and oil and gas development. This disturbance contributed to the current conditions of jurisdictional waters and wetlands within each CESA.

Future mining and other activities such as those listed in Section 2.4.2 may occur within the CESA, presumably in similar proportions to the types of current activities. The effects of future surface-disturbing actions would result in direct and indirect impacts to waters of the U.S., similar to the impacts described for mining-related activities. The impacts from all of these surface-disturbing activities would combine to alter the conditions of waters of the U.S., including wetlands.

**Table 3.2-48 Acreage of Past and Present Surface Disturbance in CESAs**

| Study Area | Disturbed Inside Study Area (acres) | Disturbed Outside Study Area/Inside CESA (acres) | Total CESA Disturbed (acres) |
|---|---|---|---|
| 1 | 52,238 | 56,683 | 108,922 |
| 2 | 40,132 | 149,693 | 189,825 |
| 3 | 38,569 | 120,045 | 158,614 |
| 4 | 5,846 | 57,722 | 63,568 |
| 5 | 3,603 | 27,100 | 30,702 |
| 6 | 2,363 | 3,596 | 5,959 |

### 3.2.5.4 Monitoring and Mitigation Measures

As currently required, a mine-specific conceptual mitigation plan would be developed and submitted to the USACE Fort Worth District in support of the Section 404 permit application. As discussed in Section 2.2.4.3, Typical Closure and Reclamation, reconstruction of impacted jurisdictional waters and wetlands could be accomplished through creation, restoration, and/or enhancement of streams, open water, and wetland resources. The conceptual mitigation plan would specify proposed plant species, success criteria and performance standards, monitoring, financial assurances, and long-term protection (e.g., conservation easement) of the reclaimed resources. Detailed stream design information for USACE and resource agency review and USACE approval prior to construction of mitigation streams would be required. The information would include but not be limited to plan, profile, and dimension measurements based on appropriate regional hydrographic and geomorphological data and successful as-built streams/systems on and/or near the respective mitigation site. No additional monitoring or mitigation measures beyond those currently required by the USACE Fort Worth District are recommended.

### 3.2.5.5 Residual Adverse Impacts

Residual adverse effects to waters of the U.S., including wetlands, have not been identified. Losses to waters of the U.S. and wetlands during mine construction and operation would be mitigated through implementation of detailed compensatory mitigation plan that would be approved by the USACE Fort Worth District.

# 3.3 Soils and Reclamation

## 3.3.1 Affected Environment

A variety of data sources were used to identify the baseline soil characteristics in the analysis area. Information on Major Land Resource Areas and soil types was obtained from NRCS literature or databases, including the Land Resource Regions and Major Land Resource Areas of the United States, the Caribbean, and the Pacific Basin, U.S. Department of Agriculture Handbook 296 (NRCS 2006), the U.S. General Soil Map (STATSGO2) (NRCS 2014b), and the Soil Survey Geographic Database (SSURGO) (NRCS 2014a). Soil baseline characterization of the analysis area was based on STATSGO2, which consists of general soil association units developed by the National Cooperative Soil Survey. It consists of a broad-based inventory of soils and non-soil areas that occur in a repeatable pattern on the landscape that can be cartographically shown at the small scale mapped (1:250,000). The dataset was created by generalizing more detailed soil survey maps or by using data on geology, topography, vegetation, and climate, together with interpretations of satellite imagery. Prime farmland information was taken from the SSURGO dataset which is the most detailed level of soil mapping done by the USDA NRCS.

### 3.3.1.1 Major Land Resource Areas

The analysis area lies within the following Major Land Resource Areas (MLRAs) (NRCS 2006), as shown in **Figure 3.3-1**. They include the following:

- 83A—Northern Rio Grande Plain
- 83B—Western Rio Grande Plain
- 86A—Northern Part of the Texas Blackland Prairie
- 87A—Southern Part of the Texas Claypan Area
- 87B—Northern Part of the Texas Claypan Area
- 133B—Western Coastal Plain

The descriptions of the soils of each MLRA were based on NRCS (2006) information.

This Northern Rio Grande Plain MLRA is generally nearly level; however, gently rolling hills and valleys also are present, primarily in the eastern part of the MLRA. Elevations in this region range from 200 feet amsl in the southeast to 1,000 feet amsl in the northwest. The soils are generally very deep, well drained or moderately well drained, and loamy or clayey. Clayey soils in this region may be smectitic and prone to shrink-swell. The major soil resource concerns are maintenance of soil quality and the condition of the soils, water erosion in areas with a slope of more than 1 percent, and wind erosion. A major management concern is controlling the brush and cactus that invade the grasslands.

The Western Rio Grande Plain MLRA consists mainly of low hills with sandstone escarpments. Most of the escarpments occur in the western half of the area. The landscape is gently undulating and somewhat dissected by intermittent streams. Elevations in this region range from 165 feet amsl in the southeast to 1,200 feet amsl in the northwest. The soils are generally moderately deep to very deep, well drained or moderately well drained, and loamy or clayey. Clayey soils in this region may be smectitic and prone to shrink-swell. The major soil resource concerns are maintenance of soil quality and the condition of the soils, water erosion in areas with a slope of more than 1 percent, and soil salinity. Wind erosion also is a concern on sandy and loamy soils. A major management concern is controlling the brush and cactus that invade the grasslands.

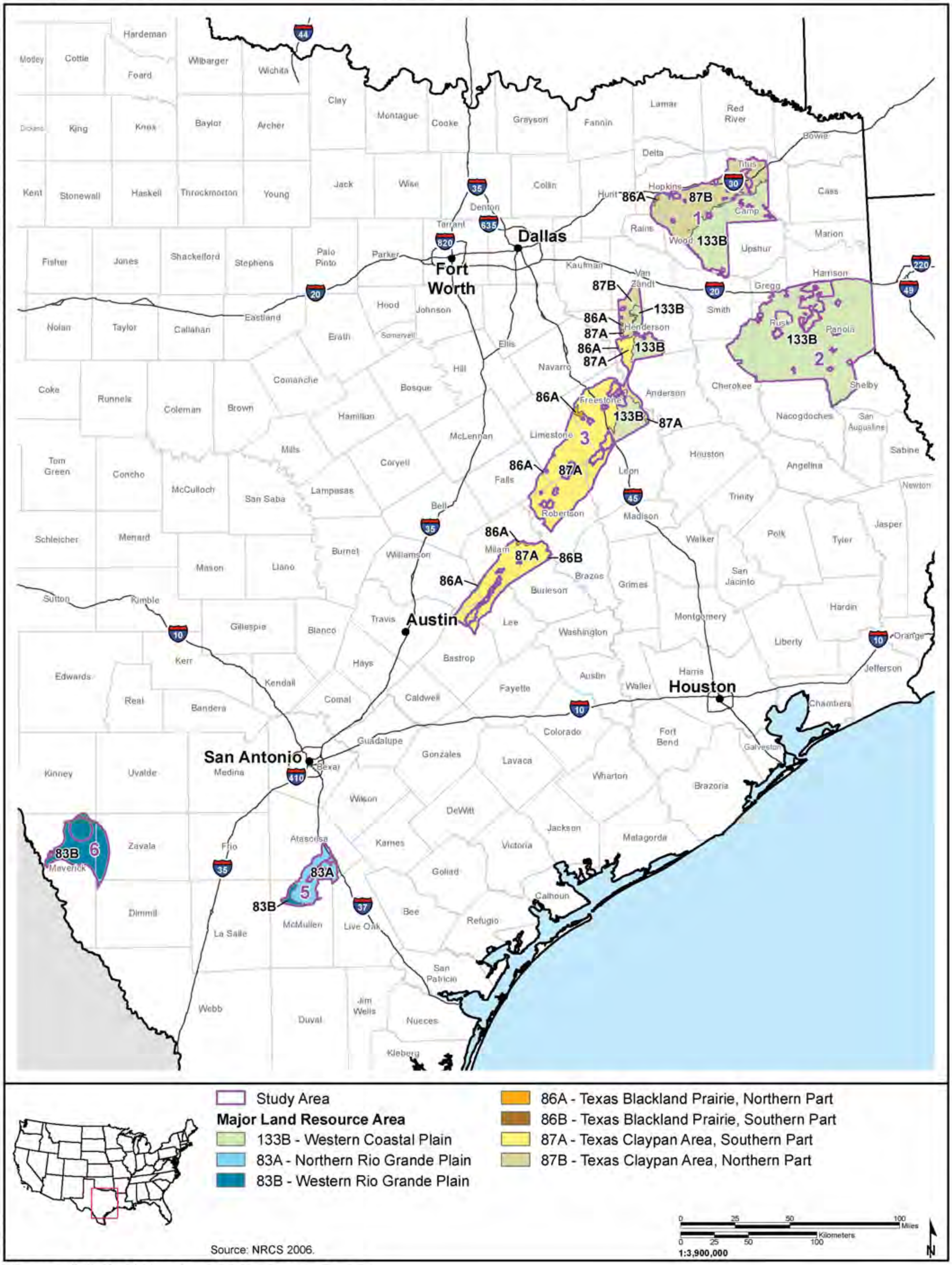


**Figure 3.3-1 Major Land Resource Areas**

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3/31/2015

The Northern Part of the Texas Blackland Prairie MLRA is a nearly level to gently sloping, dissected plain. Gently sloping uplands merge into narrow valleys with sloping valley walls. Large rivers with broad, long valleys are also present. Elevations range from 200 to 750 feet amsl, increasing gradually from south to north. The soils generally range from moderately deep to very deep, somewhat excessively drained to somewhat poorly drained, and sandy to clayey. Clayey soils in this region may be smectitic and prone to shrink-swell. The major soil resource concerns are water erosion, maintenance of the content of organic matter and productivity of the soils, and management of soil moisture.

The Southern Part of the Texas Claypan Area MLRA is a nearly level to gently sloping, dissected plain. Dissected areas with steeper slopes occur along entrenched river and creek valleys. Wide floodplains are flanked by nearly level stream terraces. Elevations range from 250 to 750 feet amsl. The soils are deep and have a medium textured or moderately coarse textured surface layer and a moderately permeable to very slowly permeable, clayey or loamy subsoil. The soils are well drained to poorly drained. Clayey soils in this region may be smectitic and prone to shrink-swell. The major soil resource concerns are water erosion, maintenance of the content of organic matter and productivity of the soils, and management of soil moisture.

The Northern Part of the Texas Claypan Area MLRA is a nearly level to gently sloping, dissected plain. Dissected areas with steeper slopes occur along entrenched river and creek valleys. Wide flood plains are flanked by nearly level stream terraces. Elevations range from 250 to 750 feet amsl. The soils are deep and have a medium textured or moderately coarse textured surface layer and a moderately permeable to very slowly permeable, clayey or loamy subsoil. The soils are well drained to poorly drained. Clayey soils in this region may be smectitic and prone to shrink-swell. The major soil resource concerns are water erosion, maintenance of the content of organic matter and productivity of the soils, and management of soil moisture.

The Western Coastal Plain MLRA consists of level to steep uplands heavily dissected by streams. Broad flood plains and terraces occur along some streams. Elevations range from 80 to 650 feet amsl, increasing gradually from southeast to northwest. Local relief is generally less than 30 feet. The soils generally are very deep, well drained to poorly drained, and loamy or clayey. Clayey soils in this region may be smectitic and prone to shrink-swell. The major resource concerns are water erosion and wetland restoration.

### 3.3.1.2 Soil Types and Limitations

The analysis area consists of croplands, rangelands, and forested lands. Portions of the analysis area previously have been disturbed by mining, oil and gas activities, and cattle grazing.

Soil characteristics such as susceptibility to erosion and the potential for revegetation are important to consider when planning for construction activities and stabilization of disturbed areas. These hazards or limitations for use are a function of many physical and chemical characteristics of each soil type, in combination with the topography, aspect, climate, and vegetation. Important soil characteristics to be considered when evaluating the effects of surface-disturbing activities and subsequent reclamation are summarized in **Table 3.3-1** by study area. The characteristics are described further below.

Water erosion is the detachment and movement of soil by water. Natural erosion rates depend on inherent soil properties, slope, soil cover, and climate. Wind erosion is the physical wearing of the earth's surface by wind. Wind erosion removes and redistributes soil. Small blowout areas may be associated with adjacent areas of deposition at the base of plants or behind obstacles, such as rocks, shrubs, fence rows, and roadbanks (Soil Quality Institute 2001). The occurrence of water erodible soils is shown in **Figure 3.3-2**.

**Table 3.3-1 Soil Characteristics within the Study Areas**

| Study Areas | Total Acres[1] | Wind Erodible | | Water Erodible | | LRP[2] | | Acidic Soils[3] | | Hydric | | Compaction Prone | | Stony Rocky | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Acres | % | Acres | % | Acres | % | Acres | % | Acres | % | Acres | % | Acres | % |
| 1 | 912,497 | 178,635 | 20 | 608,019 | 67 | 467 | <1 | 159,950 | 4 | 120,604 | 13 | 843,644 | 92 | 9,028 | 1 |
| 2 | 1,449,306 | 236,183 | 16 | 1,074,207 | 74 | 0 | 0 | 1,106,946 | 25 | 126,125 | 9 | 1,342,872 | 93 | 1,539 | 0 |
| 3 | 1,219,146 | 441,490 | 36 | 749,182 | 61 | 1,845 | <1 | 6,851 | 0 | 35,232 | 3 | 1,155,068 | 95 | 44,500 | 4 |
| 4 | 365,348 | 161,870 | 44 | 216,027 | 59 | 1,351 | <1 | 0 | 0 | 2,643 | 1 | 352,015 | 96 | 16,117 | 4 |
| 5 | 180,841 | 17,284 | 10 | 139,592 | 77 | 93,955 | 52 | 0 | 0 | 137 | <1 | 174,276 | 96 | 5,267 | 3 |
| 6 | 252,326 | 2,035 | 1 | 198,496 | 79 | 167,382 | 66 | 0 | 0 | 36 | 0 | 231,839 | 92 | 15,391 | 6 |
| Total | 4,379,465 | 1,037,497 | 24 | 2,985,523 | 68 | 265,000 | 6 | 1,273,747 | 29 | 284,778 | 7 | 4,099,714 | 94 | 91,842 | 2 |

[1] Acreages based on GIS analysis

[2] LRP = low revegetation potential

[3] pH ≤ 5.5

Source: NRCS 2014b

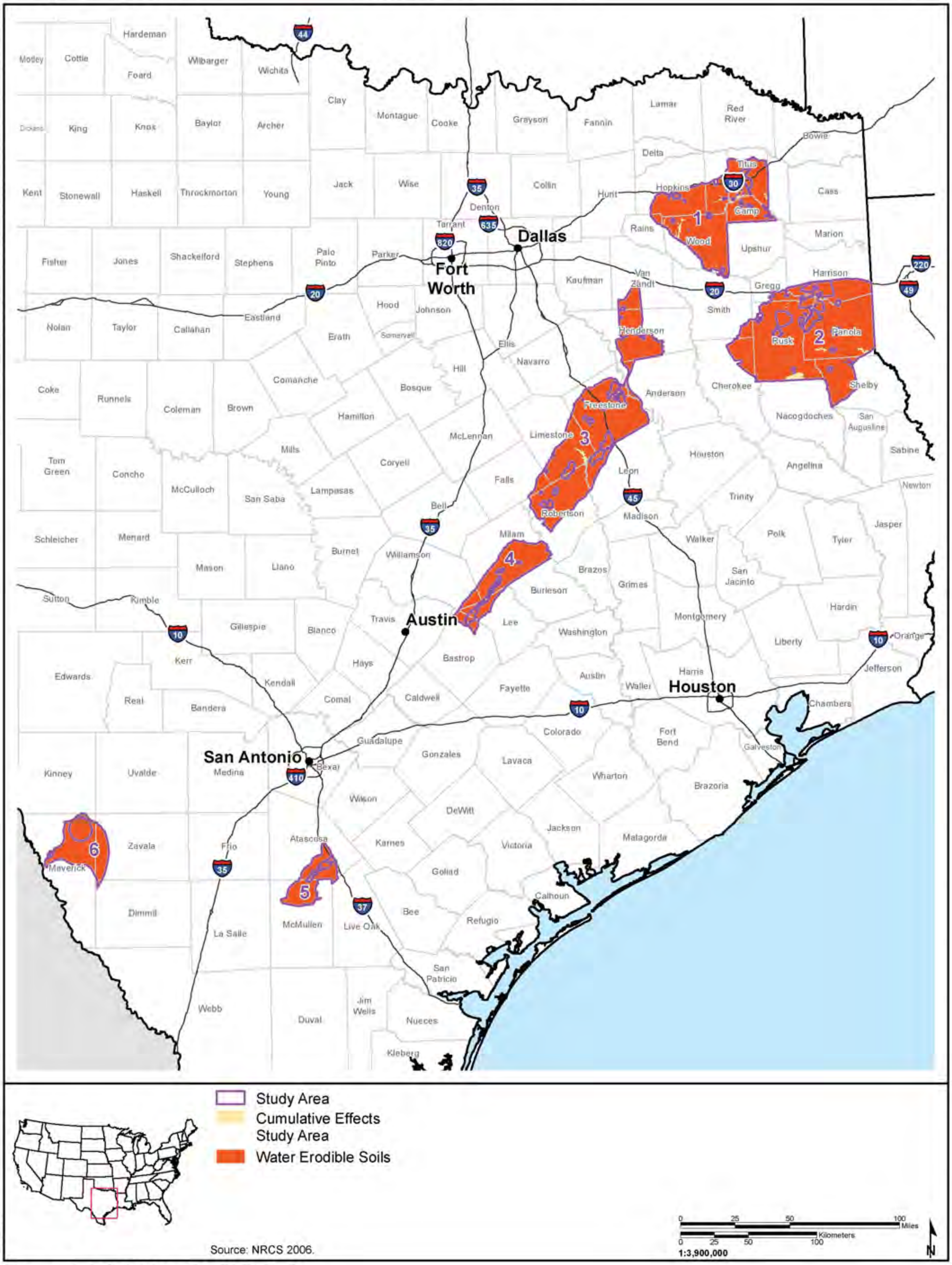



Figure 3.3-2 Water Erodible Soils

Soils with low revegetation potential have chemical characteristics such as high salts, sodium, or pH that may limit plant growth. Saline soils affect plant uptake of water, and sodic soils often have drainage limitations. In addition, the success of stabilization and reclamation efforts in these areas may be limited unless additional treatments and practices are employed to offset the adverse physical and chemical characteristics of the soils. The distribution of soils with characteristics that may limit revegetation within the analysis area is shown in **Figure 3.3-3**.

Acidic soils are soils with a pH lower than 5.5. Acidic soils can limit the availability of some essential plant nutrients and can increase the soil solution's toxic elements, such as aluminum and manganese, Low pH soils also affect microbial availability and activity.

Hydric soils are soils that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part of the soil profile. These soils are commonly associated with floodplains, lake plains, basin plains, riparian areas, wetlands, springs, and seeps. Study Areas 1, 2, 3, 4, and a very small portion of 5 have hydric soils present. However, due to the scale of mapping, small areas of hydric soils may not be evident.

Soil compaction occurs when soil particles are pressed together and the pore spaces between them are reduced. Soil compaction destroys soil structure, reduces porosity, limits water and air infiltration, and increases resistance to root penetration. Moist, fine textured soils are most susceptible to severe compaction. Compaction-prone soils are typically high in clay content which can be a limiting factor to vegetation growth. Compaction prone soils are prevalent in each of the study areas. The occurrence of compaction prone soils is shown in **Figure 3.3-4**.

Stony and rocky soils have high rock fragment content within the soil profile that can inhibit reclamation potential. Soils with significant quantities of rock fragments were identified by soil series that have a very to extremely cobbly, stony, bouldery, gravelly, or flaggy modifier to the textural class, which is equivalent to 35 percent or more rock fragments by volume.

Prime farmland is defined by the NRCS as land that has the best combination of physical and chemical characteristics for producing crops and is available for these uses. It has the combination of soil properties, growing season, and moisture supply needed to produce sustained high yields of crops in an economic manner if it is treated and managed according to acceptable farming methods. Thus, prime farmland soils have an adequate and dependable water supply from precipitation or irrigation, a favorable temperature and growing season, an acceptable level of acidity or alkalinity, an acceptable content of salt or sodium, and few or no rocks. Prime farmland soils are permeable to water and air, are not excessively eroded or saturated with water for long periods of time, and either are not subject to frequent flooding during the growing season or are protected from flooding (7 USC 4201). Prime farmland is prevalent in all of the study areas (see **Table 3.3-2** and **Figure 3.3-5**).

A site-specific investigation is required by RCT regulations under SMCRA to determine whether NRCS-designated prime farmland soil types within a proposed surface mining area may have been used historically for cropland (i.e., whether they were used to grow crops during any 5 of the 10 years immediately preceding the lease or purchase of the land for mining). Although the NRCS designation of prime farmland soils indicates the suitability of a soil for production of crops, it does not necessarily imply the historical use for cropland required to meet the SMCRA definition of prime farmland.

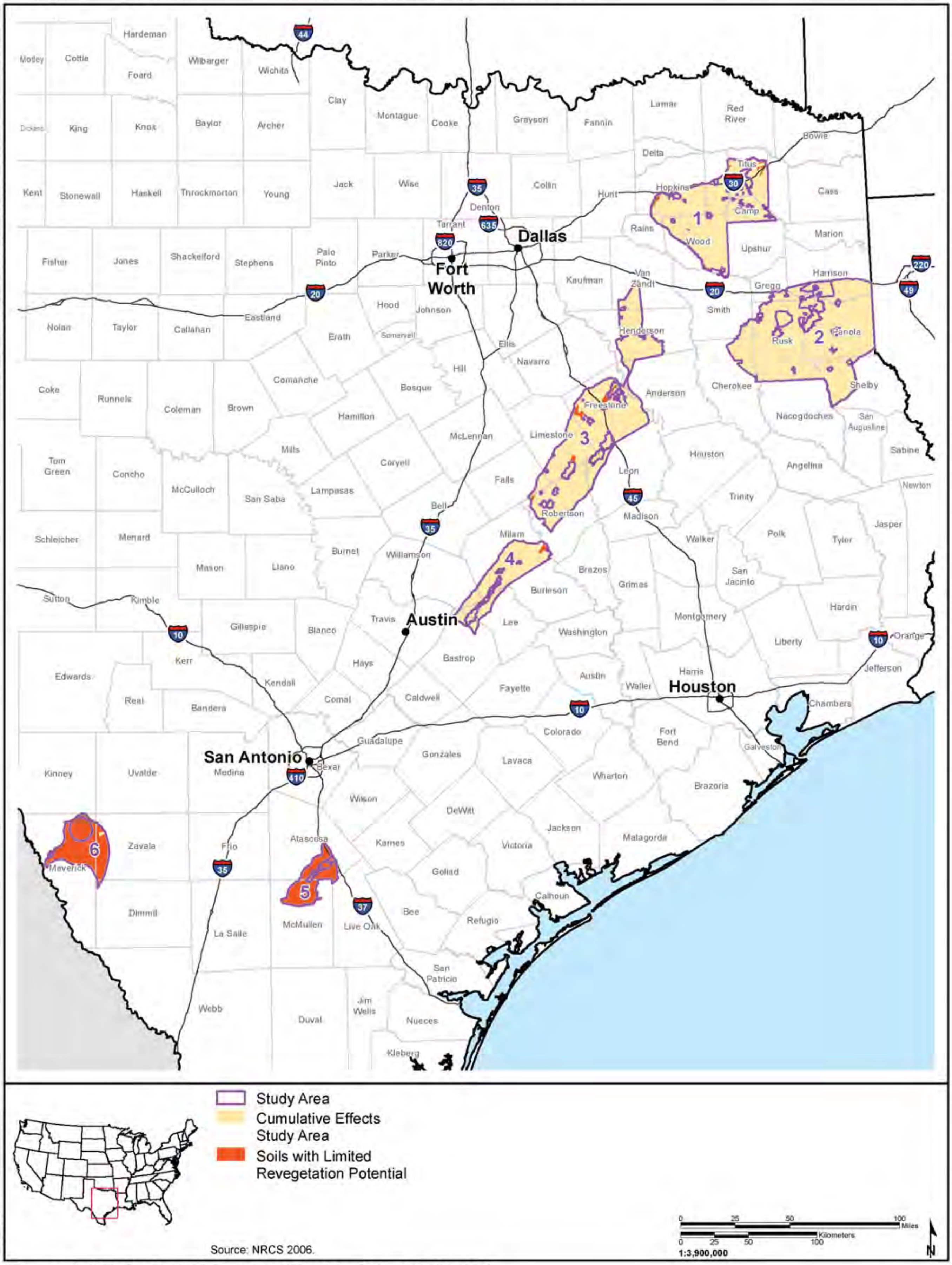



**Figure 3.3-3 Soils with Limited Revegetation Potential**

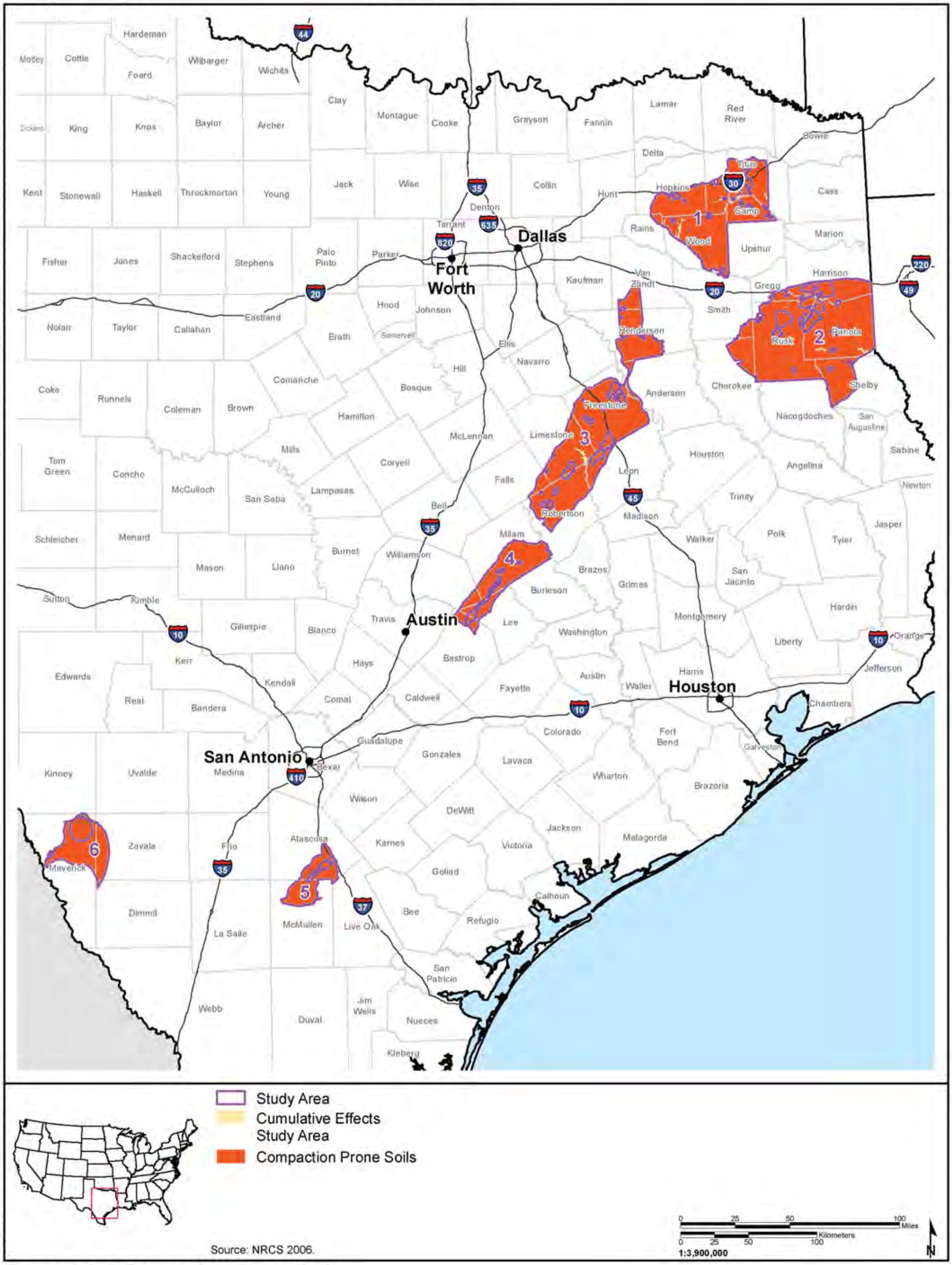



Figure 3.3-4 Compaction Prone Soils

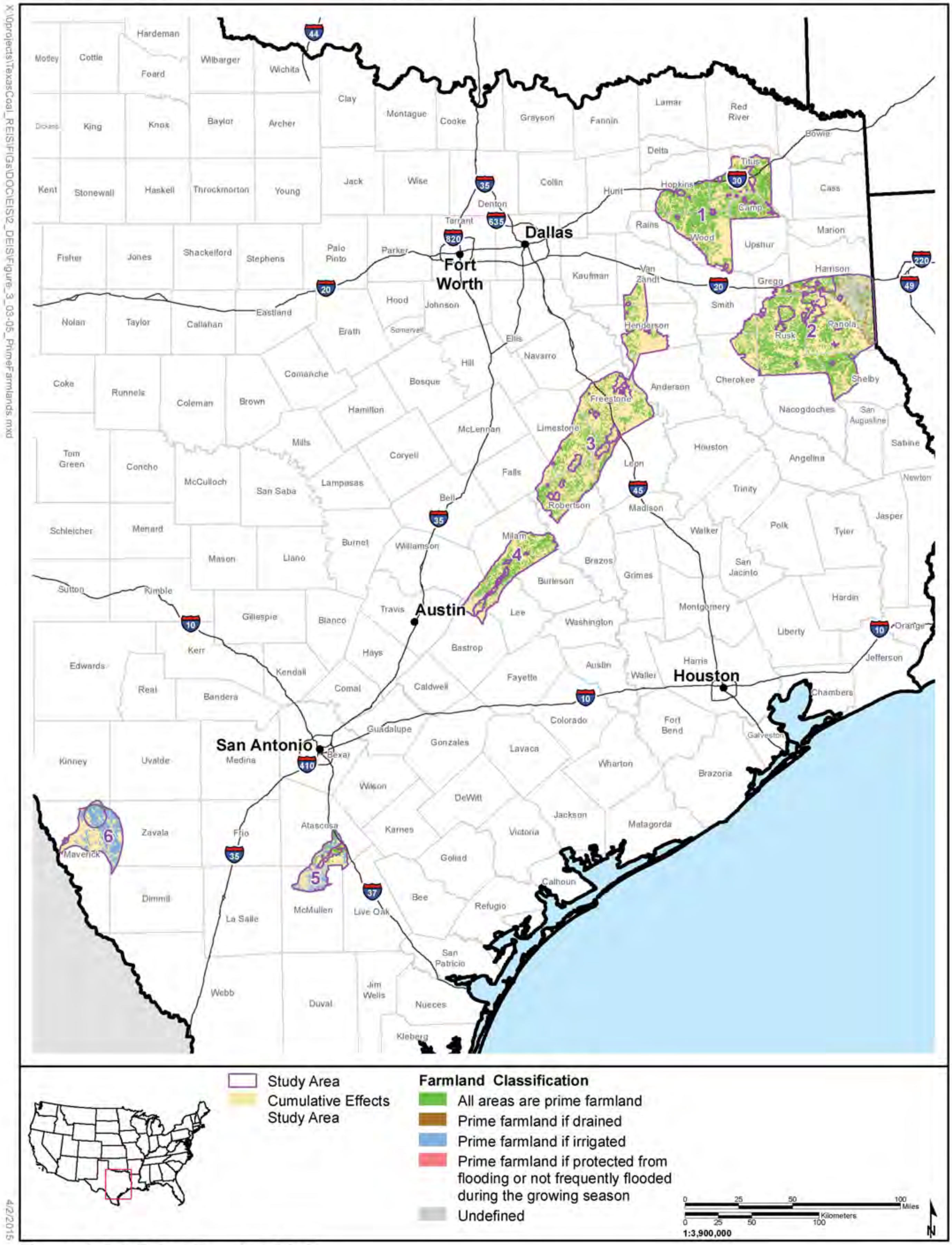



**Figure 3.3-5 Prime Farmland Soils**

**Table 3.3-2 Summary of Prime Farmland Soils by Study Area**

| Study Area | Total Acres | All Areas are Prime Farmland Soils | | Prime Farmland Soils if Drained | | Prime Farmland Soils if Irrigated | | Prime Farmland Soils if Protected from Flooding or not Frequently Flooded during the Growing Season | | Not Prime Farmland Soils | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Acres | % | Acres | % | Acres | % | Acres | % | Acres | % |
| 1 | 912,497 | 255,652 | 28 | 8,637 | 1 | 0 | 0 | 0 | 0 | 648,208 | 71 |
| 2 | 1,449,306 | 307,521 | 21 | 25,204 | 2 | 0 | 0 | 13 | <1 | 1,030,744 | 71 |
| 3 | 1,219,146 | 168,499 | 14 | 0 | 0 | 0 | 0 | 3,165 | <1 | 1,047,483 | 86 |
| 4 | 365,348 | 79,501 | 22 | 0 | 0 | 0 | 0 | 0 | 0 | 285,846 | 78 |
| 5 | 180,841 | 11,482 | 6 | 0 | 0 | 37,547 | 21 | 0 | 0 | 106,839 | 59 |
| 6 | 252,326 | 0 | 0 | 0 | 0 | 85,646 | 34 | 0 | 0 | 166,676 | 66 |
| Total | 4,379,465 | 822,655 | 19 | 33,841 | 1 | 123,193 | 3 | 3,177 | <1 | 3,285,795 | 75 |

Note: Discrepancy in percentages due to rounding.

## 3.3.2 Environmental Consequences

### 3.3.2.1 Proposed Action

Soil resource disturbances of up to 158,600 acres could occur as a result of potential future mine development within the six study areas. This would be approximately 3.6 percent of all of the study areas combined (as shown in **Table 2-3**). Potential future mine expansion areas or satellite mines would require site-specific NEPA analyses as noted in Section 2.2.2, Categories for Future NEPA Tiering or Supplementation. Site-specific analysis would require additional information such as detailed soil mapping to support the analysis of mine-specific issues.

The construction activities prior to mining that are described in Section 2.2.4 typically would result in the largest annual disturbance acreage. As shown in **Table 3.3-1**, most of the soils in the study areas are prone to compaction. Soil compaction would be most likely to occur in areas that are heavily trafficked by vehicles and equipment. Soils that are compacted would experience a decrease in infiltration of rainfall and increase surface runoff. Erosion control measures and surface water control facilities would be installed and constructed to reduce erosion and sedimentation.

Surface disturbance to soil resources would continue to occur incrementally throughout the life of a mine as mine pits and haul roads advance, additional surface water control facilities are installed, and existing roads and utilities within the mine area are relocated. The soil handling and storage processes described in Section 2.2.4.1 would help to maintain soils for future site reclamation by reducing losses to wind and water erosion and misuse. While the soil salvage operations would permanently alter the natural soil horizons and reduce soil productivity, these methods would minimize impacts over the long term and improve the potential to successfully stabilize mine-related disturbance areas following reclamation. In addition, selective handling and testing (e.g., acid-base accounting analyses as required by RCT) of overburden also would be implemented to ensure sufficient material for placement of suitable growth media (i.e., non-acid- or toxic-forming materials) in the upper 4 feet of the backfill profile as required by RCT and described in Sections 2.2.4.1 and 2.2.5.3.

Potential impacts to soils as a result of typical mine development would include an increase in soil erosion due to the removal of vegetation, alteration of soil structure, mixing of topsoil and suitable subsoil (in areas that are not prime farmland), and the temporary reduction in soil productivity. Although accelerated erosion due to mining-related soil disturbance could occur at any stage of a mine, the maximum potential for erosion would be expected during construction before the soils are stabilized, while soils are loose with no established cover. Use of temporary cover crops and the installation of erosion control measures and devices, as described in Section 2.2.5, would minimize erosion and the potential for sediment to leave a mine site. Mixing of textural zones would occur, as well as mixing of horizons with chemical limitations, such as saline, alkaline, or acidic materials, which may create adverse chemical impacts to soil quality for seedbeds. Whatever microbial populations currently exist would likely decrease during growth media stockpiling and storage. Alternately, soil horizon alterations could result in a beneficial impact by creating more suitable soil textures for plant growth, elimination of hardpans, and increased pH.

Impacts also may occur during reclamation as soil is redistributed. Soil settlement occurs after the salvaged soil is replaced during reclamation because soils that are recently excavated occupy a volume approximately 25 percent greater than the material prior to disturbance. Vertical settling often occurs unevenly on the surface over time, with settlement rates varying based on the physical soil characteristics and soil moisture content. Schneider (1977) evaluated the settlement characteristics of reclaimed surface mined land and found that the settlement rate for one location in Texas was 0.221 foot/year for approximately 2.5 years after reclamation to virtually no settlement after 10 years. Based on the evaluation, it was estimated that within 1 year after reclamation, approximately 75 percent of the expected soil settlement occurs, approximately 80 percent after 5 years, and the remaining settlement occurs over the next 1,000 years (Schneider 1977).

**Table 3.3-1** displays the soil limitations by study area. Where there are soils with severe limitations such as high susceptibility to wind or water erosion; acidic conditions; unfavorable soil properties such as shallow depth to bedrock, stoniness, and droughtiness, and low revegetation potential, the disturbed areas would most likely require more extensive BMPs and other protection measures with frequent monitoring than soils with fewer limitations.

### 3.3.2.2 No Action Alternative

The surface-disturbing activities associated with development of a surface coal or lignite mine expansion area or satellite mine under the No Action Alternative would be the same as those described for the Proposed Action Alternative. Therefore, the general impacts to soils would be the same, but may be spread over a longer period of time due to the possibly lengthier permitting process.

## 3.3.3 Cumulative Impacts

The CESA for soil resources is the area encompassed by outer boundary of study areas and includes surface disturbance associated with past and present actions and RFFAs. The acres of past and present surface disturbance for the CESA is the same as that shown in **Table 3.1-1** in the Geology section.

Cumulative impacts to soils result from surface disturbance related to mining, fire, grazing, farming, recreation, industrial development, roads and highways, municipalities, and other natural and anthropogenic activities within the analysis area. These surface-disturbing activities would be subject to soils limitations depending on the site-specific conditions. **Table 3.3-3** presents an overview of the extent of key soil limitations that affect soil stability, productivity, and uses for construction.

**Table 3.3-3 Soil Limitations within the CESAs**

| CESA | Total Acres | Wind Erodible | Water Erodible | LRP[1] | Acidic Soils | Hydric | Compaction Prone | Stony/ Rocky |
|---|---|---|---|---|---|---|---|---|
| | | (percent) | | | | | | |
| 1 | 968,422 | 19 | 67 | 0 | 16 | 13 | 93 | 1 |
| 2 | 1,605,970 | 17 | 74 | 0 | 75 | 9 | 93 | <1 |
| 3 | 1,311,765 | 37 | 61 | <1 | 1 | 3 | 95 | 4 |
| 4 | 395,528 | 43 | 61 | <1 | 0 | 1 | 96 | 4 |
| 5 | 201,289 | 10 | 77 | 52 | 0 | <1 | 97 | 3 |
| 6 | 309,759 | 1 | 79 | 64 | 0 | 0 | 91 | 6 |

[1] LRP = low revegetation potential.

Source: NRCS 2014a b.

The Proposed Action and the No Action alternatives would increase soil disturbance incrementally within all CESAs and related impacts by an additional 158,600 acres. It is assumed that portions of past mining-related disturbances have been reclaimed, and ongoing management and reclamation at existing operations would continue to minimize adverse impacts to soils. The majority of the soil disturbance and associated mining-related and other surface disturbing impacts resulting from future activities would be reclaimed unless permanently covered by structures.

## 3.3.4 Monitoring and Mitigation Measures

The following measures are recommended for consideration to further mitigate adverse impacts to soils, beyond what is required by permits and regulations.

- Rough and final grading should occur when the soils are dry, below the plastic limit, to reduce soil compaction during reclamation.
- Compacted surface or subsurface soil should be treated for compaction by deep ripping or subsoiling, prior to revegetation efforts.

### 3.3.5 Residual Adverse Effects

Should wetlands be affected by construction, there may be residual adverse effects resulting from the permanent alteration of natural hydric soils. Compensatory mitigation may result in the conversion of non-hydric soils to hydric soils. Long-term residual adverse effects to soils may result from the construction of roads and structures if the sites are not reclaimed following completion of mining.

# 3.4 Vegetation

## 3.4.1 Affected Environment

### 3.4.1.1 Ecoregions

The ecoregions in Texas as discussed by Griffith et al. (2007) were developed in a cooperative effort between the TCEQ, USEPA, USDA, and others. Based on this effort, 12 Level III ecoregions and 56 Level IV ecoregions were defined and mapped for Texas (**Figure 3.4-1**). While Level III ecoregions are useful on a broad scale, Level IV ecoregions provide a higher resolution that is useful for planning and management of vegetation resources at a large scale, such as the state of Texas.

The six study areas are within four Level III ecoregions and nine Level IV ecoregions. These ecoregions and the acreage of each within each study are identified in **Table 3.4-1**. Descriptions of each ecoregion as presented below are based on Griffith et al. (2007).

<u>Southern Texas Plains (31)</u>

The Southern Texas Plains ecoregion is a subhumid to dry region that contains a diverse mosaic of soils, mostly clay, clay loam, and sandy clay loam surface textures. These soils range from alkaline to slightly acid. This ecoregion contains a high and distinct diversity of plant and animal species. The rolling to moderately dissected plains in this ecoregion were once covered in many areas with grassland and savanna vegetation that varied during dry and wet cycles. However, due to continued grazing and fire suppression, thorny brush (e.g., honey mesquite [*Prosopis glandulosa*]) is now the predominant vegetation type. Ceniza (*Leucophyllum frutescens*) and blackbrush (*Acacia rigidula*) occur on caliche soils in this ecoregion.

*Texas-Tamaulipan Thornscrub (31c)*

The Texas-Tamaulipan Thornscrub ecoregion primarily is composed of gently rolling or irregular plains that are cut by arroyos and streams. This ecoregion is characterized by hot, dry summers and mild winters, with peak precipitation in the spring and fall. However, precipitation is erratic, with extreme year-to-year variation. Soils are varied and complex, highly alkaline to slightly acidic, ranging from clays and clay loams to deep sands. Caliche outcroppings and gravel ridges are common.

Vegetation in this ecoregion is dominated by drought-tolerant, mostly small-leaved, and often thorny small trees and shrubs. Past grazing, fire suppression, and droughts have resulted in an increase in thorny vegetation and a decrease in grasses. The most important woody species is honey mesquite and, where conditions are suitable, a dense understory of brasil (*Condalia hookeri*), Colima (*Zanthoxylum fagara*), Texas persimmon (*Diospyros texana*), lotebush (*Ziziphus obtusifolia*), granjeno (*Celtis ehrenbergiana*), kidneywood (*Eysenhardtia texana*), coyotillo (*Karwinskia humboldtiana*), Texas paloverde (*Parkinsonia texana*), anacahuita (*Cordia boissieri*), and various species of cacti. Typical on rocky, gravelly ridges and uplands are xerophytic brush species including blackbrush, guajillo (*Acacia berlandieri*), and ceniza. Mid and short grasses are common and include cane bluestem (*Bothriochloa barbinodis*), silver bluestem (*Bothriochloa laguroides*), multiflowered false rhodesgrass (*Trichloris pluriflora*), sideoats grama (*Bouteloua curtipendula*), pink pappusgrass (*Pappophorum bicolor*), bristlegrasses (*Setaria* spp.), lovegrasses (*Eragrostis* spp.), and tobosa (*Pleuraphis mutica*). Grass species on drier or overgrazed areas include red grama (*Bouteloua trifida*), Texas grama (*Bouteloua rigidiseta*), buffalograss (*Buchloe dactyloides*), and curleymesquite (*Hilaria belangeri*).

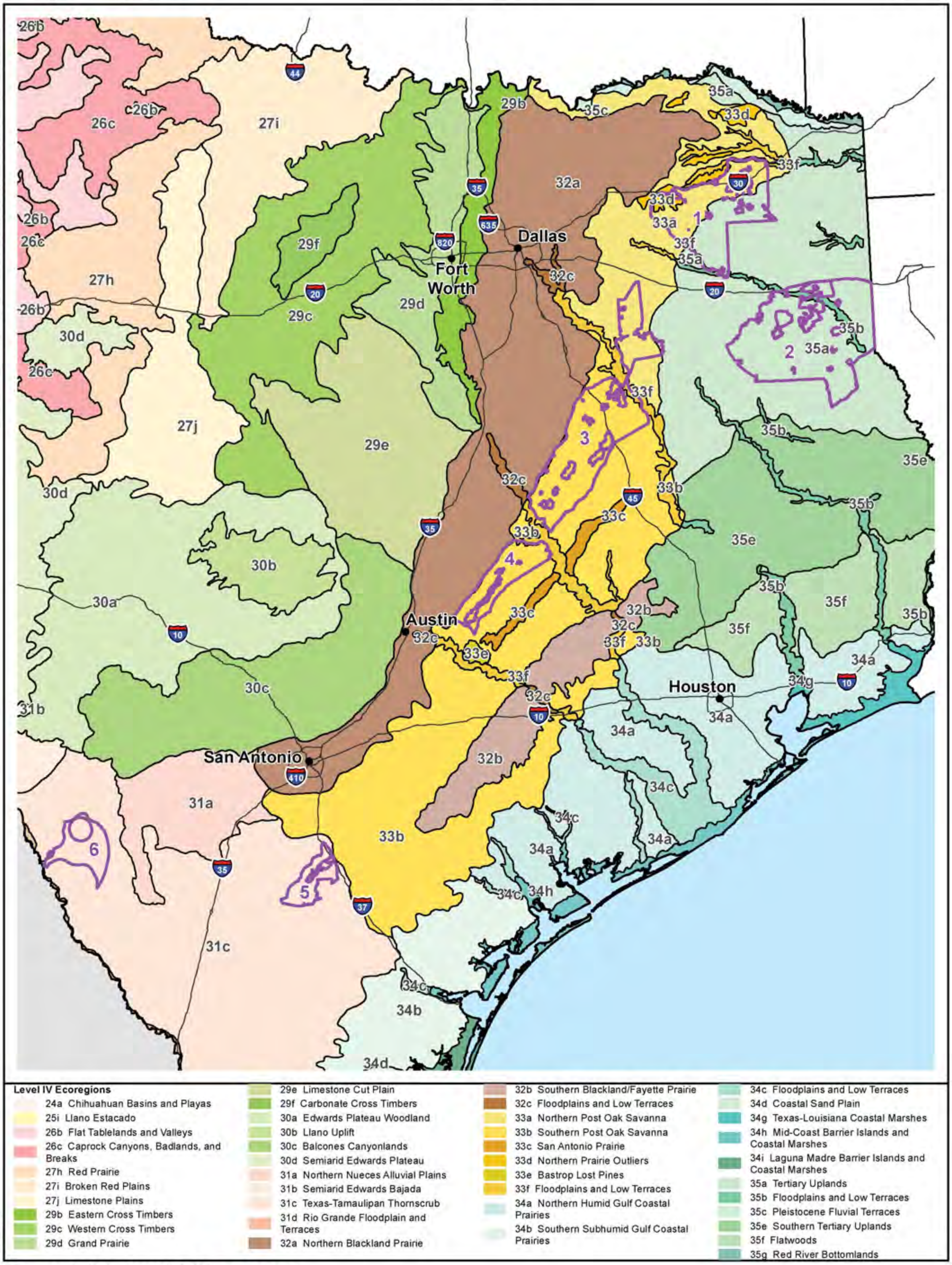





**Figure 3.4-1 Level IV Ecoregions**

**Table 3.4-1 Ecoregions for Study Areas 1 through 6**

| Ecoregion Level III | Southern Texas Plains (31) | | Texas Blackland Prairies (32) | East Central Texas Plains (33) | | | | South Central Plains (35) | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Ecoregion Level IV | Texas - Tamaulipan Thornscrub (31c) | Rio Grande Floodplain and Terraces (31d) | Northern Blackland Prairie (32a) | Northern Post Oak Savanna (33a) | Southern Post Oak Savanna (33b) | Northern Prairie Outliers (33d) | Floodplains and Low Terraces (33f) | Tertiary Uplands (35a) | Floodplains and Low Terraces (35b) | Total |
| Study Area | (acres) | | | | | | | | | |
| 1 | 0 | 0 | 0 | 432,858 | 0 | 49,699 | 8,472 | 410,453 | 11,014 | 912,496 |
| 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,373,253 | 75,997 | 1,449,251 |
| 3 | 0 | 0 | 12,647 | 250,917 | 921,730 | 0 | 25,339 | 8,512 | 0 | 1,219,144 |
| 4 | 0 | 0 | 7,233 | 0 | 350,476 | 0 | 7,639 | 0 | 0 | 365,348 |
| 5 | 180,841 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 180,841 |
| 6 | 252,303 | 23 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 252,326 |
| Total | 433,145 | 23 | 19,880 | 683,775 | 1,272,206 | 49,699 | 41,449 | 1,792,218 | 87,012 | 4,379,406 |

*Rio Grande Floodplain and Terraces (31d)*

The Rio Grande Floodplain and Terraces ecoregion is a narrow strip of vegetation along the Rio Grande River. Boundaries for the alluvial floodplain and low terraces were based on a combination of topographic, soils, and geology maps. The soils are composed of Holocene alluvium or Holocene and Pleistocene terrace deposits, with a mix of temporarily dry to predominantly dry soils and a mean annual soil temperature greater than 72 degrees Fahrenheit (°F).

Many of the wider alluvial areas of the floodplain and terraces are now in cropland, mostly with cotton, grain sorghum, and cool-season vegetables. Floodplain forests consisting of hackberry (*Celtis laevigata*), cedar elm (*Ulmus crassifolia*), and Mexican ash (*Fraxinus berlandieriana*) occur primarily in the lower portion of the ecoregion. Brushy species such as honey mesquite, huisache (*Acacia farnesiana*), blackbrush, and lotebush, and grasses such as multiflowered false rhodesgrass, sacaton (*Sporobolus wrightii*), cottontop (*Digitaria* spp.), and plains bristlegrass (*Setaria macrostachya*), occur along the margins of the ecoregion. Black willow (*Salix nigra*), black mimosa (*Mimosa pigra*), common reed (*Phragmites australis*), giant reed (*Arundo donax*), and various hydrophytes such as cattails (*Typha* spp.), bulrushes (*Schoenoplectus* spp.), and sedges (*Carex* spp.) occur in wetter areas near the river.

<u>Texas Blackland Prairies (32)</u>

The Texas Blackland Prairies ecoregion is a disjunct region separated from the surrounding regions by fine-textured, clayey soils and predominantly native prairie species. Dominant grasses included little bluestem (*Schizachyrium scoparium*), big bluestem (*Andropogon gerardii*), yellow indiangrass (*Sorghastrum nutans*), and switchgrass (*Panicum virgatum*). Currently, the area contains a higher percentage of cropland than the surrounding ecoregions, with large areas being converted to urban and industrial uses.

*Northern Blackland Prairie (32a)*

The Northern Blackland Prairie ecoregion generally coincides with a belt of upper Cretaceous chalks, marls, limestones, and shales. Boundaries of this ecoregion were determined based on soils, vegetation, land cover, and geology. This ecoregion was a vast expanse of tallgrass prairie vegetation that was maintained by fire. Soils formed on the Cretaceous deposits are mostly fine-textured, dark, calcareous, and productive. These soils are characterized by abundant smectitic (shrink/swell) clays with substantial soil movement.

The ecoregion is dominated by tallgrass prairie species such as little bluestem, big bluestem, yellow indiangrass, and tall dropseed (*Sporobolus compositus*). In lowlands and more mesic sites of higher precipitation to the northeast of the ecoregion, eastern gamagrass (*Tripsacum dactyloides*) and switchgrass occur.

<u>East Central Texas Plains (33)</u>

The East Central Texas Plains ecoregion is an area of irregular plains that originally were covered by post oak savanna vegetation composed mostly of post oak (*Quercus stellata*), blackjack oak (*Quercus marilandica*), eastern redcedar (*Juniperus virginiana*), and black hickory (*Carya texana*). It is different from the regions to the north, south, and west that are more open prairie-type ecoregions and to the east that have more pine forests. Soils are variable among the parallel ridges and valleys, but tend to be acidic, with sands and sandy loams on the upland areas and clay to clay loams in the lower areas. Many areas have a clay pan that affects water movement and moisture availability for plant growth. The majority of the ecoregion is used for pasture and range.

*Northern Post Oak Savanna (33a)*

The Northern Post Oak Savanna is generally more level and gently rolling compared to the Southern Post Oak Savanna ecoregion. Soils are wetter than in the Southern Post Oak Savanna ecoregion and are generally fine-textured loams. The average annual precipitation ranges from 40 to 48 inches. The deciduous forest/woodland vegetation is composed mostly of post oak, blackjack oak, eastern redcedar, and black hickory. The understory may include yaupon (*Ilex vomitoria*), farkleberry (*Vaccinium arboreum*), winged elm (*Ulmus alata*), and American beautyberry (*Callicarpa americana*). Prairie openings contain little bluestem and other grass and forb species. The transition along the eastern boundary to coniferous forests is subtle, with a gradual change from oaks and hardwoods to pines. Planted loblolly pines (*Pinus taeda*) have affected the natural transition to forests of the South Central Plains ecoregion.

*Southern Post Oak Savanna (33b)*

The Southern Post Oak Savanna ecoregion has more forest/woodlands than the adjacent prairie areas to the west and has more hardwoods compared to the pine forests of the South Central Plains ecoregion to the east. This ecoregion generally has more dissected and irregular topography than the Northern Post Oak Savanna ecoregion. Some clay to clay loams occur on lower areas, and a dense clay pan is usually underlying all soil types. Historically, this ecoregion was a post oak savanna. Current land cover is a mix of post oak woods, improved pasture, and rangeland, with some invasive mesquite to the south.

*Northern Prairie Outliers (33d)*

The Northern Prairie Outliers ecosystem are small, disjunct areas that have a blend of East Central Texas Plains, Texas Blackland Prairie, and East Texas Central Plains ecoregions. Vegetational influences from these ecoregions have allowed dense pine and hardwood forests to surround isolated patches of open blackland prairie. The tallgrass prairies included little bluestem, big bluestem, yellow indiangrass, and tall dropseed. Areas where precipitation is relative high may have a distinct grassland dominated by Silveanus dropseed (*Sporobolus silveanus*), longspike tridens (*Tridens strictus*), and Mead's sedge (*Carex meadii*) along with bluestems, yellow indiangrass, and other grasses. Current land cover of this ecoregion is mostly pasture, with some cropland.

*Floodplains and Low Terraces (33f)*

The Floodplains and Low Terraces ecoregion occurs on the wider floodplains of major streams. It primarily includes the Holocene deposits and part of the Pleistocene deposits on older, high terraces. Geology, soils, and physiography patterns were used to delineate these floodplain and terrace areas. The eastern bottomland forests are composed of water oak (*Quercus nigra*), post oak, elms (*Ulmus* spp.), green ash (*Fraxinus caroliniana*), pecan (*Carya illinoinensis*), and willow oak (*Quercus phellos*). The western bottomland forests have the same eastern bottomland forest species with some hackberry and eastern cottonwood (*Populus deltoides*). Understory vegetation includes grape vines (*Vitis* spp.), poison ivy (*Toxicodendron* spp.), dewberry (*Rubus* spp.), Virginia wildrye (*Elymus virginicus*), switchgrass, and other grass and forb species. Flowering dogwood (*Cornus florida*) occur in the understory of the northeastern section of the ecosystem. The diversity of the forest vegetation follows the east-west moisture gradient, with higher diversity in the wetter east side of the ecoregion. Land cover of the ecoregion is mostly forest/woodland in the northern areas, with the southern areas containing more cropland and pasture.

<u>South Central Plains (35)</u>

This ecoregion is the western edge of the southern coniferous forest belt consisting of mostly irregular plains. Historically it was a mixture of pine and hardwood forests; however, currently is mostly loblolly and shortleaf pine (*Pinus echinata*) plantations. Soils are mostly acidic sands and sandy loams. Approximately one sixth of this ecoregion is cropland, mainly along the Red River.

*Tertiary Uplands (35a)*

The Tertiary Uplands ecoregion is comprised of rolling uplands that are gently to moderately sloping with numerous small streams creating a diversity of habitats. Soils are mostly well-drained with sandy and loamy surface textures. The natural vegetation of the ecoregion has been altered by long-term timber harvest and commercial pine plantation activities. The native trees include loblolly pine, shortleaf pine, southern red oak (*Quercus falcata*), post oak, white oak (*Quercus alba*), and hickory (*Carya* spp.), with understory species of American beautyberry, sumac (*Rhus* spp.), greenbrier (*Smilax* spp.), and hawthorn (*Crataegus* spp.), yellow indiangrass, pinehill bluestem (*Schizachyrium scoparium* var. *divergens*), narrowleaf woodoats (*Chasmanthium sessiliflorum*), and panicums (*Panicum* spp.). Sandier areas may have more bluejack oak (*Quercus incana*), post oak, and stunted pines. Pine density is less in this ecoregion than in ecoregions to the south and east. This ecoregion transitions to the west following the east-west moisture gradient. It has more pasture, oak-pine, and oak-hickory forest compared to the other ecoregions in the South Central Plains.

*Floodplains and Low Terraces (35b)*

The Floodplains and Low Terraces ecoregion includes only the wider areas of floodplains and bottomland hardwoods where there is a distinct vegetation change into bottomland oak (*Quercus* spp.) and gum (*Nyssa* spp.) forest. A complex continuum of vegetation is created by the differences in topography, length of soil saturation, and soil characteristics within this ecoregion, as well as current and historic human impacts. Soils range from somewhat poorly drained to very poorly drained, clayey, and loamy. Wetness and flooding severely limit agricultural uses.

In general, the forested vegetation of this ecoregion is composed of water oak, willow oak, sweetgum (*Liquidambar styraciflua*), blackgum (*Nyssa sylvatica*), elm, red maple (*Acer rubrum*), southern red oak, swamp chestnut oak (*Quercus michauxii*), and loblolly pine. Associated with the forest are holly (*Ilex* spp.) and various vines such as grape, poison ivy, crossvine (*Bignonia capreolata*), and greenbrier (*Smilax* spp.). A variety of ferns and mosses also are present.

Bald cypress (*Taxodium distichum*) and water tupelo (*Nyssa aquatica*) are found in semi-permanently flooded areas, especially in sloughs, channels, and oxbows; Spanish moss (*Tillandsia usneoides*) hangs in these trees. Floating aquatic plants often occur in semi-permanent to permanent flooded areas. Species on the seasonally flooded wet flats, back swamps, and swamp margins include overcup oak (*Quercus lyrata*), water hickory (*Carya aquatica*), water elm (*Planera aquatica*), sweetgum, green ash (*Fraxinus pennsylvanica*), and red maple. River banks may contain black willow, sycamore (*Platanus occidentalis*), and eastern cottonwood.

### 3.4.1.2 Vegetation Mapping

TPWD has developed a land cover classification and mapping for Texas called the Ecological Systems Classification of Texas Project (ESCTP) (TPWD 2012a,b,c,d); more detail on the ESCTP is provided by TPWD and Texas Natural Resources Information System (2009). The ESCTP identifies plant community quality and distribution to be used for county-level planning. ESCTP mapping has been completed in the areas encompassed by the six study areas for this REIS. To facilitate characterization of the vegetation in the study areas and the surrounding regions, mapping developed by Texas Department of Transportation (TxDOT), which aggregates the 420 detailed vegetation groups developed for the ESCTP into 13 broader vegetation classes for regional planning purposes, was used. One additional class that includes ROWs also was identified within each study area. The acreage of each TxDOT vegetation class within each study area is presented in **Table 3.4-2**. Brief descriptions of each of the TxDOT vegetative classes (based on the TPWD vegetation class descriptions) are presented below.

**Table 3.4-2 Summary of Vegetation Classes by Study Area**

| Vegetation Class[1] | Study Areas (acres) | | | | | |
|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 |
| Agriculture | 30,045 | 89,263 | 46,566 | 6,095 | 2,003 | 3,329 |
| Coastal Barrens and Glades | 0 | 140 | 0 | 0 | 0 | 0 |
| Disturbed Prairie | 130,304 | 334,678 | 20,337 | 19,100 | 33,385 | 32,542 |
| Edwards Plateau Savannah, Woodland, and Shrubland | 0 | 0 | 0 | 67 | 0 | 0 |
| Floodplain | 0 | 0 | 138,747 | 30,829 | 15,626 | 10,767 |
| Mixed Woodlands and Forest | 205,011 | 746,004 | 6,987 | 0 | 0 | 0 |
| Post Oak Savanna | 368,759 | 0 | 929,070 | 290,123 | 1,454 | 0 |
| Riparian | 158,286 | 253,339 | 44,132 | 10,642 | 5,646 | 16,444 |
| ROWs | 11,881 | 15,863 | 11,967 | 2,120 | 0 | 770 |
| Scrub, Thornscrub, Shrubland | 0 | 0 | 0 | 0 | 85,640 | 160,735 |
| Seep and Bog | 37 | 95 | 1 | 0 | 0 | 0 |
| Tallgrass Prairie, Grassland | 2,577 | 0 | 12,649 | 3,543 | 34,544 | 26,146 |
| Urban | 5,090 | 7,750 | 8,688 | 2,829 | 2,543 | 1,594 |
| Wet Savanna, Swamp, Baygall | 505 | 2,118 | 0 | 0 | 0 | 0 |
| **Total Acreage** | **912,496** | **1,449,251** | **1,219,144** | **365,348** | **180,841** | **252,326** |

[1] Based on TxDOT vegetation classes plus ROWs.

Agriculture

The Agriculture class includes all cropland where fields are fallow for some portion of the year, areas of dominated by Bermuda grass (*Cynodon dactylon*) (e.g., golf courses and greens), and grass farms. Grass farms include areas of fast-growing grasses and managed hay meadows. Some fields that rotate into and out of cultivation frequently, or have year-round cover crops, were generally mapped as grassland. This classification also includes pine plantations (mostly loblolly pine) and barren areas. Barren areas are locations that had little or no vegetation cover at the time of image data collection and include areas cleared for development, heavily grazed pastures where bare soil is dominant, stream beds with exposed gravel or bedrock, rock outcrops, quarries, mines, and year-round fallow fields.

Coastal Barrens and Glades

Of the Coastal Barrens and Glades class, only one vegetation component (TPWD's Weches herbaceous glades) occur in the analysis area. Weches herbaceous glades occur on relatively shallow to deep soils. Common grass species include Bermuda grass, threeawns (*Aristida* spp.), hairy grama (*Bouteloua hirsuta*), Texas grama, little bluestem, and broomsedge bluestem (*Andropogon virginicus*). Shrubs and scattered trees such as eastern redbud (*Cercis canadensis*), gum bumelia (*Sideroxylon lanuginosum*), roughleaf dogwood (*Cornus drummondii*), eastern redcedar, post oak, and loblolly pine may be present. The shallowest soils may be dominated by species such as poverty dropseed (*Sporobolus vaginiflorus*), Texas sedum (*Lenophyllum texanum*), and Ozark savory (*Clinopodium arkansanum*).

Disturbed Prairie

The Disturbed Prairie class is composed of a variety of heavily grazed grasslands, including managed exotic vegetation pastures; areas of disturbed soils; and areas dominated by invasive species. Common dominant grass species in heavily grazed areas include Bermuda grass, Kleberg bluestem (*Dichanthium annulatum*), Johnson grass (*Sorghum halepense*), King Ranch bluestem (*Bothriochloa ischaemum* var. *songarica*), buffelgrass (*Pennisetum ciliare*), kleingrass (*Panicum coloratum*), broomsedge bluestem, threeawns, and guineagrass (*Urochloa maxima*). Important native grasses such as little bluestem, silver bluestem (*Bothriochloa laguroides* ssp. *torreyana*), yellow indiangrass, Texas wintergrass (*Nassella leucotricha*), hairy grama, and broomsedge bluestem also may be present. Non-native grasses including Bahia grass (*Paspalum notatum*), perennial ryegrass (*Lolium perenne*), tall fescue (*Schedonorus arundinaceus*), and/or rescuegrass (*Bromus catharticus*) also may occur.

The invasive species of shrubs and small trees vary from the wetter to drier locations and encroach into the heavily grazed grasslands. For example, honey mesquite, huisache, lotebush, and granjeno are common components in the drier areas. Plateau live oak (*Quercus fusiformis*), post oak, eastern redcedar, honey mesquite, huisache, yaupon, and winged elm also may be present in wetter areas. A variety of deciduous species also may be present, including cedar elm, winged elm, hackberry, sweetgum, water oak, and honey mesquite. In the southeast, loblolly pine is often the dominant tree. Common herbaceous flowering plants also may occur, including broomweed (*Amphiachyris dracunculoides*), western ragweed (*Ambrosia psilostachya*), and hog croton (*Croton capitatus*).

Edwards Plateau Savannah, Woodland, and Shrubland

The Edwards Platuea Savannah, Woodland, and Shrubland class is a mixture of small forested areas or mottes and open herbaceous areas. Live Oak motte areas are dominated by plateau live oak, with other overstory trees such as white shin oak (*Quercus sinuata* var. *breviloba*), cedar elm, Texas oak (*Quercus buckleyi*), hackberry (*Celtis* spp.), Lacey oak (*Quercus laceyi*), post oak, and Vasey shin oak (*Quercus vaseyana*) present. In the more hardwood motte areas, Texas oak and cedar elm are the dominant species. White shin oak, hackberry, mesquite, and post oak also may occur in the overstory. Post oak and shin oak dominate some of the motte areas.

Open herbaceous areas are dominated by little bluestem, grama (*Bouteloua* spp.), Texas wintergrass, threeawns, King Ranch bluestem, and cedar sedge (*Carex planostachys*).

Floodplain

The Floodplain class is a combination of forested, shrub, and herbaceous areas that occupy relatively broad flat areas at low topographic position. Dominate evergreen and hardwood trees in forested areas include bald cypress, pecan, white ash (*Fraxinus americana*), water oak, cedar elm, hackberry, American elm (*Ulmus americana*), plateau oak, coastal live oak (*Quercus virginiana*), American sycamore, boxelder (*Acer negundo*), bur oak (*Quercus macrocarpa*), red mulberry (*Morus rubra*), green ash, and western soapberry (*Sapindus saponaria* var. *drummondii*). Vines such as Alabama supplejack (*Berchemia scandens*), common trumpet creeper (*Campsis radicans*), grapes, Virginia creeper (*Parthenocissus quinquefolia*), and peppervine (*Ampelopsis arborea*) may be conspicuous. Understory species include roughleaf dogwood, rusty blackhaw (*Viburnum rufidulum*), and yaupon. In shrub areas, dominate species include possumhaw (*Ilex decidua*), mesquite, black willow, roughleaf dogwood, and/or common buttonbush (*Cephalanthus occidentalis*). The herbaceous areas are generally dominated by Bermuda grass, Johnson grass, eastern gamagrass, switchgrass, Virginia wildrye, frostweed (*Verbesina virginica*), inland sea-oats (*Chasmanthium latifolium*), narrowleaf woodoats, eastern gamagrass, Drummond's aster (*Symphyotrichum drummondii* var. *texanum*), white avens (*Geum canadense*), Canada snakeroot (*Sanicula canadensis*), bedstraw (*Galium* spp.), and caric sedge.

Mixed Woodlands and Forest

The Mixed Woodlands and Forest class occurs over a wide variety of landforms, with drier expressions occurring on hilltops and ridges. It occupies slopes and lower landscape positions where conditions are more mesic, with species composition varying across these gradients. The dominate pine species include loblolly pine and shortleaf pine, with longleaf pine (*Pinus palustris*) dominate in some locations. Currently, 75 percent or more of the canopy of some areas may be dominated by pines.

Typical deciduous hardwoods in this class include sweetgum, black hickory, post oak, southern red oak, white oak, water oak, winged elm, cedar elm, and blackgum. In some locations, 75 percent or more of the canopy cover is composed of hardwoods. Common shrub species are yaupon, American beautyberry, wax-myrtle, farkleberry, and flowering dogwood.

Woody vines in this class include saw greenbrier (*Smilax bona-nox*), grape, Virginia creeper, and poison ivy. Species in the sparse herbaceous layer (often less than 20 percent cover) include little bluestem, slender woodoats (*Chasmanthium laxum*), narrowleaf woodoats, and brackenfern (*Pteridium aquilinum*). In the western drier areas, additional herbaceous species include big bluestem, Texas wintergrass, pineywoods dropseed (*Sporobolus junceus*), brownseed paspalum (*Paspalum plicatulum*), fringeleaf paspalum (*Paspalum setaceum*), threeawns, rough dropseed (*Sporobolus clandestinus*), fall witchgrass (*Digitaria cognata*), Scribner's panicgrass (*Dichanthelium oligosanthes* var. *scribnerianum*), and Heller's rosette grass (*Dichanthelium oligosanthes*).

Post Oak Savanna

The Post Oak Savanna class represents a transition from forest/woodlands of east Texas to the prairies in west Texas, and specifically the Blackland Prairie. Fire suppression and overgrazing have resulted in increased woody species and invasion of eastern redcedar in the north and honey mesquite in the south. Dominant overstory species include post oak, blackjack oak, and black hickory. Other overstory species include bluejack oak (on drier sites), plateau live oak, winged elm, cedar elm, eastern redcedar, and honey mesquite. In the wetter eastern areas, southern red oak, water oak, sweetgum, shortleaf pine, loblolly pine, and mockernut hickory (*Carya alba*) may be co-dominant.

The understory in this class may have substantial cover, with species of yaupon, American beautyberry, gum bumelia, hawthorn, possumhaw, poison ivy, eastern redcedar, and coral-berry (*Symphoricarpos orbiculatus*). In the wetter eastern areas, farkleberry, wax-myrtle (*Morella cerifera*), common persimmon (*Diospyros virginiana*), and flowering dogwood may be common in the understory.

In the more open prairie patches, herbaceous cover is typically little bluestem, yellow Indiangrass, switchgrass and caric sedges, big bluestem, silver bluestem, brownseed paspalum (to the south), rosette grasses (*Dichanthelium* spp.), threeawns, Texas wintergrass, and sand dropseed (*Sporobolus cryptandrus*). Non-native grass species such as King Ranch bluestem, Bahia grass, and Bermuda grass may dominate these more open areas.

Riparian

The Riparian class can be divided into two groups: the wetter Central and Pineywoods riparian and the drier South Texas Ramadero and Pond/Laguna areas. Also included in this class are marsh areas and open water (mainly reservoirs) that occur mostly in east and central Texas.

*Central and Pineywoods Riparian*

The Central and Pinewoods riparian subclass includes broad floodplains with substantial development of bottomland soils, and includes natural levees, point bars, meander scrolls, oxbows, terraces, and sloughs. The hydrology of these areas is variable from semi-permanently flooded to mostly dry.

Tree species in wetter areas include bald cypress, water tupelo, water honeylocust (*Gleditsia aquatica*), and water hickory. Common duckweed (*Lemna minor*), pondweeds (*Potamogeton* spp.), coontail (*Ceratophyllum demersum*), and American waterlily (*Nymphaea odorata*) also may occur in the wetter areas. In the seasonally flooded areas, overcup oak, bald cypress, willow oak, green ash, sweetgum, swamp tupelo (*Nyssa biflora*), Carolina ash, and bottomland post oak (*Quercus similis*) are typical dominant canopy species. In the drier temporarily flooded areas, sweetgum, water oak, green ash, laurel oak (*Quercus laurifolia*), swamp chestnut oak, cherrybark oak (*Quercus pagoda*), hackberry, red maple, cedar elm, American elm, white ash, plateau oak, coastal live oak, western soapberry, and pecan can be dominant. Loblolly pine has been planted in some areas and may be found on some better drained sites. Chinese tallow (*Triadica sebifera*) is invasive species within this subclass.

Woody understory species in this subclass include smooth alder (*Alnus serrulata*), giant cane (*Arundinaria gigantea*), American hornbeam (*Carpinus caroliniana*), possumhaw, American holly (*Ilex opaca*), yaupon, American beautyberry, green hawthorn (*Crataegus viridis*), parsley hawthorn (*Crataegus marshallii*), riverflat hawthorn (*Crataegus opaca*), American snowbell (*Styrax americanus*), sebastian-bush (*Ditrysinia fruticosa*), common elderberry (*Sambucus nigra* ssp. *canadensis*), common buttonbush, swamp privet (*Forestiera acuminata*), water elm, and/or dwarf palmetto (*Sabal minor*).

Herbaceous understory species may include false nettle (*Boehmeria cylindrica*), lizard's tail (*Saururus cernuus*), narrow plumegrass (*Saccharum baldwinii*), Virginia wildrye, sensitive fern (*Onoclea sensibilis*), Cherokee sedge (*Carex cherokeensis*), bladder sedge (*Carex intumescens*), cypress swamp sedge (*Carex joorii*), sedges (*Carex* spp.), inland sea-oats, narrowleaf woodoats, looseflower water-willow (*Justicia ovata*), eastern gamagrass, Drummond's aster, white avens, Canada snakeroot, bearded beggarticks (*Bidens aristosa*), maidencane (*Panicum hemitomon*), Virginia cutgrass (*Leersia virginica*), switchgrass, and bedstraw.

*South Texas Ramadero and Pond/Laguna Riparian*

The South Texas Ramadero and Pond/Laguna riparian subclass is associated with ephemeral drainages and depressions. These areas are associated with sandy clay loam, clay loam, and clay soils that hinder drainage.

Dominate tree species along drainages include honey mesquite, huisache, granjeno, and retama (*Parkinsonia aculeata*). Common shrub species include whitebrush (*Aloysia gratissima*), snake-eyes (*Phaulothamnus spinescens*), granjeno, brasil, desert olive (*Forestiera angustifolia*), Texas persimmon, lotebush, allthorn (*Koeberlinia spinosa*), Barbados cherry (*Malpighia glabra*), colima, Lindheimer pricklypear (*Opuntia engelmannii* var. *lindheimeri*), guayacan (*Guaiacum angustifolium*), Texas hogplum (*Colubrina texensis*), and Texas torchwood (*Amyris texana*).

Herbaceous species include old man's beard (*Clematis drummondii*), cucumberweed (*Parietaria pensylvanica*), tropical sage (*Salvia coccinea*), straggler daisy (*Calyptocarpus vialis*), pigeonberry (*Rivina humilis*), Rio Grande false-mallow (*Malvastrum americanum*), wild petunia (*Ruellia* spp.), and southern frostweed (*Verbesina microptera*), multiflowered false Rhodes grass, cane bluestem, sideoats grama, southwestern bristlegrass (*Setaria scheelei*), plains bristlegrass, streambed bristlegrass (*Setaria leucopila*), hooded windmill grass (*Chloris cucullata*), Arizona cottontop (*Digitaria californica*), pink pappusgrass, red grama, and curlymesquite. In some locations, introduced grasses (buffelgrass [*Bouteloua dactyloides*], guineagrass, and Bermuda grass) dominate the herbaceous layer.

Dominate tree species in depression areas typically are the same species as along the drainages in this subclass. Where soils are saturated, rattlebox sesbania (*Sesbania drummondii*) is typically found. Typical herbaceous species include guineagrass, spiny aster (*Chloracantha spinosa*), old man's beard, Cuban germander (*Teucrium cubense*), Bermuda grass, sedge species (*Eleocharis* spp. and *Cyperus* spp.), and annual bulrush (*Schoenoplectus saximontana*).

ROW

The ROW class includes estimated TxDOT road and highway ROWs. Typical dominate species include non-native grass species (e.g., King Ranch bluestem, Bahia grass, and Bermuda grass) that are routinely mowed. TxDOT has conducted seeding with native grass species (e.g., Virginia wildrye) and has a wildflower seeding program specific to each vegetation region (TxDOT 2014a).

Scrub, Thornscrub, Shrubland

The Scrub, Thornscrub, Shrubland class typically occupies xeric, rocky uplands on calcareous substrates (i.e., limestone, caliche, calcareous gravels, and calcareous sandstone) of south Texas. Soils are usually thin, and sites are most frequently dominated by shrubs.

A diversity of shrub species typically is present, with dominate species including cenizo, guajillo, and blackbrush. In some areas, a sparse overstory of species such as Texas ebony, anacahuita, and bareta (*Helietta parvifolia*) also may occur. The herbaceous layer of many sites is now dominated by non-native grasses, particularly King Ranch bluestem and buffelgrass. Other grasses species such as Texas grama, hairy grama, buffalograss, curlymesquite, purple threeawn (*Aristida purpurea*), sideoats grama, and steambed bristlegrass often are present, as are forbs ad subshrubs.

Seep and Bog

Seep and Bog class is found on slopes, as well as on valley floors and toe slopes where seepage from upslope occurs through deep sands. These small areas generally are dominated by herbaceous species with occasional a wax myrtle shrub layer. A diversity of forbs is typically present, such as simpleleaf eryngo (*Eryngium integrifolium*), common boneset (*Eupatorium perfoliatum*), waterspider false reinorchid (*Habenaria repens*), dwarf St. John's-wort (*Hypericum mutilum*), bushy seedbox (*Ludwigia alternifolia*), clubmoss (*Lycopodiella* spp.), cinnamon fern (*Osmunda cinnamomea*), royal fern (*Osmunda regalis*), rose pogonia (*Pogonia ophioglossoides*), drumheads (*Polygala cruciata*), Maryland meadowbeauty (*Rhexia mariana*), pitcher-plant (*Sarracenia alata*), bushy aster (*Symphyotrichum dumosum* var. *dumosum*), chainfern (*Woodwardia* spp.), and yellow-eyed grasses (*Xyris* spp.). Grass species may include bushy bluestem (*Andropogon glomeratus*), velvet panicum (*Dichanthelium scoparium*), beaked panicum (*Panicum anceps*), pimple panicgrass (*Panicum brachyanthum*), switchgrass, smooth paspalum (*Paspalum laeve*), sugarcane plumegrass (*Saccharum giganteum*), and gaping panicum (*Steinchisma hians*). Sedges and rushes may include false nutgrass (*Cyperus strigosus*), needle spikesedge (*Eleocharis acicularis*), hairy umbrellasedge (*Fuirena squarrosa*), forked rush (*Juncus dichotomus*), slimpod rush (*Juncus diffusissimus*), common rush (*Juncus effusus*), and beakrushes (*Rhynchospora* spp.).

Tallgrass Prairie, Grassland

The Tallgass Prairie, Grassland class is found on gently rolling to nearly level sites with clayey to sandy soils. In areas with clayey soils, the overstory may be sparse with a scattering of trees and shrubs. The sandier sites are more open and primarily are dominated by grasses, rushes, and sedges.

Dominated woody species include Colima, brasil, Berlandier wolfberry, granjeno, Lindheimer pricklypear, Texas persimmon, Texas hogplum, tasajillo, and huisache. The herbaceous layer is typically dominated by grasses, rushes, and sedges and may be dense. Grasses, such as little bluestem, seacoast bluestem (*Schizachyrium littorale*), hooded windmill grass, gulfdune paspalum (*Paspalum monostachyum*), brownseed paspalum, Pan American balsamscale (*Elionurus tripsacoides*), Texas grama, fringed signalgrass (*Urochloa ciliatissima*), tanglehead (*Heteropogon contortus*), red lovegrass (*Eragrostis secundiflora*), silver bluestem, multiflowered false Rhodes grass, threeawns, sand dropseed, and. rosette grasses, commonly dominate or co-dominate the herbaceous layer. Forbs also are common, including species such as Indian blanket, heartsepal wildbuckwheat (*Eriogonum multiflorum*), croton (*Croton* spp.), Texas bull-nettle (*Cnidoscolus texanus*), lazy daisy (*Aphanostephus skirrhobasis*), blackeyed Susan, cowpen daisy (*Verbesina encelioides*), old man's beard, bearded shallow-wort (*Cynanchum barbigerum*), parralena, hairy tubetongue (*Justicia pilosella*), fiddleleaf nama (*Nama jamaicense*), spotted beebalm (*Monarda punctata*), Texas palafoxia (*Palafoxia texana*), white palafoxia (*Florestina tripteris*), bracted zornia (*Zornia bracteata*), scratch-daisy (*Croptilon divaricatum*), American snoutbean (*Rhynchosia americana*), and hairy zexmania (*Wedelia texana*).

Urban

The Urban class includes most area within cities and towns. As such, much of the area is dominated by impervious cover.

Wet Savanna, Swamp, Baygall

The Wet Savanna, Swamp, Baygall class that is located in the lowest topographic position within the level to gently undulating flatwoods terraces. Hydrology is driven by rainfall rather than overbank flooding. Soils are fine-textured, with an impermeable subsurface horizon leading to a perched water table and extended periods of saturated soils. Dominate overstory species include willow oak, laurel oak, overcup oak, water oak, and swamp chestnut oak, with winged elm, and sweetgum. Chinese tallow is a commonly encountered as an invasive non-native species. The understory and herbaceous layers are not well developed, as the canopy tends to be closed.

Where the canopy is more open or open, the following species are typical:  maidencane, caric sedges, beaksedges, spikerushes (*Eleocharis* spp.), bushy bluestem, and water-primroses (*Ludwigia* spp.). Some sites may be dominated by the non-native Bermuda grass. Some woody species occur in the herbaceous dominant areas such as swamp tupelo, sweetgum, water oak, water elm, and common buttonbush.

### 3.4.1.3 Special Status Plant Species

Special status species are those species that are listed as federally threatened or endangered, or have been proposed or are considered as candidates for such listing by the USFWS, as well as those species that are state-listed as threatened or endangered by the TPWD and Louisiana Department of Wildlife and Fisheries (LDWF). Federally listed and proposed species and federally designated critical habitat receive protection under the ESA. State-listed species are protected by laws and regulations contained in Chapters 67 and 68 of the Texas Parks and Wildlife Code, Sections 65.171-65.184 of Title 31 of the TAC, and Title 56 of the Louisiana Revised Statutes.

Six federally listed species with the potential to occur in the analysis area have been identified; five of these species also are state listed. Five are Texas endemic species found only in Texas. Earth fruit also is found in Missouri, Arkansas, and Louisiana (USFWS 2009). The six species, their associated habitats, and their occurrence potential within the study areas are presented in **Table 3.4-3**. No special status species with the potential to occur in Study Areas 1 or 5 have been identified.

**Table 3.4-3 Special Status Plant Species**

| Study Area[1] | Ecoregion | County | Common Name | Scientific Name | Habitat[2] | ESA Status[3] | State Status[3] |
|---|---|---|---|---|---|---|---|
| 2 | South Central Plains | Cherokee and Harrison | Neches River rose-mallow | *Hibiscus dasycalyx* | Texas endemic that inhabits open marshy habitats in seasonally wet alluvial soils, most often near standing rather than flowing water. Flowering period is June-August. | T | -- |
| 2 and 3 | East Central Texas Plains | Anderson, Harrison, and Panola | Earth fruit (Tinytim) | *Geocarpon minimum* | In Texas, the species is found on vegetated edges of slick spots in saline barren soils just above the floodplain of the Nueces River. Occurs on soils with claypan that hold late winter rains, drying quickly to hardened cement. Topographic association includes pimple mounds with micro highs/lows. Elsewhere, it occurs in open, sparingly vegetated glades on shallow soils over sandstone outcrops; sometimes in shallow depressions within such areas and saline prairies where soils are very thin and high in magnesium or sodium; mostly found on the cryptogamic lip along slick spot perimeter. The flowering period is late February-March. | T | T |
| 3 | East Central Texas Plains | Leon, Robertson, and Freestone | Large-fruited sand-verbena | *Abronia macrocarpa* | Texas endemic that is restricted to sparse herbaceous vegetation in deep, somewhat excessively drained sands in openings in Post oak woodlands, sometimes in active blowouts. All known occurrence sites are underlain by sandy Eocene strata. Flowering period is late February-May (-June; also in the fall following periods of high rainfall). | E | E |
| 3 and 4 | East Central Texas Plains and Texas Blackland Prairies, East Central Texas Plains | Bastrop, Brazos (CESA), Burleson, Freestone, Leon, Limestone, Milam, and Robertson | Navasota ladies'-tresses | *Spiranthes parksii* | Texas endemic that occurs in openings in post oak woodlands in sandy loams along upland drainages or intermittent streams, often in areas with suitable hydrologic factors, such as a perched water table associated with the underlying claypan. Flowering populations fluctuate widely from year to year, an individual plant does not flower every year; flowering late October-early November (-early December). | E | E |

**Table 3.4-3 Special Status Plant Species**

| Study Area[1] | Ecoregion | County | Common Name | Scientific Name | Habitat[2] | ESA Status[3] | State Status[3] |
|---|---|---|---|---|---|---|---|
| 6 | Southern Texas Plains | Kinney | Tobusch fishhook cactus | *Sclerocactus brevihamatus* ssp *tobuschii* | Texas endemic that occurs in shallow, moderately alkaline, stony clay and clay loams over massive fractured limestone; Usually occupies level to slightly sloping hilltops; occasionally on relatively level areas on steeper slopes, and in rocky floodplains. Usually found in open areas within a mosaic of oak-juniper woodlands, occasionally in pine-oak woodlands, rarely in cenizo shrublands or little bluestem grasslands. Flowering period (late January-) February-March (rarely early April) | E | E |
| 6 | Southern Texas Plains | Kinney | Texas snowbells | *Styrax platanifolius ssp texanus* | Texas endemic; limestone bluffs, boulder slopes, cliff faces, and gravelly streambeds, usually along perennial streams or intermittent drainages in canyon bottoms, in full sun or in partial shade of cliffs and/or Sycamore-Little walnut woodlands, oak-juniper woodlands, or mixed oak shrublands; flowering late March-April | E | E |

[1] Based on USFWS Information, Planning, and Conservation, TPWD, and LDWF county list searches.

[2] Based on habitat descriptions from TPWD (2014a) county lists.

[3] T – Threatened; E – Endangered.

Neches River Rose-mallow

Neches River rose mallow was listed as threatened by the USFWS on October 11, 2013 (*Federal Register* 2013b), with critical habitat listed for nine locations in Texas within Cherokee, Harrison, Houston, Nacogdoches, and Trinity counties. Only one critical habitat location (Unit 2) is within the analysis area; it is located outside of Study Area 2 but within the associated CESA. Neches River rose mallow has white flowers and is threatened by interspecific hybridization with encroachment of other hibiscus species (*H. laevis* and *H. moscheutos*), as well as loss of preferred wetland habitat along the Neches River and tributaries (Poole et al. 2007). In addition to known occurrences in Cherokee and Harrison counties, the species has been observed in Houston, Nacogdoches, and Trinity counties.

Earth Fruit

Earth fruit (also called tinytim) was listed as threatened by USFWS on June 16, 1987 (*Federal Register* 1987) and state listed as threatened on April 4, 2005. No critical habitat has been designated for this species. Earth fruit is a small annual, ranging from 0.4 to 1.6 inches in height. Earth fruit stands out from other microflora in its habitat by its succulent appearance and pinkish to purplish color (Poole et al. 2007). In Missouri, earth fruit occur in open glades on shallow soils over sandstone outcrops that are sparingly vegetated. In Arkansas and Louisiana it has been found in sparingly vegetated areas (slick spots) on saline prairies.

Large-fruited Sand-verbena

Large-fruited sand-verbena was listed as endangered by USFWS on September 28, 1988 (*Federal Register* 1988) and state listed as endangered December 30, 1988. No critical habitat has been designated for this species. Large-fruited sand-verbena is an herbaceous perennial with stems up to 20 inches in height, magenta flowers, and thick textured leaves. There are five known locations within Study Area 3 (USFWS 2007). Large-fruited sand-verbena has only been observed in Leon, Robertson, and Freestone counties (Poole et al. 2007).

Navasota Ladies'-tresses

Navasota ladies'-tresses was listed as endangered by USFWS on May 6, 1982 (*Federal Register* 1982) and state listed as endangered on April 29, 1983. No critical habitat has been designated for this species. Navasota ladies'-tresses is a perennial that has unbranched stems 6 to 12 inches tall and creamy white flowers in late October to early December. Navasota ladies’-tresses is endemic to the Post Oak Belt of eastern Central Texas, which includes the counties listed in **Table 3.4-3**. This species also has been observed in Fayette, Grimes, Jasper, Madison, and Washington counties of Texas (Poole et al. 2007).

Tobusch Fishhook Cactus

Tobusch fishhook cactus was listed as endangered by USFWS on December 8, 1979 (*Federal Register* 1979) and state listed as endangered on April 29, 1983. No critical habitat has been designated for Tobusch fishhook cactus. Tobusch fishhook cactus is a perennial stemed succulent that is 1 to 6 inches in tall and 0.4 to 6 inches wide (Poole et al. 2007). Flowers are bright yellow or greenish. USFWS has recommended that this species be down listed to threatened based on reduced threat and increased distribution and abundance (*Federal Register* 2013a). The Tobusch fishhook cactus is found in the Edwards Plateau region of Texas, which includes parts of Kinney County. This species also has been observed in Bandera, Edwards, Kerr, Kimble, Real, Ulvalde, and Val Verde counties of Texas (Poole et al. 2007).

Texas Snowbells

Texas snowbells was federally listed as endangered by USFWS on October 12, 1984 (*Federal Register* 1984) and state listed as endangered on January 23, 1987. No critical habitat has been designated for the species. Texas snowbells is a slender, spreading, deciduous shrub that is 3 to 20 feet in height (Poole et al. 2007). Texas snowbells is endemic to the Edwards Plateau region of Texas, where in addition to Kinney County is has been observed in Edwards, Real, and Val Verde counties. The species has been introduced in Uvalde County, Texas (Poole et al. 2007).

### 3.4.2 Environmental Consequences

#### 3.4.2.1 Proposed Action

The direct and indirect impacts associated with the development of future surface coal or lignite mine expansion areas or satellite mines in Study Areas 1 through 6 are discussed below.

General Vegetation

Short-term (limited to the life of a typical mine and reclamation) and long-term (extending beyond the life of a typical mine and reclamation) impacts to vegetation would occur as a result of mine construction and operation. Short-term impacts would result from the removal of vegetation within a mine area, transportation and utility corridors, and ancillary facilities. Mine disturbance areas would be reclaimed to achieve post-mining land uses as required by RCT and per landowner agreements, as discussed in Section 2.2.4.3, Typical Closure and Reclamation. Riparian and wetland vegetation would be reclaimed in accordance with the mine-specific detailed compensatory mitigation plans and Section 404 permit requirements. Wetland compensatory mitigation would result in a conversion of upland vegetation to wetland vegetation in some locations.

It is assumed that with the implementation of a site-specific reclamation plan, herbaceous species would recover to pre-existing conditions within 1 to 5 years following reseeding. Impacts to woody species would be long-term, because it would take approximately 5 to 15 years for shrub species and up to 20 years for tree species to become established and grow to a similar size as those removed during construction and operations. Because reclamation of mine pits would proceed concurrently with mining operations as pits are backfilled, the total extent of pit-related surface disturbance at any given point in time for a typical mine would range from 250 to 650 acres (see Section 2.2.4.2). Ancillary facility areas would be reclaimed following the completion of mining, resulting in long-term impacts to both herbaceous and woody species in these areas. Some haul roads and transportation corridors would be reclaimed following the completion of mining, resulting in the re-establishment of vegetation after long-term use. However, those roads that would be retained for post-mine monitoring and management purposes, or where retained and modified for public access (based on prior authorizations and agreements), would result in permanent impacts to vegetation.

Up to 158,600 acres of vegetation, or approximately 3.6 percent of the 4,379,400 acres within all study areas, is projected to be directly affected by future surface coal or lignite mine expansion areas or satellite mines. The estimated percentage of each study area that would be disturbed is identified in **Table 2-3**, and ranges from 1.5 percent for Study Area 1 to 9.9 percent for Study Area 6. Vegetation removal would continue to occur incrementally throughout the life of a mine as mine pits and haul roads, utility corridors, and erosion and surface water control facilities are relocated. It is possible that the types of vegetation affected by mining-related surface disturbance generally would occur in similar proportions to the vegetation classes listed for each study area in **Table 3.4-2**, with the possible exception of urban areas and ROWs.

Indirect effects to vegetation from future mining-related surface disturbance would include: 1) increased potential for the spread and establishment of noxious weeds or invasive plant species; 2) economic impacts to commercially harvestable trees and herbaceous vegetation (where present), which provide timber, hay production, and forage for livestock grazing; and 3) increased soil erosion in disturbance areas and associated and off site sedimentation. The establishment of noxious weeds or invasive plant species would be minimized to the extent possible through prompt revegetation and pesticide use (as discussed in Section 2.2.4.3, Typical Closure and Reclamation) and the maintenance of disturbed areas in compliance with RCT reclamation standards and USACE Fort Worth District compensatory mitigation standards. BMPs would be implemented during all phases of mining/reclamation to minimize impacts to vegetation, including measures to control erosion and, thus, off site sedimentation.

The loss of commercially harvestable herbaceous vegetation and its associated use would be minimized with successful implementation of mine-specific reclamation plans. Reclaimed areas would provide forage for livestock and wildlife several years after reclamation. During reclamation, trees would be replanted in the disturbance areas in accordance with the designated post-mining land use and landowner agreements; however, any commercial value would not be realized for a number of years.

Special Status Species

Federal or state listed plant species identified for Study Areas 2, 3, 4, and 6 are identified in **Table 3.4-3**; no listed species were identified for Study Areas 1 or 5. Depending on the location of future mine disturbance areas, mine-related construction and operations could result in the direct removal of individual plants or potentially suitable habitat. Any potential impacts to the six threatened and endangered species would require coordination with USFWS under the ESA. Compliance with the state laws and regulations described in Section 3.4.1.3 would minimize adverse effects to state-listed species.

### 3.4.2.2 No Action Alternative

Under the No Action Alternative, development of a future surface coal or lignite mine expansion area or satellite mine would be the same as under the Proposed Action alternative. Therefore, the direct and indirect impacts to vegetation, including special status plant species, would be the same as described for the Proposed Action; however, impacts may be spread over a longer period of time due to the possibly lengthier permitting process.

### 3.4.3 Cumulative Impacts

The past and present actions and RFFAs identified in Section 2.4 include the known and foreseeable surface-disturbing activities that have or would affect vegetation. Most of the identified surface disturbance would be reclaimed in accordance with permit requirements following the completion of construction (e.g., pipeline) or life of a project (e.g., surface coal and lignite mines, oil and gas well fields). The CESA boundaries for vegetation include the area encompassed by outer boundary of the study areas and the riparian or wetland vegetation within the study area-specific 5-foot groundwater drawdown area described in Section 3.2.3.3, Groundwater, and shown in **Appendix A**, **Figures A-2** through **A-8**. **Table 3.4-4** summarizes the acreage of past and present actions within each CESA that cumulatively have affected vegetation in each study area through ground-disturbing activities such as mining, reservoir development, road construction, urban development, power generation, and oil and gas development.

Identified RFFAs include future surface coal and lignite mining activities. Projected future mining-related disturbance areas in each study area are identified in **Table 2-3**. These actions would contribute to the cumulative impacts to vegetation in each study area. In all but CESA 6, the acreage of surface-disturbing activities from past and present actions is more than the estimated acreage of future mining-related disturbance. This most likely is due to the rural nature of Study Area 6 and relative lack of other development. The impacts from all of these surface-disturbing activities would combine to alter the vegetative cover by removal or changing the long-term plant communities through reclamation.

**Table 3.4-4 Acreage of Past and Present Surface Disturbance in the Vegetation CESAs**

| Study Area | Disturbance Area Inside Study Area (acres) | Disturbance Area Outside Study Area/Inside CESA (acres) | Total CESA Disturbance Area (acres) |
|---|---|---|---|
| 1 | 52,238 | 56,683 | 108,922 |
| 2 | 40,132 | 149,693 | 189,825 |
| 3 | 38,569 | 120,045 | 158,614 |
| 4 | 5,846 | 57,722 | 63,568 |
| 5 | 3,603 | 27,100 | 30,702 |
| 6 | 2,363 | 3,596 | 5,959 |

### 3.4.4 Monitoring and Mitigation Measures

Mitigation measures may include the following, depending on the site-specific conditions of future mines.

- Prior to ground-disturbing activities, special status plant species surveys would be conducted by a qualified botanist in areas of potentially suitable habitat. If special status plant species are identified during the surveys, the mining company, in coordination with the USFWS and TPWD, as applicable, would develop appropriate mitigation to minimize impacts and a management plan for monitoring and reporting.
- Riparian area and wetland field surveys would be conducted to delineate the boundaries of any non-jurisdictional riparian areas and wetlands. Where possible, a vegetation buffer would be maintained between mine-related surface disturbance and wetland and riparian areas.
- Prior to ground disturbing activities, select plant species (e.g., pitcher-plant) may be removed and re-planted in areas of suitable habitat. The relocation of select plant species would be conducted in coordination with the applicable jurisdictional agency.

### 3.4.5 Residual Adverse Effects

Residual adverse effects to vegetation would include long-term impacts to woody species, as it would take up to 15 years for shrub species, and up to least 20 years for tree species of comparable size, to be re-established. Where successful reclamation is achieved, these residual adverse effects would be reduced over time. Long-term, there may be a permanent conversion of upland vegetation to wetland vegetation associated with wetland compensatory mitigation.

## 3.5 Fish and Wildlife Resources (including Special Status Species)

### 3.5.1 Affected Environment

#### 3.5.1.1 Terrestrial Wildlife Resources

Regulatory Background

Regulations that directly influence the management of wildlife species and habitats within the analysis area primarily are implemented by the USFWS, TPWD, and, for the portion of the CESA 2 that extends into Caddo and DeSoto parishes in Louisiana, the LDWF. As part of their permitting process and responsibilities under NEPA as lead federal agency, the USACE is required to evaluate if proposed projects have the potential to affect federally listed species, as well as proposed and candidate species for federal listing. Regulations and legal requirements related to wildlife species and habitat are listed below by regulatory authority. State agencies are required to evaluate potential impacts to state listed species.

TPWD

- Chapter 12 of the Texas Parks and Wildlife Code for protection of fish and wildlife resources.
- Chapters 67 and 68 of the Texas Parks and Wildlife Code and Sections 65.171 – 65.176 of Title 31 of the Texas Administrative Code for protection of state-listed endangered and threatened animal species.
- Section 68.002 of the Texas Parks and Wildlife Code that identifies endangered and threatened species in Texas.
- Section 68.015 and 65.171 prohibits the take of state-listed species.

LDWF

- Title 56 of the Louisiana Revised Statutes for wildlife and fisheries.

USFWS

- Endangered Species Act (ESA)
- Bald and Golden Eagle Protection Act (BGEPA)
- Migratory Bird Treaty Act (MBTA)

Information regarding wildlife species and their habitat within the analysis area was obtained from a review of published literature. Key documents on habitat and occurrence information include the TPWD Texas Conservation Action Plan (TPWD 2012a); TPWD Rare, Threatened, and Endangered Species of Texas website (TPWD 2014a); LDWF Species by Parish List (LDWF 2014); the USFWS ECOS website (USFWS 2014b); the USFWS Information, Planning, and Conservation (IPaC) system (USFWS 2014b); and various species' recovery plans.

Regional Summary

Under Section 12 of the Texas Parks and Wildlife Code, the TPWD is charged with "providing recommendations that will protect fish and wildlife resources to local, state, and federal agencies that approve, permit, license, or construct developmental projects" and "providing information on fish and wildlife resources to any local, state, and federal agencies or private organizations that make decisions affecting those resources." The six study areas and their CESAs are within four TPWD defined ecoregions as summarized in **Tables 3.5-1** and **3.5-2**, respectively. The EPA ecoregions described in Section 3.4, Vegetation, differ slightly from those used by the TPWD to analyze wildlife and wildlife habitat conservation by ecoregion. Descriptions of the TPWD defined ecoregions are provided in Texas Conservation Action Plans (TPWD 2012a-d).

**Table 3.5-1 TPWD Ecoregions within the Study Areas**

| Study Area | Ecoregion (acres) | | | | Total Acres |
|---|---|---|---|---|---|
| | Southern Texas Plains | Texas Blackland Prairies | East Central Texas Plains | South Central Plains | |
| 1 | 0 | 0 | 491,028 | 421,468 | 912,496 |
| 2 | 0 | 0 | 0 | 1,449,251 | 1,449,251 |
| 3 | 0 | 12,647 | 1,197,986 | 8,512 | 1,219,144 |
| 4 | 0 | 7,233 | 358,115 | 0 | 365,348 |
| 5 | 180,841 | 0 | 0 | 0 | 180,841 |
| 6 | 252,326 | 0 | 0 | 0 | 252,326 |
| **Total** | **433,168** | **19,880** | **2,047,129** | **1,879,230** | **4,379,406** |

**Table 3.5-2 TPWD Ecoregions within the CESAs**

| CESA | Ecoregion (acres) | | | | Total Acres |
|---|---|---|---|---|---|
| | Southern Texas Plains | Texas Blackland Prairies | East Central Texas Plains | South Central Plains | |
| 1 | 0 | 0 | 566,588 | 499,682 | 1,066,270 |
| 2 | 0 | 0 | 0 | 1,757,229 | 1,757,229 |
| 3 | 0 | 14,299 | 1,876,106 | 60,321 | 1,950,726 |
| 4 | 0 | 18,218 | 1,463,308 | 0 | 1,481,526 |
| 5 | 314,182 | 0 | 12,709 | 0 | 326,891 |
| 6 | 323,186 | 0 | 0 | 0 | 323,186 |
| **Total** | **637,368** | **32,517** | **3,918,711** | **2,317,232** | **6,905,828** |

Terrestrial wildlife habitats in the analysis area include agricultural lands; coastal barrens and plains; floodplains; Edwards Plateau savannah, woodlands, and shrubland; mixed woodlands and forest; post oak savannah; riparian; scrub, thornscrub, shrubland; seep and bog; tallgrass prairie, grassland; wet savannah, swamp, baygall; and disturbed areas (urban and ROW) as described in Section 3.4.1, Vegetation, and summarized by study area in **Tables 3.4-2** respectively. Aquatic habitats within these areas include rivers, streams, reservoirs, lakes, ponds, and wetlands, which are discussed in Section 3.5.1.2, Fisheries and Other Aquatic Biological Resources.

*Big Game*

Big game species within the analysis area include white-tailed deer (*Odocoileus virginianus*) and javelin (*Tayassu [Pecari] tajacu*).

White-tailed Deer

The white-tailed deer is the most numerous big game animal in in the U.S., and Texas has more white-tailed deer than any other state (Cook 1992). This species occurs primarily in the pine and mixed pine/hardwood upland forests and the hardwood forests that occur in the floodplains of major streams and rivers (Spencer 1992). The breeding season for white-tailed deer in Texas ranges from early September through mid-January (Cook 1992). The peak breeding activity occurs in mid-November in Central Texas and late December in South Texas (Cook 1992).

Breeding studies have been conducted by the TPWD Post Oak and Pineywoods Districts (Study Areas 1, 2, 3, and 4) (Based on the studies, the majority (90 percent) of the fawns in the Post Oak District were born by June 17 in the central area and by June 26 in the southern area (TPWD 2014d). In the Pineywoods District, the majority (90 percent) of the fawns are born by June 29 in the northern area and by June 19 in the southern area, with 1.7 fawns per doe (TPWD 2014d).

Known as "Texas Hill Country," the Edwards Plateau savannah, woodland, and shrubland habitat type within the Post Oak Savannah and Blackland Prairie Level IV ecoregions, is one of the best-known deer producing areas in the world (Armstrong and Young 2000). Within the analysis area, this habitat type only occurs within Study Area 4 where is occupies less than 0.1 percent of the study area (see **Table 3.4-2**). White-tailed deer population densities average 65 deer per 1,000 acres (15 acres per deer) for the 35 counties in the study areas (Armstrong and Young 2000). Higher populations occur in many areas of the region, with densities reaching one deer per 3 acres (Armstrong and Young 2000). In 1998, the estimated 1,555,000 white-tailed deer population for the Hill Country constituted over 40 percent of the white-tailed deer found in Texas (Young and Traweek 1997.

Javelina

Originally distributed in Texas from Brownsville to the Red River, the javelina's current range has been restricted to the southwestern one-third of the state, including portions of the lower coastal plains, the South Texas Plains, the western half of the Edwards Plateau, the Trans-Pecos, and the southern edge of the Rolling Plains (Taylor and Synatzske 2008). Within the analysis area, the current range of the javelina overlaps with Study Areas 5 and 6. Although there is no reliable census technique, javelina population trends have been determined from aerial surveys in conjunction with deer and pronghorn surveys (Taylor and Synatzske 2008). Based on these data, there are an estimated 100,000 javelina currently occupying approximately 62 million acres in Texas where they primarily inhabit semi-arid brushlands or oak-juniper woodlands in areas with precipitation ranging from 10 to 30 inches annually (Taylor and Synatzske 2008).

*Upland Game Birds*

Upland game birds within the analysis area include bobwhite (*Colinus virginianus*) and scaled quail (*Callipepla squamata*), eastern (*Meleagris gallopavo silvestris*) and Rio Grande turkey (*Meleagris gallopavo intermedia)*, mourning dove (*Zenaida macroura*), and chachalaca (*Ortalis vetula*).

Bobwhite Quail

Bobwhite quail may be found from the tip of the Panhandle to the mouth of the Rio Grande in Texas, although its principal range is considered to be from the 101st meridian eastward (Jackson et al. 1990). The current range of bobwhite quail in Texas overlaps all six study areas and overlaps with the scaled quail range in Study Areas 5 and 6. Bobwhite quail habitat varies throughout Texas; however, within the analysis area it is found in brush, farmlands, chaparral, and open pinelands (TPWD 2005). Despite the wide range of habitat, quail habitat always requires an area capable of providing at least one covey with all of its life needs season after season (Jackson et al. No Date), including a year-round adequate supply of food and protection from hazards, including prey species (Jackson et al. 1990).

Roadside quail surveys were conducted by TPWD from 1976 to 1988, and in select High Plains locations in 1993, to track quail production trends at the statewide and physiographic region spatial scales (TPWD 2014c). Based on these surveys, the average number of bobwhite quail observed per survey route in 2013 was 6.0 compared to 7.9 in 2012. This is well below the long-term mean of 17.6 and is predictive of a below average hunting season.

Scaled Quail

Scaled quail inhabit arid and semi-arid lowlands of sparse low-growing shrubs in level or rugged terrain. They are found throughout West Texas, except in the higher elevations (above 6,500 feet amsl) and throughout the Panhandle where the highest densities occur along drainages, canyons, and rough breaks (Cantu et al. 2006). Within the analysis area, this species occurs within Study Areas 5 and 6.

Scaled quail populations declined over most of their range in Texas over the last 30 years, especially during the 1990s (Cantu et al. 2006). The most severe declines occurred in the Rolling Plains and Edwards Plateau ecoregions. However, quail abundance rebounded over much of West Texas since 2004 (Cantu et al. 2006). Scaled quail populations normally fluctuate with precipitation patterns.

Turkey

Two varieties of wild turkey are common to Texas. The eastern turkey is found in the forests and dense thickets of East Texas and occurs in Study Areas 1, 2, and 3 based on the species' current range (Cook and Gore 1984; National Wild Turkey Federation 2014). The Rio Grande turkey is found in most of south, central, and north Texas and based on current range occurs in Study Areas 3, 4, 5, and 6 (Cook and Gore 1984; National Wild Turkey Federation 2014). Habitat for turkeys includes ample numbers of mature trees as well as brush and shrubs to provide food (pecans, acorns, berries, seeds) as well as cover and roosting areas. Turkeys require a large annual range, often moving 8 to 10 miles from winter roost sites to summer nesting areas (Cook and Gore 1984).

Mourning Dove

The mourning dove is the most widely distributed game bird in North America (George 1988). Mourning doves are common within all of the study areas and are capable of traveling long distances to fulfill all of their habitat needs. Mourning doves prefer fairly open habitat with scattered trees for perching and nesting. Preferred habitat includes dry upland areas, grain fields, and shrublands (TPWD 2005).

Chachalaca

The plain chachalaca typically occurs in small groups of three to five individuals in tall, thorny thickets, scrubland, and second-growth forest edges along the Gulf-Caribbean slope from the lower Rio Grande Valley of Texas and Nuevo Leon, Mexico, south to Honduras and Costa Rica (TPWD 2014i). Within the analysis area, chachalacas have the potential to occur within Study Areas 5 and 6.

*Other Game Species*

Based on known ranges and habitat preferences, a variety of small game species, mammalian predators, and furbearers are likely to be present in the study areas because most of these species are relatively widespread and common. Species include numerous waterfowl, rabbits and hares, squirrels, snipe, badger, beaver, fox, mink, muskrat, nutria, opossum, otter, raccoon, ring-tailed cat, skunk, and civet cat (spotted skunk). Waterfowl are present within the study areas as migrants or winter residents.

Texas is considered the most important wintering area for migratory waterfowl in the Central Flyway. An estimated 3 to 5 million birds rely on Texas' wetlands for winter habitat each year (TPWD 2014f).

*Nongame Species*

A diversity of nongame species (e.g., mammals, reptiles, raptors, and passerines) occupy a variety of habitat types within the study areas. Common nongame wildlife species include small mammals (e.g., bats, voles, chipmunks, gophers, woodrats, armadillo, ground squirrels, and mice). These species provide a substantial prey base for predators including larger mammals (e.g., coyote, bobcat, American badger, bear, and mountain lions), raptors (e.g., eagles, hawks, falcons, owls), and reptiles (e.g., lizards and snakes).

Common reptile species observed in the study area included western cottonmouth, Texas rat snake, red-eared slider, ground skinks, and five-lined skinks. A number of these nongame species are dependent on the riparian and wetland habitats associated with creeks and ponds in the study areas.

A wide variety of nongame birds occur in the study areas, including passerine (also known as songbirds) and non-passerine (including raptor) species. Common passerine species in the analysis area include pine siskin, purple finch, Brewer’s blackbird, red-eyed vireo, rufous-sided towhee, white-throated sparrow, yellow-rumped warbler, tufted titmouse, American robin, northern cardinal, white-crowned sparrow, summer tanager, hummingbirds, hairy woodpecker, yellow-bellied sapsucker, and red-bellied woodpecker. Common raptor species include turkey vultures, red-tailed hawks, red-shouldered hawks, kestrels, barred owls, northern harriers, Cooper’s hawk, sharp-shinned hawk, and Swainson’s hawk. Many of these species are neotropical migrants that breed in North America and winter in South America. Resident species that breed and over-winter in the same area also are common.

Migratory Bird Treaty Act

Nongame birds encompass a variety of passerine and raptor species, most of which are migratory bird species that are protected under the MBTA of 1918 (16 USC 703-711). The MBTA applies only to migratory bird species that are native to the U.S. or its territories. A native migratory bird is one that is present as a result of natural biological or ecological processes, not species whose presence in the U.S. is solely the result of human-assisted introductions. Nongame species that are excluded from protection under the MBTA include the rock pigeon, Eurasian collared-dove, European starling, and Old World sparrows such as the house sparrow.

To protect native migratory bird species, the MBTA includes, but is not limited to, the following points.

- Protection of 1,007 species of migratory birds and their parts, including eggs, feathers, and nests.
- Eagle nests are protected year-round; other migratory bird nests are protected only during the active nesting season.
- The MBTA is a strict liability statute. Proof of intent to violate the MBTA is not required for prosecution.
- The MBTA has no consultation process such as Section 7 consultation under the ESA.
- The MBTA does not permit incidental or unintentional take, such as that provided by Sections 7 and 10 of the ESA.

Executive Order 13186

EO 13186, Responsibilities of Federal Agencies to Protect Migratory Birds, was signed in January 2001. In order to avoid or minimize the taking of migratory birds, EO 13186 requires the development and implementation of Memorandums of Understanding with all pertinent federal agencies when the actions or decisions of those agencies "…have had or are likely to have negative effects on migratory birds protected under MBTA." While the MBTA has no provision for protecting bird habitats, EO 13186 provides opportunities for protecting, improving, or replacing affected habitats.

Bald and Golden Eagle Protection Act

In addition to the MBTA, bald and golden eagles are protected under the BGEPA (16 USC 668 et seq.). This statute prohibits anyone without a permit from committing a "take" of bald and golden eagles, including their parts, nests, and eggs. "Take" is defined as the actions to pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest, or disturb. In 2009, the USFWS implemented two rules authorizing new permits under BGEPA.

- 50 CFR 22.26 authorizes limited "take" of bald and golden eagles where the "take" is associated with, but is not the purpose of, an activity and cannot practicably be avoided.
- 50 CFR 22.27 authorizes the intentional take of eagle nests where necessary to alleviate safety hazards to people or eagles; to ensure public health and safety; where a nest prevents the use of a human-engineered structure; and when an activity, or mitigation for the activity, will provide a net benefit to eagles. Only inactive nests are allowed to be taken, except in the case of safety emergencies.

BGEPA provides the Secretary of the Interior with the authority to issue eagle-take permits only if he/she is able to determine that the take is compatible with the preservation of the eagle. This take must be "…consistent with the goal of increasing or stabilizing breeding populations." For golden eagles, current data indicate a negative population trend in the lower latitudes, such as the southwestern U.S., while data indicate a positive population trend in the northern Bird Conservation Regions. These trends may simply indicate movement patterns; however, evidence may demonstrate a lack of resiliency in golden eagle populations.

USFWS Birds of Conservation Concern

A list of Birds of Conservation Concern (BCC) was developed by the USFWS as a result of a 1988 amendment to the Fish and Wildlife Conservation Act. This act mandates that the USFWS "identify species, subspecies, and populations of all migratory nongame birds that, without additional conservation actions, are likely to become candidates for listing under the Endangered Species Act of 1973." The goal of the BCC list is to prevent or remove the need for ESA bird listings by implementing proactive management and conservation actions and requiring consultation in accordance with EO 13186 (USFWS 2008).

*Special Status Species*

Special status species are those species that are listed as federally threatened or endangered, or have been proposed or are considered as candidates for such listing by the USFWS, as well as those species that are state-listed as threatened or endangered by the TPWD and LDWF. Federally listed and proposed species and federally designated critical habitat receive protection under the ESA. State-listed species are protected by laws and regulations contained in Chapters 67 and 68 of the Texas Parks and Wildlife Code, Sections 65.171-65.184 of Title 31 of the TAC, and Title 56 of the Louisiana Revised Statutes.

Information regarding special status wildlife species and their habitats within the analysis area was obtained from a review of existing published and online sources including file information from the USFWS, TPWD, and LDFW. A total of 36 special status terrestrial wildlife species have the potential to occur within the study areas. These species, their associated habitats, and their potential for occurrence are summarized in **Appendix B**. Occurrence potential within the study areas was evaluated for each species based on its habitat requirements and known geographic distribution. Based on these parameters, eight special status wildlife species have been eliminated from detailed analysis, as discussed in **Appendix B**. The 28 special status wildlife species carried forward are listed below for each study area, as applicable.

Study Area Descriptions

A wide variety of wildlife habitats and species are found within the analysis area. Many of these species are found over a wide geographic area in various habitat types and at various elevations. As described in Section 3.4, Vegetation, 14 habitat types described as vegetation communities are found within the analysis area. Although the urban land cover type is not considered to be suitable wildlife habitat, some wildlife species may utilize these areas. Wildlife species (including special status species) and habitats specific to each study area are summarized in the following sections.

*Study Area 1*

Habitat

Study Area 1 is located within the East Central Texas Plains and Western Gulf Coastal Plains ecoregions. The study area is dominated by post oak savanna (approximately 40 percent) and mixed woodlands and forest (approximately 22 percent) (**Table 3.4-2**). Approximately 17 percent of Study Area 1 consists of wetland and riparian habitats (i.e., riparian areas, seeps and bogs, and wet savanna, swamp, and baygall).

Game and Nongame Species

Numerous game and nongame species representing those described above under the Regional Description subsection occur within Study Area 1. The list of BCC birds potentially occurring in Study Area 1 is presented in **Table 3.5-3**.

**Table 3.5-3 Birds of Conservation Concern Potentially Occurring in Study Area 1**

| Common Name | Scientific Name | Seasonal Occurrence |
|---|---|---|
| American Kestrel | *Falco sparverius* ssp. *paulus* | Year-round |
| Bald Eagle | *Haliaeetus leucocephalus* | Wintering, Year-round |
| Bell's Vireo | *Vireo bellii* | Breeding |
| Bewick's Wren | Thryomanes bewickii ssp. *bewickii* | Wintering |
| Brown-headed Nuthatch | *Sitta pusilla* | Year-round |
| Burrowing Owl | *Athene cunicularia* | Wintering |
| Harris's Sparrow | *Zonotrichia querula* | Wintering |
| Le Conte's Sparrow | *Ammodramus leconteii* | Wintering |
| Least Bittern | *Ixobrychus exilis* | Breeding |
| Lesser Yellowlegs | *Tringa flavipes* | Wintering |
| Little Blue Heron | *Egretta caerulea* | Breeding |
| Mississippi Kite | *Ictinia mississippiensis* | Breeding |
| Orchard Oriole | *Icterus spurius* | Breeding |
| Rusty Blackbird | *Euphagus carolinus* | Wintering |
| Scissor-tailed Flycatcher | *Tyrannus forficatus* | Breeding |
| Swainson's Warbler | *Limnothlypis swainsonii* | Breeding |

**Table 3.5-3 Birds of Conservation Concern Potentially Occurring in Study Area 1**

| Common Name | Scientific Name | Seasonal Occurrence |
|---|---|---|
| Wood Thrush | *Hylocichla mustelina* | Breeding |
| Worm-eating Warbler | *Helmitheros vermivorum* | Breeding |

Source: USFWS 2014b.

Special Status Species

Based on the USFWS IPaC system and TPWD county occurrence information, Study Area 1 contains potential habitat for 13 special status terrestrial wildlife species (**Table 3.5-4**). Of the 13 species, four (interior least tern, Louisiana black bear, black bear, and Louisiana pine snake) are federally listed or a federal candidate. No designated critical habitat for these species is present in Study Area 1. Habitat associations and known distribution for these species is presented in **Appendix B**.

**Table 3.5-4 Special Status Wildlife Species by County with Potentially Occurring in Study Area 1**

| Common Name | Scientific Name | ESA Status[1] | State Status[1] | Counties | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Camp | Franklin | Hopkins | Rains | Smith | Titus | Wood |
| **Birds** | | | | | | | | | | |
| American Peregrine Falcon | *Falco peregrinus anatum* | | T | X | X | X | X | X | X | X |
| Bachman's Sparrow | *Aimophila aestivalis* | | T | X | X | X | X | X | X | X |
| Bald Eagle | *Haliaeetus leucocephalus* | | T | X | X | X | X | X | X | X |
| Interior Least Tern | *Sterna antillarum athalassos* | E | E | X | X | X | X | X | X | X |
| Peregrine Falcon | *Falco peregrinus* | | T | X | X | X | X | X | X | X |
| Wood Stork | *Mycteria americana* | | T | X | X | X | X | X | X | X |
| **Mammals** | | | | | | | | | | |
| Louisiana Black Bear | *Ursus americanus luteolus* | T | T | | | | | | | |
| Black Bear | *Ursus americanus* | T/SA | T | X | X | X | X | X | X | X |
| Rafinesque's big-eared bat | *Corynorhinus rafinesquii* | | T | | | | | | | |
| **Reptiles** | | | | | | | | | | |
| Louisiana Pine Snake | *Pituophis ruthveni* | C | T | | | | | X | | X |
| Northern Scarlet Snake | *Cemophora coccinea copei* | | T | X | X | | X | X | X | X |
| Texas Horned Lizard | *Phrynosoma cornutum* | | T | X | X | X | X | X | X | X |
| Timber/Canebrake rattlesnake | *Crotalus horridus* | | T | X | X | X | X | X | X | X |

[1] T—Threatened; E—Endangered; C—Candidate; T/SA – Listed as threatened by similarity of appearance.

Sources: TPWD 2014a; USFWS 2014b.

*Study Area 2*

Habitat

Study Area 2 is located within the Western Gulf Coastal Plains ecoregion and is dominated by mixed woodlands and forest (approximately 50 percent) and disturbed prairie (approximately 23 percent) (**Table 3.4-2**). Approximately 18 percent of the study area consists of wetland and riparian habitats (i.e., riparian areas, coastal barrens and glades, seeps and bogs, and wet savanna, swamp, and baygall).

Game and Nongame Species

Numerous game and nongame species representing those described above under the Regional Description subsection occur within Study Area 2. The list of BCC birds potentially occurring in the study area is presented in **Table 3.5-5**.

**Table 3.5-5 Birds of Conservation Concern Potentially Occurring in Study Area 2**

| Common Name | Scientific Name | Seasonal Occurrence |
|---|---|---|
| American Kestrel | *Falco sparverius* ssp. *paulus* | Year-round |
| American Bittern | *Botaurus lentiginosus* | Wintering |
| Bald Eagle | *Haliaeetus leucocephalus* | Wintering, Year-round |
| Bell's Vireo | *Vireo bellii* | Breeding |
| Bewick's Wren | *Thryomanes bewickii* ssp. *bewickii* | Wintering |
| Brown-headed Nuthatch | *Sitta pusilla* | Year-round |
| Chuck-will's-widow | *Caprimulgus carolinensis* | Breeding |
| Harris's Sparrow | *Zonotrichia querula* | Wintering |
| Le Conte's Sparrow | *Ammodramus leconteii* | Wintering |
| Least Bittern | *Ixobrychus exilis* | Breeding |
| Lesser Yellowlegs | *Tringa flavipes* | Wintering |
| Little Blue Heron | *Egretta caerulea* | Breeding |
| Mississippi Kite | *Ictinia mississippiensis* | Breeding |
| Orchard Oriole | *Icterus spurius* | Breeding |
| Rusty Blackbird | *Euphagus carolinus* | Wintering |
| Swainson's Warbler | *Limnothlypis swainsonii* | Breeding |
| Wood Thrush | *Hylocichla mustelina* | Breeding |
| Worm-eating Warbler | *Helmitheros vermivorum* | Breeding |

Source: USFWS 2014b.

Special Status Species

Based on the USFWS IPaC system and TPWD county occurrence information, Study Area 2 contains potential habitat for 16 special status terrestrial wildlife species (**Table 3.5-6**). Of the 16 species, five (interior least tern, red-cockaded woodpecker, Louisiana black bear, black bear, and Louisiana pine snake) are federally listed or a federal candidate. No designated critical habitat is found in Study Area 2. Habitat and life history information for each species is provided in **Appendix B**.

**Table 3.5-6 Special Status Wildlife Species by County Potentially Occurring in Study Area 2**

| Common Name | Scientific Name | ESA Status[1] | State Status[1] | Counties | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Cherokee | Gregg | Harrison | Panola | Rusk | Shelby | Smith |
| American Peregrine Falcon | *Falco peregrinus anatum* | | T | X | X | X | X | X | X | X |
| Bachman's Sparrow | *Aimophila aestivalis* | | T | X | X | X | X | X | X | X |
| Bald Eagle | *Haliaeetus leucocephalus* | | T | X | X | X | X | X | X | X |
| Interior Least Tern | *Sterna antillarum athalassos* | E | E | X | X | X | X | X | X | X |
| Peregrine Falcon | *Falco peregrinus* | | T | X | X | X | X | X | X | X |
| Red-cockaded Woodpecker | *Picoides borealis* | E | E | X | | | X | | X | |
| Sprague's Pipit | *Anthus spragueii* | C | | | | | | | | |
| Swallow-tailed Kite | *Elanoides forficatus* | | T | | | | | | X | |
| Wood Stork | *Mycteria americana* | | T | X | X | X | X | X | X | X |
| **Mammals** | | | | | | | | | | |
| Louisiana Black Bear | *Ursus americanus luteolus* | T | T | X | X | X | X | X | X | |
| Black Bear | *Ursus americanus* | T/SA | T | X | X | X | X | X | X | X |
| Rafinesque's Big-eared Bat | *Corynorhinus rafinesquii* | | T | X | X | X | X | X | X | |
| **Reptiles** | | | | | | | | | | |
| Louisiana Pine Snake | *Pituophis ruthveni* | C | T | X | | | | X | X | X |
| Northern Scarlet Snake | *Cemophora coccinea copei* | | T | X | X | X | X | X | X | X |
| Texas Horned Lizard | *Phrynosoma cornutum* | | T | X | | | | X | | X |
| Timber/Canebrake Rattlesnake | *Crotalus horridus* | | T | X | X | X | X | X | X | X |

[1] ESA Status: T – Threatened; E – Endangered; C – Candidate; T/SA – Listed as threatened by similarity of appearance.

Sources: TPWD 2014a; USFWS 2014b.

*Study Area 3*

Habitat

Study Area 3 is located within the Texas Blackland Prairies, East Central Texas Plains, and Western Gulf Coastal Plains ecoregions, and is dominated by post oak savanna (approximately 76 percent) (**Table 3.4-2**). Approximately 15 percent of the study area consists of wetland and riparian habitats (i.e., riparian areas, floodplain, seeps and bogs).

Game and Nongame Species

Numerous game and nongame species representing those described above under the Regional Description subsection occur within Study Area 3. The list of BCC birds potentially occurring in this study area are presented in **Table 3.5-7**.

**Table 3.5-7 Birds of Conservation Concern Potentially Occurring in Study Area 3**

| Common Name | Scientific Name | Seasonal Occurrence |
|---|---|---|
| American Kestrel | *Falco sparverius* ssp. *paulus* | Year-round |
| Bald Eagle | *Haliaeetus leucocephalus* | Wintering, Year-round |
| Bell's Vireo | *Vireo bellii* | Breeding |
| Brown-headed Nuthatch | *Sitta pusilla* | Year-round |
| Burrowing Owl | *Athene cunicularia* | Wintering |
| Harris's Sparrow | *Zonotrichia querula* | Wintering |
| Lark Bunting | *Calamospiza melanocorys* | Wintering |
| Le Conte's Sparrow | *Ammodramus leconteii* | Wintering |
| Least Bittern | *Ixobrychus exilis* | Breeding |
| Lesser Yellowlegs | *Tringa flavipes* | Wintering |
| Little Blue Heron | *Egretta caerulea* | Breeding |
| Louisiana Waterthrush | *Parkesia motacilla* | Breeding |
| Mississippi Kite | *Ictinia mississippiensis* | Breeding |
| Mountain Plover | *Charadrius montanus* | Wintering |
| Orchard Oriole | *Icterus spurius* | Breeding |
| Rusty Blackbird | *Euphagus carolinus* | Wintering |
| Scissor-tailed Flycatcher | *Tyrannus forficatus* | Breeding |
| Swainson's Warbler | *Limnothlypis swainsonii* | Breeding |
| Wood Thrush | *Hylocichla mustelina* | Breeding |
| Worm-eating Warbler | *Helmitheros vermivorum* | Breeding, Migrating |
| Yellow Rail | *Coturnicops noveboracensis* | Wintering |

Source: USFWS 2014b.

Special Status Species

Based on the USFWS IPaC system and TPWD county occurrence information, Study Area 3 contains potential habitat for 13 special status terrestrial wildlife species (**Table 3.5-8**). Of the 13 species, four (interior least tern, whooping crane, Louisiana black bear, and black bear) are federally listed. No designated critical habitat is found in the Study Area 3. Habitat and life history information for each species is provided in **Appendix B**.

**Table 3.5-8 Special Status Wildlife Species by County Potentially Occurring in Study Area 3**

| Common Name | Scientific Name | ESA Status[1] | State Status[1] | County | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Anderson | Falls | Freestone | Henderson | Leon | Limestone | Robertson | Van Zandt |
| **Birds** | | | | | | | | | | | |
| American Peregrine Falcon | *Falco peregrinus anatum* | | T | X | X | X | X | X | X | X | X |
| Bachman's Sparrow | *Aimophila aestivalis* | | T | X | | X | X | X | | | X |
| Bald Eagle | *Haliaeetus leucocephalus* | | T | X | X | X | X | X | X | X | X |
| Interior Least Tern | *Sterna antillarum athalassos* | E | E | X | X | X | X | X | X | X | X |
| Peregrine Falcon | *Falco peregrinus* | | T | X | X | X | X | X | X | X | X |
| White-faced Ibis | *Plegadis chihi* | | T | X | X | | | | X | | |
| Whooping Crane | *Grus americana* | E | E | X | X | X | X | X | X | X | X |
| Wood Stork | *Mycteria americana* | | T | X | X | X | X | X | X | X | X |
| **Mammals** | | | | | | | | | | | |
| Louisiana Black Bear | *Ursus americanus luteolus* | T | T | X | | | | X | | X | |
| Black Bear | *Ursus americanus* | T/SA | T | X | | | X | | | | X |
| Reptiles | | | | | | | | | | | |
| Northern Scarlet Snake | *Cemophora coccinea copei* | | T | | | | X | | | | X |
| Texas Horned Lizard | *Phrynosoma cornutum* | | T | X | X | X | X | X | X | X | X |
| Timber/Canebrake Rattlesnake | *Crotalus horridus* | | T | X | X | X | X | X | X | X | X |

1 T – Threatened; E – Endangered; T/SA – Listed as threatened by similarity of appearance.

Sources: TPWD 2014a; USFWS 2014b.

*Study Area 4*

Habitat

Study Area 4 is located within the East Central Texas Plains and Texas Blackland Prairie ecoregions and is dominated by post oak savanna (approximately 79 percent) (**Tables 3.4-2**). Approximately 11 percent of this study area consists of wetland and riparian habitats (i.e., riparian areas and floodplain).

Game and Nongame Species

Numerous game and nongame species representing those described above under the Regional Description subsection occur within Study Area 4. The list of BCC birds potentially occurring in this study area are presented in **Table 3.5-9**.

**Table 3.5-9 Birds of Conservation Concern Potentially Occurring in Study Area 4**

| Common Name | Scientific Name | Seasonal Occurrence |
|---|---|---|
| Audubon's Oriole | Icterus graduacauda | Year-round |
| Bald Eagle | *Haliaeetus leucocephalus* | Wintering |
| Bell's Vireo | *Vireo bellii* | Breeding |
| Burrowing Owl | *Athene cunicularia* | Wintering, Year-round |
| Chestnut-collared Longspur | *Calcarius ornatus* | Wintering |
| Harris's Sparrow | *Zonotrichia querula* | Wintering |
| Lark Bunting | *Calamospiza melanocorys* | Wintering |
| Le Conte's Sparrow | *Ammodramus leconteii* | Wintering |
| Least Bittern | *Ixobrychus exilis* | Breeding |
| Lesser Yellowlegs | *Tringa flavipes* | Wintering |
| Little Blue Heron | *Egretta caerulea* | Breeding |
| Mississippi Kite | *Ictinia mississippiensis* | Breeding |
| Mountain Plover | *Charadrius montanus* | Wintering |
| Orchard Oriole | *Icterus spurius* | Breeding |
| Rufous-crowned Sparrow | *Aimophila ruficeps* | Year-round |
| Rusty Blackbird | *Euphagus carolinus* | Wintering |
| Scissor-tailed Flycatcher | *Tyrannus forficatus* | Breeding |
| Swainson's Warbler | *Limnothlypis swainsonii* | Breeding |
| Worm-eating Warbler | *Helmitheros vermivorum* | Breeding, Migrating |
| Yellow Rail | *Coturnicops noveboracensis* | Wintering |

Source: USFWS 2014b.

Special Status Species

Based on the USFWS IPaC system and TPWD county occurrence information, Study Area 4 contains potential habitat for ten special status terrestrial wildlife species (**Table 3.5-10**). Of the 11 species, five (black-capped vireo, golden-cheeked warbler, interior least tern, whooping crane, and Louisiana black bear) are federally listed. No designated critical habitat is found in Study Area 4. Habitat and life history information for each species is provided in **Appendix B**.

**Table 3.5-10 Special Status Wildlife Species by County Potentially Occurring in Study Area 4**

| Common Name | Scientific Name | ESA Status[1] | State Status[1] | Counties | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | Bastrop | Burleson | Lee | Milam | Williamson |
| **Birds** | | | | | | | | |
| American Peregrine Falcon | *Falco peregrinus anatum* | | T | X | X | X | X | X |
| Bald Eagle | *Haliaeetus leucocephalus* | | T | X | X | X | X | X |
| Black-capped Vireo | *Vireo atricapilla* | E | E | | | | | X |
| Golden-cheeked Warbler | *Setophaga chrysoparia* | E | E | | | | | X |
| Interior Least Tern | *Sterna antillarum athalassos* | E | E | X | X | X | X | |
| Peregrine Falcon | *Falco peregrinus* | | T | X | X | X | X | X |
| Whooping Crane | *Grus americana* | E | E | X | X | X | X | X |
| Wood Stork | *Mycteria americana* | | T | X | X | X | X | |
| **Mammals** | | | | | | | | |
| Louisiana Black Bear | *Ursus americanus luteolus* | T | T | | X | | | |
| **Reptiles** | | | | | | | | |
| Texas Horned lizard | *Phrynosoma cornutum* | | T | X | X | X | X | X |
| Timber/Canebrake Rattlesnake | *Crotalus horridus* | | T | X | X | X | X | X |

[1] T – Threatened; E – Endangered; C – Candidate.

Sources: TPWD 2014a; USFWS 2014b.

*Study Area 5*

Habitat

Study Area 5 is located within the Southern Texas Plains Ecoregion and is dominated by scrub, thornscrub, and shrubland (approximately 47 percent) (**Table 3.5-2**). Disturbed prairie and tallgrass prairie and grassland combined represent approximately 40 percent of the study area. Approximately 12 percent of the Study Area 5 consists of wetland and riparian habitats (i.e., riparian areas and floodplain).

Game and Nongame Species

Numerous game and nongame species representing those described above under the Regional Description subsection occur within Study Area 5. The list of BCC birds potentially occurring in this study area are presented in **Table 3.5-11**.

**Table 3.5-11 Birds of Conservation Concern Potentially Occurring in Study Area 5**

| Common Name | Scientific Name | Seasonal Occurrence |
|---|---|---|
| Audubon's Oriole | *Icterus graduacauda* | Year-round |
| Audubon's Shearwater | *Puffinus lherminieri* | Wintering |
| Bald Eagle | *Haliaeetus leucocephalus* | Wintering |
| Bell's Vireo | *Vireo bellii* | Breeding |
| Black Skimmer | *Rynchops niger* | Year-round |
| Burrowing Owl | *Athene cunicularia* | Wintering |
| Cassin's Sparrow | *Aimophila cassinii* | Year-round |
| Chestnut-collared Longspur | *Calcarius ornatus* | Wintering |
| Curve-billed Thrasher | *Toxostoma curvirostre* | Year-round |
| Harris's Hawk | *Parabuteo unicinctus* | Year-round |
| Harris's Sparrow | *Zonotrichia querula* | Wintering |
| Hooded Oriole | *Icterus cucullatus* | Breeding |
| Lark Bunting | *Calamospiza melanocorys* | Wintering |
| Le Conte's Sparrow | *Ammodramus leconteii* | Wintering |
| Least Bittern | *Ixobrychus exilis* | Breeding |
| Lesser Yellowlegs | *Tringa flavipes* | Wintering |
| Little Blue Heron | *Egretta caerulea* | Breeding |
| Mountain Plover | *Charadrius montanus* | Wintering |
| Orchard Oriole | *Icterus spurius* | Breeding |
| Scissor-tailed Flycatcher | *Tyrannus forficatus* | Breeding |
| Sedge Wren | *Cistothorus platensis* | Wintering |
| Solitary Sandpiper | *Tringa solitaria* | Wintering |
| Summer tanager | *Piranga rubra* | Breeding |
| Verdin | *Auriparus flaviceps* | Year-round |
| Worm-eating Warbler | *Helmitheros vermivorum* | Migrating |
| Yellow Rail | *Coturnicops noveboracensis* | Wintering |

Source: USFWS 2014b.

Special Status Species

Based on the USFWS IPaC system and TPWD county occurrence information, Study Area 5 contains potential habitat for 13 special status terrestrial wildlife species (**Table 3.5-12**). Of the 13 species, five (Sprague's pipit, whooping crane, black bear, jaguarundi, and ocelot) are federally listed or a federal candidate. No designated critical habitat is found in Study Area 5. Habitat and life history information for each species is provided in **Appendix B**.

**Table 3.5-12 Special Status Wildlife Species by County Potentially Occurring in Study Area 5**

| Common Name | Scientific Name | ESA Status[1] | State Status[1] | Counties | | |
|---|---|---|---|---|---|---|
| | | | | Atascosa | Live Oak | McMullen |
| **Birds** | | | | | | |
| American Peregrine Falcon | *Falco peregrinus anatum* | | T | X | X | X |
| Peregrine Falcon | *Falco peregrinus* | | T | X | X | X |
| Sprague's Pipit | *Anthus spragueii* | C | | X | X | X |
| White-tailed Hawk | *Buteo albicaudatus* | | T | | X | |
| Whooping Crane | *Grus americana* | E | E | X | X | X |
| Wood Stork | *Mycteria americana* | | T | X | X | X |
| **Mammals** | | | | | | |
| Black Bear | *Ursus americanus* | T/SA | T | X | | X |
| Jaguarundi | *Herpailurus yaguarondi* | E | E | | X | |
| Ocelot | *Leopardus pardalis* | E | E | X | X | X |
| **Reptiles** | | | | | | |
| Reticulate collared lizard | *Crotaphytus reticulatus* | | T | | X | X |
| Texas horned lizard | *Phrynosoma cornutum* | | T | X | X | X |
| Texas indigo snake | *Drymarchon melanurus erebennus* | | T | X | X | X |
| Texas tortoise | *Gopherus berlandieri* | | T | X | X | X |

[1] T – Threatened; E – Endangered; C- Candidate; T/SA – Listed as threatened by similarity of appearance.

Sources: TPWD 2014a; USFWS 2014b.

*Study Area 6*

Habitat

Study Area 6 is located within the Southern Texas Plains Ecoregion and is dominated by scrub, thornscrub, and shrubland (approximately 65 percent) (**Tables 3.4-2**). Approximately 11 percent of the study area consists of wetland and riparian habitats (i.e., riparian areas and floodplain).

Game and Nongame Species

Numerous game and nongame species representing those described above under the Regional Description subsection occur within Study Area 6. The list of BCC birds potentially occurring in this study area are presented in **Table 3.5-13**.

**Table 3.5-13 Birds of Conservation Concern Potentially Occurring in Area 6**

| Common Name | Scientific Name | Seasonal Occurrence |
|---|---|---|
| Audubon's Oriole | *Icterus graduacauda* | Year-round |
| Bald Eagle | *Haliaeetus leucocephalus* | Wintering |
| Bell's Vireo | *Vireo bellii* | Breeding |
| Brewer's Sparrow | *Spizella breweri* | Wintering |
| Burrowing Owl | *Athene cunicularia* | Wintering, Year-round |
| Cassin's Sparrow | *Aimophila cassinii* | Year-round |
| Chestnut-collared Longspur | *Calcarius ornatus* | Wintering |
| Curve-billed Thrasher | *Toxostoma curvirostre* | Year-round |
| Curve-billed Thrasher | *Toxostoma curvirostre* | Breeding |
| Harris's Hawk | *Parabuteo unicinctus* | Year-round |
| Harris's Sparrow | *Zonotrichia querula* | Wintering |
| Hooded Oriole | *Icterus cucullatus* | Breeding |
| Lark Bunting | *Calamospiza melanocorys* | Wintering |
| Least Bittern | *Ixobrychus exilis* | Breeding |
| Lesser Yellowlegs | *Tringa flavipes* | Wintering |
| Mountain Plover | *Charadrius montanus* | Wintering |
| Orchard Oriole | *Icterus spurius* | Breeding |
| Rufous-crowned Sparrow | *Aimophila ruficeps* | Year-round |
| Summer Tanager | *Piranga rubra* | Breeding |
| Verdin | *Auriparus flaviceps* | Year-round |

Source: USFWS 2014b.

Special Status Species

Based on the USFWS IPaC system and TPWD county occurrence information, Study Area 6 contains potential habitat for 14 special status terrestrial wildlife species (**Table 3.5-14**). Of the 14 species, 6 (black-capped vireo, golden-cheeked warbler, Sprague's pipit, black bear, jaguarundi, and ocelot) are federally listed or a federal candidate. No designated critical habitat is found in the Study Area 6. Habitat and life history information for each species is provided in **Appendix B**.

**Table 3.5-14 Special Status Wildlife Species by County Potentially Occurring in Study Area 6**

| Common Name | Scientific Name | ESA Status[1] | State Status[1] | Counties | | | |
|---|---|---|---|---|---|---|---|
| | | | | Dimmit | Kinney | Maverick | Zavala |
| **Birds** | | | | | | | |
| American Peregrine Falcon | *Falco peregrinus anatum* | | T | X | X | X | X |
| Black-capped Vireo | *Vireo atricapilla* | E | E | | X | | |
| Golden-cheeked Warbler | *Setophaga chrysoparia* | E | E | | X | | |

**Table 3.5-14 Special Status Wildlife Species by County Potentially Occurring in Study Area 6**

| Common Name | Scientific Name | ESA Status[1] | State Status[1] | Counties | | | |
|---|---|---|---|---|---|---|---|
| | | | | Dimmit | Kinney | Maverick | Zavala |
| Peregrine Falcon | *Falco peregrinus* | | T | X | X | X | X |
| Sprague's Pipit | *Anthus spragueii* | C | | X | X | X | X |
| Zone-tailed Hawk | *Buteo albonotatus* | | T | | X | | |
| **Mammals** | | | | | | | |
| Black Bear | *Ursus americanus* | T/SA | T | X | X | X | X |
| Jaguarundi | *Herpailurus yaguarondi* | E | E | X | | X | |
| Ocelot | *Leopardus pardalis* | E | E | X | X | X | X |
| White-nosed coati | *Nasua narica* | | T | X | X | X | X |
| **Reptiles** | | | | | | | |
| Reticulate collared lizard | *Crotaphytus reticulatus* | | T | X | X | X | X |
| Texas horned lizard | *Phrynosoma cornutum* | | T | X | X | X | X |
| Texas indigo snake | *Drymarchon melanurus erebennus* | | T | X | X | X | X |
| Texas tortoise | *Gopherus berlandieri* | | T | X | X | X | X |

[1] T – Threatened; E – Endangered; C – Candidate; T/SA – Listed as threatened by similarity of appearance.

Sources: TPWD 2014a; USFWS 2014b.

### 3.5.1.2 Fisheries and Other Aquatic Biological Resources

Regulatory Background

Regulations that directly influence aquatic species and habitat management decisions within the analysis area primarily are implemented by TPWD, USFWS, and USACE. Regulations and legal requirements related to aquatic species and habitat are listed in **Table 3.5-15**. In terms of management of aquatic species and their habitat in Texas, TPWD has management authority. The USFWS has regulatory oversight regarding the management of federally listed aquatic species. As part of their permitting process and responsibilities under NEPA as lead federal agency, the USACE is required to evaluate if proposed projects have the potential to affect federally listed species. State agencies are required to evaluate potential impacts to state listed species.

Regional Summary

Four Texas ecoregions overlap with the analysis area: East Central Texas Plains, Texas Blackland Prairies, Southern Texas Plains, and West Gulf Coastal Plain. Ecoregions that overlap with the study areas include: Study Area 1 (East Central Texas Plains and West Gulf Coastal Plain); Study Area 2 (West Gulf Coastal Plain); Study Areas 3 and 4 (East Central Texas Plains and Texas Blackland Prairies); and Study Areas 5 and 6 (Southern Texas Plains). Descriptions of these ecoregions are provided in Texas Conservation Action Plans (TPWD 2012a-d). The West Gulf Coastal Plain is dissected by numerous perennial streams that flow through rolling plains and form flat fluvial terraces, bottomlands, sandy low hills, and low cuestas (TPWD 2012d). This ecoregion also contains an abundance of reservoirs and lakes, as well as swamps, bogs, fens, springs, and seeps. The East Central Texas Plains ecoregion consists of gently rolling hills and a mosaic of woodlands and prairies that are crossed by streams and rivers (TPWD 2012a). The region is referred to as the “clay pan savannah,” which contains clay-dominated soils. The predominance of clay soils near the surface in portions of this region results in limited surface water resources. The Texas Blackland Plains ecoregion is a gently rolling to mostly flat area that contains an abundance of streams associated with the headwaters of the Trinity, Brazos, and Colorado river systems. Wetlands in this ecoregion, which consist of oxbows of the Trinity River system, are numerous (TPWD 2012c). The South Texas Plains ecoregion consists of gently rolling plains that are crossed by streams and rivers, which originate in the Edwards Plateau area (TPWD 2012b). Lakes and reservoirs are not prevalent in this ecoregion.

**Table 3.5-15 Relevant Regulations for Aquatic Species**

| Topic | Regulation |
|---|---|
| Aquatic Species Protection | TPWD<br>• Chapter 12 of the Texas Parks and Wildlife Code for protection of fish and wildlife resources.<br>• Chapters 67 and 68 of the Texas Parks and Wildlife Code and Sections 65.171 – 65.176 of Title 31 of the TAC for protection of state-listed endangered and threatened animal species.<br>• Section 68.002 of the Texas Parks and Wildlife Code that identifies endangered and threatened species in Texas.<br>• Section 68.015 and 65.171 prohibits the take of state-listed species. |
| | Federal<br>• Endangered Species Act—protect federally listed species.<br>• USACE (Section 10 of the Rivers and Harbors Act and 404 of the CWA)—regulate work in navigable waters (Section 10) and the discharge of dredge and fill material (Section 404) for the purpose of protecting aquatic resources. |
| Invasive Species Control | Chapter 12 of the Texas Parks and Wildlife Code for the control of nuisance or noxious aquatic vegetation. |

Overall, aquatic habitat in the analysis area includes a mixture of rivers, streams, reservoirs, lakes, ponds, wetlands, springs, seeps, and swamps. River and stream habitats consist of perennial, intermittent, and ephemeral waterbodies. Perennial streams contain water and wetted habitat continuously during a normal or average year, while intermittent (sporadic or periodic flows) and ephemeral (short-lived or transitory flow) provide temporary habitat for fish and other aquatic species. Important aquatic habitat in the analysis area is based on ecologically significant stream segments that are identified in the Texas Conservation Action Plans (TPWD 2012a-d). Ecologically significant stream segments are river and stream segments with ecological value, as defined by the Texas Water Development Board (Texas Administrative Board in coordination with TPWD) (TAC, Rule 352.2). The following criteria are used to define streams with unique ecological value:

- Biological Function—Stream segments which display significant overall habitat value including both quantity and quality considering the degree of biodiversity, age, and uniqueness observed including terrestrial, wetland, aquatic, or estuarine habitat;
- Hydrologic Function—Stream segments which are fringed by habitats that perform valuable hydrologic functions related to water quality, flood attenuation, flow stabilization, or groundwater recharge and discharge;

- Riparian Conservation Areas—Stream segments which are fringed by significant areas in public ownership including state and federal refuges, wildlife management areas, preserves, parks, mitigation areas, or other areas held by government purposes, or stream segments which are fringed by other areas managed for conservation purposes under a governmentally approved conservation plan;
- High Water Quality/Exceptional Aquatic Life/High Aesthetic Value—Stream segments and spring resources that are significant due to unique or critical habitats and exceptional aquatic life uses dependent on or associated with high water quality; or
- Threatened or Endangered Species/Unique Communities—Sites along streams where water development projects would have significant detrimental effects on state or federally listed threatened or endangered species, and sites along streams considered to be significant due to the presence of unique, exemplary, or unusually extensive natural communities.

Aquatic species discussed in this section include fish, freshwater mussels, amphibians, and reptiles. As a result of their recreational or commercial value, game and commercial fish species are an important focus in the management of aquatic species within Study Areas 1 through 6. Game fish resources within the study areas include warmwater species and are listed by study area and watershed in **Table 3.5-16**. Game fish species occurrence in lakes and reservoirs within the analysis area are listed in **Table 3.5-17**.

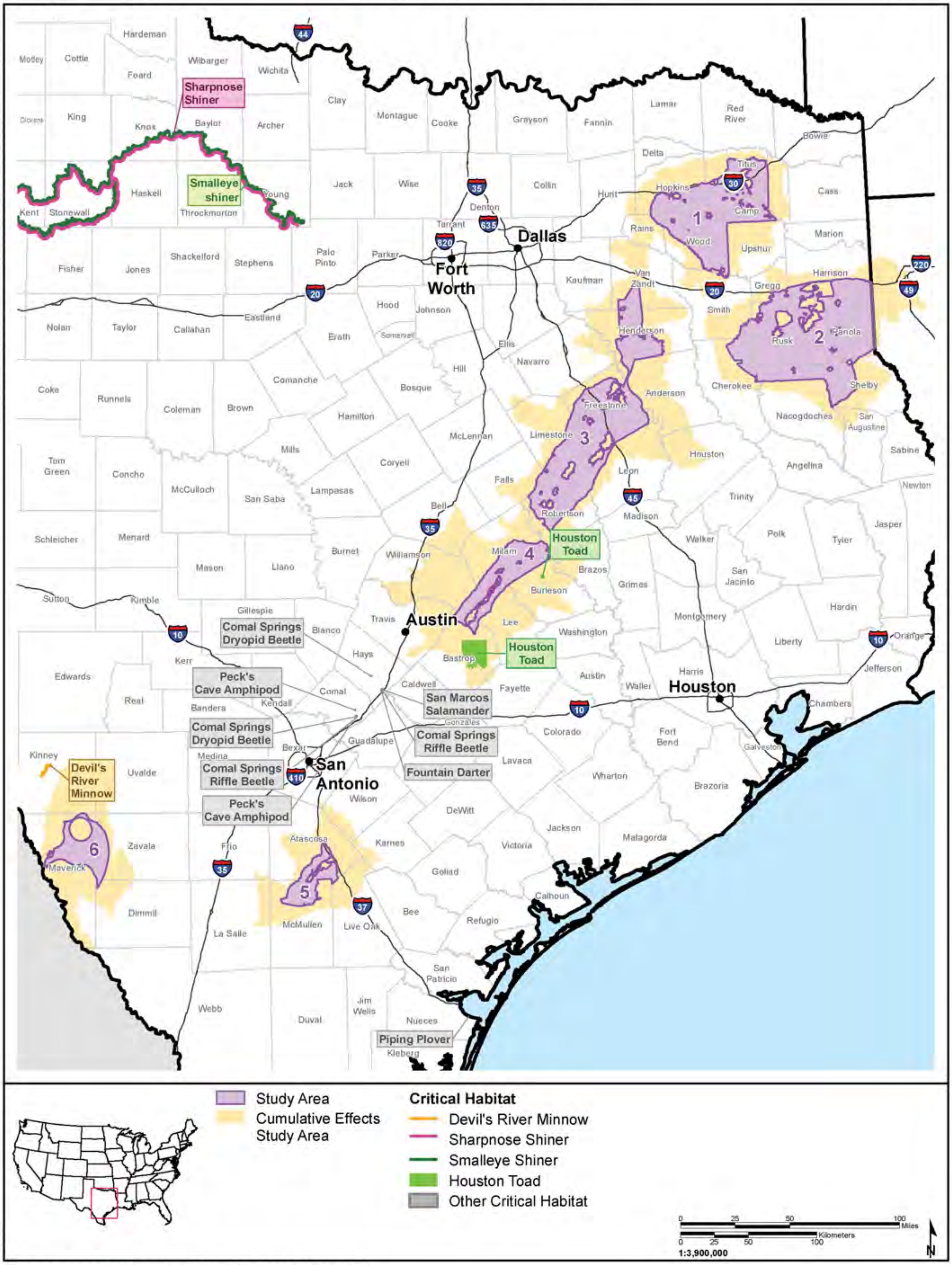
Information also is discussed for special status fish, mussel, amphibian, and reptile species, which include federally listed or proposed for listing species and state protected species. Information sources for species occurrence included Hendrickson and Cohen (2012), TPWD (2014a,b,c,d,g,h,i,j; 2012b,c,d), and the IPaC System. These information sources identified special status species that were evaluated for potential occurrence in Study Areas 1 through 6, as listed in **Appendix B**. Occurrence and habitat information was reviewed for these species to determine their potential for occurrence in Study Areas 1 through 6 or their elimination from further consideration in this analysis. Special status aquatic species with the potential to occur in Study Areas 1 through 6 are listed in **Table 3.5-18**. Critical habitat for special status species considered in this analysis is shown in **Figure 3.5-1**.

<u>Study Areas</u>

*Study Area 1*

<u>Habitat</u>

Aquatic habitat in Study Area 1 is associated with 11 watersheds (HUC 10) (see **Table 3.5-16**). Approximately 831 miles of perennial stream habitat is located within this study area. Four ecologically significant stream segments are present, including Big Cypress Creek, Little Cypress Creek, Little Sandy Creek, and the Sabine River. In total, approximately 38 miles of these segments occur in Study Area 1. The largest stream lengths of ecologically significant streams within Study Area 1 include Big Cypress Creek (19 miles) and the Sabine River (9 miles). Numerous large reservoirs also occur in the study area, including Lake Bob Sandlin, Lake Monticello, Lake Cypress Springs, Lake Winnsboro, Lake Quitman, Lake Hawkins, and Lake Fork.

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4/6/2015

**Figure 3.5-1 Designated Critical Habitat**

**Table 3.5-16 Game and Commercial Fish Species Occurrence by Watershed in Study Areas**

| Subbasins (HUC 8) | Watersheds (HUC 10) | Smallmouth buffalo | Black crappie | Guadalupe bass | Largemouth bass | Smallmouth bass | Spotted bass | Sunfish spp. | White crappie | Blue catfish | Bullhead spp. | Channel catfish | Flathead catfish | Headwater catfish | Chain pickerel | Redfin pickerel | Striped bass | White bass | Sauger | Yellow bass | Striped mullet | White mullet | Skipjack herring | Rainbow trout |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Area 1** | | | | | | | | | | | | | | | | | | | | | | | | |
| Lake Fork | Dry-Creek-Lake Fork Creek | | | | | | | | X | | | | | | | | | | | | | | | |
| | Lake Fork Creek-Case Lake | | | | | | | | | | | | | | | | | | | | | | | |
| | Running Creek-Case Lake | | | | | | | | | | | | | | | | | | | | | | | |
| Lake O' the Pines | Boggy Creek | | X | | X | | | | X | | X | X | | | | X | | | | | | | | |
| | Brushy Creek-Big Cypress Creek | | | | | | | | | | | | | | | | | | | | | | | |
| | Glade Branch-Big Cypress Creek | | | | | | | | | | | | | | | | | | | | | | | |
| Little Cypress | Little Cypress Creek | | | | X | | X | X | | | X | | X | | | X | | | | | | | | |
| Middle Sabine | Lake Winnsboro-Big Sandy Creek | | X | | X | | X | | X | X | X | X | X | | | X | | X | | X | | | | |
| | Old Sabine River Channel-Sabine River | | | | | | | | | | | | | | | | | | | | | | | |
| Upper Neches (CESA Only) | Black Fork Creek-Neches River | | | X | X | | | X | X | | X | X | | | | | | | | | | | | |

## Table 3.5-16 Game and Commercial Fish Species Occurrence by Watershed in Study Areas

| Subbasins (HUC 8) | Watersheds (HUC 10) | Smallmouth buffalo | Black crappie | Guadalupe bass | Largemouth bass | Smallmouth bass | Spotted bass | Sunfish spp. | White crappie | Blue catfish | Bullhead spp. | Channel catfish | Flathead catfish | Headwater catfish | Chain pickerel | Redfin pickerel | Striped bass | White bass | Sauger | Yellow bass | Striped mullet | White mullet | Skipjack herring | Rainbow trout |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| White Bayou | Lower Oak Creek | | | | X | | | X | | | | | | | | X | | | | | | | | |
| | Upper White Oak Creek | | | | | | | | | | | | | | | | | | | | | | | |
| **Area 2** | | | | | | | | | | | | | | | | | | | | | | | | |
| Bayou Pierre (CESA Only) | Wallace Bayou | X | X | | X | | X | X | X | X | X | X | X | | | X | | | X | X | X | | | |
| Cross Bayou, Caddo Lake | Cross Bayou | | | | X | | | X | X | | X | | | | X | X | | | | | | | | |
| | Paw Paw Bayou | | | | | | | | | | | | | | | | | | | | | | | |
| Lower Angelina | Caney Creek-Mud Creek | X | X | | X | | X | X | X | | X | X | | | | X | | | | | | | | |
| | Naconiche-Attoyac River | | | | | | | | | | | | | | | | | | | | | | | |
| Middle Sabine | Cherokee Bayou-Sabine River | X | X | | X | | X | X | X | X | X | X | X | | | X | | X | | X | | | | |
| | Eightmile Creek-Sabine River | | | | | | | | | | | | | | | | | | | | | | | |
| | Irons Bayou | | | | | | | | | | | | | | | | | | | | | | | |
| | Martin Creek | | | | | | | | | | | | | | | | | | | | | | | |
| | Murvaul Creek-Sabine River | | | | | | | | | | | | | | | | | | | | | | | |
| | Rabbit Creek-Sabine River | | | | | | | | | | | | | | | | | | | | | | | |

**Table 3.5-16 Game and Commercial Fish Species Occurrence by Watershed in Study Areas**

| Subbasins (HUC 8) | Watersheds (HUC 10) | Smallmouth buffalo | Black crappie | Guadalupe bass | Largemouth bass | Smallmouth bass | Spotted bass | Sunfish spp. | White crappie | Blue catfish | Bullhead spp. | Channel catfish | Flathead catfish | Headwater catfish | Chain pickerel | Redfin pickerel | Striped bass | White bass | Sauger | Yellow bass | Striped mullet | White mullet | Skipjack herring | Rainbow trout |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Socagee Creek-Sabine River | | | | | | | | | | | | | | | | | | | | | | | |
| Toledo Bend Reservoir | Flat Fork Creek | | X | | X | | X | X | X | X | X | X | X | | | | X | | | X | X | | | |
| | Tenaha Creek | | | | | | | | | | | | | | | | | | | | | | | |
| Upper Angelina | East Fork Angelina River-Angelina River | | X | | X | | X | X | X | | X | X | | | | X | | | | | | | | |
| | Shawnee Creek-Angelina River | | | | | | | | | | | | | | | | | | | | | | | |
| | Johnson Creek | | | | | | | | | | | | | | | | | | | | | | | |
| **Area 3** | | | | | | | | | | | | | | | | | | | | | | | | |
| Cedar | Cedar Creek Reservoir-Cedar Creek | | | | X | | | X | X | | X | | X | | | | | | | | | | | |
| Lower Brazos-Little Brazos | Cedar Creek-Brazos River | X | X | | X | | X | X | X | X | X | X | X | | | X | | X | | | | | | |
| | Little Brazos River-Brazos River | | | | | | | | | | | | | | | | | | | | | | | |
| | Walnut Creek-Brazos River | | | | | | | | | | | | | | | | | | | | | | | |
| Lower Trinity-Tehuacana | Buffalo Creek | X | X | | X | | X | X | X | | X | | X | | | | | | | | | | | |

**Table 3.5-16 Game and Commercial Fish Species Occurrence by Watershed in Study Areas**

| Subbasins (HUC 8) | Watersheds (HUC 10) | Smallmouth buffalo | Black crappie | Guadalupe bass | Largemouth bass | Smallmouth bass | Spotted bass | Sunfish spp. | White crappie | Blue catfish | Bullhead spp. | Channel catfish | Flathead catfish | Headwater catfish | Chain pickerel | Redfin pickerel | Striped bass | White bass | Sauger | Yellow bass | Striped mullet | White mullet | Skipjack herring | Rainbow trout |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Caney Creek-Tehuacana Creek<br>Catfish Creek<br>Lake Creek-Trinity River<br>Upper Keechi River | | | | | | | | | | | | | | | | | | | | | | | |
| Lower Trinity (CESA Only) | Lower Keechi Creek | | X | | X | | X | X | X | X | X | X | | | | | | X | X | X | | X | | |
| Navasota | Christmas Creek-Navasota River<br>Duck Creek-Navasota River | X | X | | X | | X | X | X | X | X | X | X | | | | | X | | | | | | |
| Richland (CESA Only) | Alligator Creek-Richland Creek | | | | | | | X | X | | | X | | | | | | | | | | | | |
| Upper Neches | Kickapoo Creek | X | X | | X | | X | X | X | | X | X | | | | X | | | | | | | | |
| Upper Sabine | Mill Creek-Sabine River | | X | | X | | X | X | X | | X | X | | | | X | | | | | | | | |
| Upper Trinity | Rush Creek-Trinity River | | | | X | | | X | X | | X | X | | | | | | X | | | | | | X |
| **Area 4** | | | | | | | | | | | | | | | | | | | | | | | | |
| Lower Brazos-Little Brazos | Cedar Creek-Brazos River | X | | X | X | | X | X | X | X | X | X | X | | | X | | X | | | X | X | X | |

**Table 3.5-16 Game and Commercial Fish Species Occurrence by Watershed in Study Areas**

| Subbasins (HUC 8) | Watersheds (HUC 10) | Smallmouth buffalo | Black crappie | Guadalupe bass | Largemouth bass | Smallmouth bass | Spotted bass | Sunfish spp. | White crappie | Blue catfish | Bullhead spp. | Channel catfish | Flathead catfish | Headwater catfish | Chain pickerel | Redfin pickerel | Striped bass | White bass | Sauger | Yellow bass | Striped mullet | White mullet | Skipjack herring | Rainbow trout |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lower Colorado-Cummins | Piney Creek-Colorado River | X | | X | X | | | X | X | X | | X | | | | | | | | | X | | | |
| Little (CESA Only) | Big Elm Creek<br>Lower Elm Creek<br>Upper Little River | | | | X | | | X | | | | | | | | | | | | | | | | |
| Little Cypress | Lower Little River | | | | X | | | X | | | | | | | | | | | | | | | | |
| Navasota (CESA Only) | Wickson Creek-Navasota River | X | X | | X | | X | | X | X | X | X | X | | | X | | X | | | | | | |
| San Gabriel (CESA Only) | Granger Lake-San Gabriel River<br>Turkey Creek-Brushy Creek | | | X | X | X | X | | | | X | X | X | | | | | X | | | | | | |
| Yegua | Davidson Creek<br>East Yegua River | | X | | X | | | X | X | | X | X | X | | | | X | | | | | | | |
| **Area 5** | | | | | | | | | | | | | | | | | | | | | | | | |
| Atascosa | Borrego Creek-Atascosa River<br>La Jarita Creek-San Miguel Creek<br>La Jarita Creek-San Atascosa River | X | | | | | | X | | | X | | | | | | | | | | | | | |

**Table 3.5-16 Game and Commercial Fish Species Occurrence by Watershed in Study Areas**

| Subbasins (HUC 8) | Watersheds (HUC 10) | Smallmouth buffalo | Black crappie | Guadalupe bass | Largemouth bass | Smallmouth bass | Spotted bass | Sunfish spp. | White crappie | Blue catfish | Bullhead spp. | Channel catfish | Flathead catfish | Headwater catfish | Chain pickerel | Redfin pickerel | Striped bass | White bass | Sauger | Yellow bass | Striped mullet | White mullet | Skipjack herring | Rainbow trout |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Lower Atascosa River | | | | | | | | | | | | | | | | | | | | | | | |
| Lower Frio | San Miguel Creek-Frio River | | | | | | | X | | | X | X | | | | | | | | | | | | |
| Middle Nueces (CESA Only) | Rex Cabiniss Creek-Nueces River | | | X | X | | | X | X | | X | X | | X | | | | | | | | | | |
| San Miguel (CESA Only) | LaJarita Creek-Atascosa River | | | | X | | | X | X | | X | X | | | | | | | | | | | | |
| **Area 6** | | | | | | | | | | | | | | | | | | | | | | | | |
| Elm-Sycamore | Elm Creek | X | | | X | X | | X | X | X | X | X | X | X | | | X | | | | | | | |
| San Ambrosia-San Isabel (CESA Only) | Rosita Creek-Rio Grande | X | | | X | X | X | X | | X | X | X | X | X | | | | X | | X | | | | |
| Turkey (CESA Only)[1] | Chaparrosa Creek<br>Lower Turkey Creek<br>Palo Blanco Creek-Comanche Creek | | | | | | | | | | | | | | | | | | | | | | | |

[1] No game fish species present in the subbasin and watersheds

Sources: Henrikson and Cohen 2012; USDA, NRCS 2004.

**Table 3.5-17 Game Fish Species in Lakes and Reservoirs within Study Areas**

| Study Area; Lake/Reservoir | Largemouth Bass | Sunfish Species | Bluegill | Redear Sunfish | Crappie Species | Spotted Bass | Catfish Species | Bluehead Catfish | Channel Catfish | Flathead Catfish | Spotted Bass | White Bass | Hybid Striped Bass | Chain Pickerel | Red Drum | Smallmouth Buffalo | Carp |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Study Area 1** | | | | | | | | | | | | | | | | | |
| Lake Bob Sandlin | X | | X | X | | X | X | | | | X | X | | | | | |
| Lake Monticello | X | | X | X | | | | | X | | | | | | | | |
| Lake Cypress Springs | X | | X | X | X | X | X | | | | X | X | | | | | |
| Lake Winnsboro | X | | | | X | | X | | | | | | | | | | |
| Lake Quitman | X | | X | X | X | | | | X | | | | | | | | |
| Lake Hawkins | X | X | | | X | | | | | | | | | X | | | |
| Lake Fork | X | | | | X | | X | | X | | | X | | | | | |
| **Study Area 2** | | | | | | | | | | | | | | | | | |
| Brandy Branch Reservoir | X | | X | X | | | | | X | | | | | | | | |
| Lake Murvaul | X | | X | X | X | | | | X | X | | | | | | | |
| Martin Creek Lake | X | X | | | X | | X | | | | | | | | | | |
| Striker Reservoir | X | | | | X | X | X | | | | | | | | | | |
| Lake Pinkston | X | X | | | X | | X | | | | X | | | | | | |
| Timpson Reservoir | X | X | | | X | | X | | | | | | | | | | |
| Lake Naconiche | | X | | | X | | | | X | | | | | | | | |
| **Study Area 3** | | | | | | | | | | | | | | | | | |
| Fairfield Lake | X | | | | | | X | | | | | | | X | | | |
| Lake Limestone | X | X | | | X | | | X | X | X | | X | | | | | |
| Cedar Creek Reservoir | X | X | | | X | | | X | X | X | | X | X | | | | |
| Lake Athens | X | | | X | X | | X | | | | | X | | | | | |
| Richland Chambers Reservoir | X | X | | | X | | | X | X | | | | X | | | X | X |
| **Study Area 5** | | | | | | | | | | | | | | | | | |
| Choke Canyon Reservoir | X | X | X | X | X | | | X | X | X | | X | | | | | |

Note: No game fish species occur in the lakes and reservoirs within Study Areas 4 and 6.

Source: TPWD 2014k.

**Table 3.5-18 Federal and State Listed Aquatic Species with Potential Habitat in the Study Area Counties**

| | Fish | | | | | | | Mussels | | | | | | | | | | | | | Amphibians | | Reptiles | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Common Name** | **Blackside darter** | **Blue sucker** | **Bluehead shiner** | **Creek chubsucker** | **Paddlefish** | **Pallid sturgeon** | **Rio Grande darter** | **Golden orb** | **Mexican fawnsfoot mussel** | **Salina mucket** | **Sandbank pocketbook** | **Smooth pimpleback** | **Southern hickorynut** | **Texas fatmucket** | **Texas fawnsfoot** | **Texas heelsplitter** | **Texas hornshell** | **Texas pigtoe** | **Texas pimpleback** | **Triangle pigtoe** | **Black-spotted newt** | **Houston toad** | **Aligator snapping turtle** | **Brazos River watersnake** |
| **Scientific Name** | *Percina maculata* | *Cycleptus elongatus* | *Pteronotropis hubbsi* | *Erimyzon oblongus* | *Polydon spathula* | *Scaphirhychus albus* | *Etheostoma grahami* | *Quadrula aurea* | *Truncilla cognata* | *Potamilus metnecktayi* | *Lampsilis satura* | *Quadrula houstonensis* | *Obovaria jacksoniana* | *Lampsilis bracteata* | *Truncilla macrodon* | *Potamilus amphichaenus* | *Popenaias popeii* | *Fusconaia askewi* | *Quadrula petrina* | *Fusconaia lananensis* | *Notophthalmus meridinalis* | *Anaxyrus houstonensis* | *Macrochelys temminckii* | *Nerodia harteri* |
| **Status** | ST | ST | ST | ST | ST | FE | ST | FC, ST | ST | ST | ST | FC, ST | ST | FC, ST | FC, ST | ST | FC, ST | ST | FC, ST | ST | ST | FE, SE | ST | ST |
| **Study Area 1 Counties** | | | | | | | | | | | | | | | | | | | | | | | | |
| Camp | X | | | X | X | | | | | | | | X | | | | | | | | | | X | |
| Franklin | X | | | X | X | | | | | | | | X | | | | | | | | | | X | |
| Hopkins | X | | | X | X | | | | | | | | | | | | | | | | | | X | |
| Morris (CESA) | X | | X | | X | | | | | | | | X | | | | | X | | | | | X | |
| Rains | | | | X | X | | | | | | X | | X | | | X | | X | | | | | X | |
| Smith (CESA) | | | | X | X | | | | | | X | | X | | | X | | X | | | | | X | |
| Titus | | | | X | X | | | | | | | | X | | | | | X | | | | | X | |
| Upshur (CESA) | | | X | X | X | | | | | | X | | X | | | X | | X | | | | | X | |
| Wood | | | | X | X | | | | | | X | | X | | | X | | X | | | | | X | |
| **Study Area 2 Counties** | | | | | | | | | | | | | | | | | | | | | | | | |
| Cherokee (CESA) | | | | X | X | | | | | | X | | X | | | X | | X | | | | | X | |
| Gregg | X | X | | X | X | | | | | | X | | X | | | X | | | | | | | | |
| Harrison | X | | X | X | X | | | | | | X | | X | | | X | | X | | | | | X | |
| Nacogdaches (CESA) | X | | X | | X | | | | | | X | | X | | | X | | X | | X | | | X | |
| Panola | X | | | X | X | | | | | | X | | X | | | X | | | | | | | X | |
| Rusk | | | | X | X | | | | | | X | | X | | | X | | X | | | | | X | |
| San Augustine (CESA) | | | | X | X | | | | | | X | | X | | | X | | X | | X | | | | |
| Shelby | X | | | X | X | | | | | | X | | X | | | X | | X | | | | | X | |
| Smith (CESA) | | | | X | X | | | | | | X | | X | | | X | | X | | | | | X | |
| Upshur (CESA) | | | X | X | X | | | | | | X | | X | | | X | | X | | | | | X | |
| Caddo & DeSoto LA (CESA) | | | | | | X | | | | | | | | | | | | | | | | | | |
| **Study Area 3 Counties** | | | | | | | | | | | | | | | | | | | | | | | | |
| Anderson (CESA) | | | | | | | | | | | X | | X | | | X | | X | | | | | X | |
| Falls | | | | | | | | | | | | X | | | X | | | | | | | | X | |
| Freestone | | | | | | | | | | | X | | | | | X | | X | | | | X | X | |
| Henderson | | | | X | | | | | | | X | | X | | | X | | X | | | | | X | |

**Table 3.5-18 Federal and State Listed Aquatic Species with Potential Habitat in the Study Area Counties**

| | Fish | | | | | | | Mussels | | | | | | | | | | | | | Amphibians | | Reptiles | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Common Name** | **Blackside darter** | **Blue sucker** | **Bluehead shiner** | **Creek chubsucker** | **Paddlefish** | **Pallid sturgeon** | **Rio Grande darter** | **Golden orb** | **Mexican fawnsfoot mussel** | **Salina mucket** | **Sandbank pocketbook** | **Smooth pimpleback** | **Southern hickorynut** | **Texas fatmucket** | **Texas fawnsfoot** | **Texas heelsplitter** | **Texas hornshell** | **Texas pigtoe** | **Texas pimpleback** | **Triangle pigtoe** | **Black-spotted newt** | **Houston toad** | **Aligator snapping turtle** | **Brazos River watersnake** |
| **Scientific Name** | *Percina maculata* | *Cycleptus elongatus* | *Pteronotropis hubbsi* | *Erimyzon oblongus* | *Polydon spathula* | *Scaphirhychus albus* | *Etheostoma grahami* | *Quadrula aurea* | *Truncilla cognata* | *Potamilus metnecktayi* | *Lampsilis satura* | *Quadrula houstonensis* | *Obovaria jacksoniana* | *Lampsilis bracteata* | *Truncilla macrodon* | *Potamilus amphichaenus* | *Popenaias popeii* | *Fusconaia askewi* | *Quadrula petrina* | *Fusconaia lananensis* | *Notophthalmus meridinalis* | *Anaxyrus houstonensis* | *Macrochelys temminckii* | *Nerodia harteri* |
| **Status** | ST | ST | ST | ST | ST | FE | ST | FC, ST | ST | ST | ST | FC, ST | ST | FC, ST | FC, ST | ST | FC, ST | ST | FC, ST | ST | ST | FE, SE | ST | ST |
| Hill (CESA) | | | | | | | | | | | | | | | X | | | | | | | | | X |
| Houston (CESA) | | | | X | X | | | | | | X | | X | | | X | | | | | | | X | |
| Leon | | | | | | | | | | | X | X | | | | X | | X | | | | X | X | |
| Limestone | | | | | | | | | | | | X | | | X | | | | | | | | X | |
| Navajo (CESA) | | | | | | | | | | | X | | | | | X | | X | | | | | | |
| Robertson | | X | | | | | | | | | | X | | | X | | | | | | | X | X | |
| Van Zandt | | | | X | X | | | | | | X | | X | | | X | | X | | | | | X | |
| **Study Area 4 Counties** | | | | | | | | | | | | | | | | | | | | | | | | |
| Bastrop | | X | | | | | | | | | | X | | | X | | | | X | X | | X | | |
| Bell (CESA) | | | | | | | | | | | | X | | | X | | | | | | | | | |
| Burlson (CESA) | | X | | | | | | | | | | | | | | | | | | | | X | X | |
| Fayette (CESA) | | X | | | | | | | | | | X | | | | | | | X | | | | | |
| Lee | | | | | | | | | | | | X | | | X | | | | | | | X | | |
| Milam | | X | | | | | | | | | | X | | | X | | | | | | | X | X | |
| Travis (CESA) | | | | | | | | | | | | X | | X | | | | | X | | | | | |
| Williamson | | | | | | | | | | | | X | | | X | | | | | | | | X | |
| **Study Area 5 Counties** | | | | | | | | | | | | | | | | | | | | | | | | |
| Atascosa | | | | | | | | X | | | | | | | | | | | | | | | | |
| Frio (CESA) | | | | | | | | | | | | | | | | | | | | | | | | |
| Karnes (CESA) | | | | | | | | X | | | | | | | | | | | X | | | | | |
| LaSalle (CESA) | | | | | | | | | | | | | | | | | | | | | | | | |
| Live Oak (CESA) | | | | | | | | X | | | | | | | | | | | | | X | | | |
| McMullen | | | | | | | | X | | | | | | | | | | | | | X | | | |
| Wilson (CESA) | | | | | | | | X | | | | | | | | | | | X | | | | | |
| **Study Area 6 Counties** | | | | | | | | | | | | | | | | | | | | | | | | |
| Dimmit (CESA) | | | | | | | | | | | | | | | | | | | | | | | | |
| Kinney (CESA) | | X | | | | | X | | X | X | | | | | | | X | | | | | | | |
| Maverick | | | | | | | X | | X | X | | | | | | | | | | | | | | |
| Zavada | | | | | | | | | | | | | | | | | | | | | | | | |

FT = Federal threatened; FE = Federal endangered; PE = Federally proposed endangered FC = Federal candidate; EX/NE = Experimental/Non-essential; ST = Texas threatened; and SE = Texas endangered.
CH = critical habitat has been designated for the species.

Game Fish/Commercial Species

Twelve game fish species occur within the Study Area 1 counties. The number of game fish species range from 1 in Dry Creek-Lake Fork Creek, Lake Fork Creek-Case Lake, and Running Creek-Case Lake watersheds to 11 species in the Lake Winnsboro-Big Sandy Creek and Old Sabine River Channel-Sabine River watersheds. The most diverse fisheries occur in the Lake Winneboro-Big Sandy Creek, Old Sabine River Channel-Sabine River, and Little Cypress Creek watersheds, as represented by largemouth bass, spotted bass, sunfishes, temperate basses (i.e., white and yellow bass), redfin pickerel, and catfishes (blue, channel, and flathead catfish). Lakes and reservoirs in Study Area 1 contain a mixture of largemouth bass, sunfishes, temperate basses, and catfishes (see **Table 3.5-17**. Largemouth bass is a predominant species in all reservoirs in Study Area 1. The most diverse game fisheries in the Study Area 1 lakes and reservoirs occur in Lake Cypress Springs and Lake Bob Sandlin, with 8 and 7 species or groups of species, respectively.

Special Status Species

Based on county occurrence information, species evaluations were conducted for four fish (blackside darter, bluehead shiner, creek chubsucker, and paddlefish), five mussels (Louisiana pigtoe, sandbank pocketbook, southern hickorynut, Texas heelsplitter, and Texas pigtoe), and one reptile species (alligator snapping turtle) that are state listed (**Appendix B**). No federally listed species potentially occur in Study Area 1. The potential occurrence of the state threatened species in Study Area 1 is listed below by river or stream. Species occurrence by county is shown in **Table 3.5-18**. Habitat and life history information is provided in **Appendix B**.

- Cypress River – blackside darter, alligator snapping turtle;
- Sabine River – creek chubsucker, paddlefish, sandbank pocketbook, southern hickorynut, Texas heelsplitter, Texas pigtoe, and alligator snapping turtle;
- Small streams in Camp, Franklin, Hopkins, and Morris counties – blackside darter; and
- Small streams in Morris and Upshur counties – bluehead shiner.

*Study Area 2*

Habitat

Study Area 2 overlaps with aquatic habitat in 16 watersheds (HUC 10) (see **Table 3.5-16**). Approximately 1,797 miles of perennial stream habitat is located within the study area. Based on channel size or geographic extent, major rivers or streams in Study Area 2 include the Angelina River, Sabine River, Murvail Creek, Flat Fork Creek, Caddo Creek, Brushy Creek, Sixmile Creek, Martin Creek, and Socagee Creek. Five ecologically significant stream segments occur in Study Area 2, including Attoyoc Bayou, Irons Bayou, Sandy Creek, Sabine River, and West Creek. In total, approximately 133 miles of these segments overlap with the Study Area 2 boundary. The largest stream lengths of ecologically significant streams within Study Area 2 include the Sabine River (81 miles), Irons Bayou (28 miles), and Attoyac River (17 miles). Large reservoirs or lakes in Study Area 2 include Brandy Branch Reservoir, Lake Murvaul, Martin Creek Lake, Striker Reservoir, Lake Pinston, Timpson Reservoir, and Lake Naconiche.

Game Fish/Commercial Species

Thirteen game fish species or species groups occur in the Study Area 2 counties. The game fish species include largemouth bass, spotted bass, sunfishes, crappies, temperate bass, catfish, chain pickerel, and redfin pickerel. Commercial species include smallmouth buffalo, which occurs in the Middle Sabine and Lower Angelina subbasins, and striped mullet, which is present in the Toledo Bend Reservoir subbasin.

The number of game fish species or species groups ranges from 6 to 13, with the most diverse fisheries occurring in the Middle Sabine and Toledo Bend subbasins (see **Table 3.5-16**). Game fish species in the Study Area 2 lakes and reservoirs contain a mixture of largemouth bass, sunfishes, crappies, catfish species (**Table 3.5-17**). The number of species range from 2 to 6, with the most diverse game fisheries in Lake Marvual (6 species) and Lake Pinkston (5). Largemouth bass is present in all of the Study Area 2 lakes and reservoirs except Lake Naconiche.

Special Status Species

Potential habitat for 13 special status aquatic species was evaluated in Study Area 2, which included six fish (blackside darter, blue sucker, bluehead shiner, creek chubsucker, paddlefish, and pallid sturgeon), six mussels (Louisiana pigtoe, sandbank pocketbook, southern hickorynut, Texas heelsplitter, Texas pigtoe, and Triangle pigtoe), and one reptile (alligator snapping turtle) (**Appendix B**). The potential county occurrence of species in Study Area 2 is presented in **Table 3.5-18**. Occurrence by river or stream is listed below. Habitat and life history information is provided in **Appendix B**.

- Angelina River – triangle pigtoe;
- Sabine River – blue sucker, creek chubsucker, paddlefish, sandbank pocketbook, southern hickorynut, Texas heelsplitter, Texas pigtoe, and alligator snapping turtle; and
- Red River (Louisiana) (CESA) – pallid sturgeon.

*Study Area 3*

Habitat

Fourteen watersheds (HUC 10) are located within the boundary of Study Area 3, with approximately 411 miles of perennial stream habitat (see **Table 3.5-16**). Major rivers or streams in Study Area 3 include Cedar Creek, Cottonwood Creek, Brazos River, Tehuacana Creek, Trinity River, Navasota River, Mill Creek, Sabine River, Upper Keechi Creek, and Walnut Creek. Five ecologically significant stream segments overlap with the Study Area 3 boundary: Buffalo Creek, Catfish Creek, Linn Creek, Purtis Creek, and Trinity River. In total, approximately 74 miles of these segments occur in Study Area 3. The largest stream lengths of ecologically significant streams within Study Area 3 include Trinity River (46 miles), Buffalo Creek (14 miles), and Purtis Creek (8 miles). Large reservoirs or lakes in Study Area 3 include Cedar Creek Reservoir, Fairfield Lake, Lake Athens, Lake Limestone, and Richland Chambers Reservoir.

Game Fish/Commercial Species

Thirteen game fish species or species groups occur in the Study Area 3 watersheds (see **Table 3.5-16**). One coldwater species, rainbow trout, is present in the Rush Creek-Trinity River watershed. The other game fish species are indicative of warmwater environments and include largemouth bass, spotted bass, sunfishes, crappies, temperate bass, catfish, and chain pickerel. Commercial species include the smallmouth buffalo that occurs in the Lower Brazos-Little Brazos, Lower Trinity-Tehuacana, Navasota, and Upper Neches subbasins. The number of game fish species or species groups ranges from 7 to 12, with the most diverse fisheries occurring in the Navasota and Lower Brazos subbasins. Game fish species in the Study Area 3 lakes and reservoirs contain a mixture of largemouth bass, sunfishes, crappies, and catfish species (**Table 3.5-17**). Carp and smallmouth buffalo occur in Richland Chambers Reservoir. The number of species range from 3 to 8, with the most diverse game fisheries in Cedar Creek Reservoir and Richland Chambers Reservoir. Seven game fish species or groups are present in in Lake Limestone. Largemouth bass occurs in all of the Study Area 3 lakes and reservoirs.

Special Status Species

Potential habitat for 16 state listed species was evaluated for Study Area 3, which included five fish (blue sucker, creek chubsucker, paddlefish, sharpnose shiner, and smalleye shiner), eight mussels (false spike mussel, Louisiana pigtoe, sandbank pocketbook, smooth pimpleback, southern hickorynut, Texas fawnsfoot, Texas heelsplitter, and Texas pigtoe), one amphibian (Houston toad), and two reptiles (alligator snapping turtle and Brazos River watersnake) (**Appendix B**). Based on the evaluation, species with potential occurrence in Study Area 3 are listed in **Table 3.5-18**. Potential habitat for one federally listed amphibian species, Houston toad, occurs in three counties in Study Area 3 (Freestone, Leon, and Robertson). Houston toad uses aquatic habitat such as perennial and ephemeral pools and stock tanks for breeding. Two federally endangered species, sharpnose shiner and smalleye shiner, were eliminated from further consideration due to the lack of occurrence data and habitat in Study Area 3. Three federal candidate mussels, smooth pimpleback, Texas fawnsfoot, and Texas pimpleback, potentially occur in Study Area 3.

The potential occurrence of other state listed fish and mussel species in Study Area 3 is listed below by river or stream. Potential county occurrence is shown in **Table 3.5-18**. Habitat and life history information is provided in **Appendix B**.

- Brazos River and tributaries – blue sucker, Brazos River watersnake;
- Sabine River and tributaries – blue sucker, creek chubsucker, sandbook pocketbook, southern hickorynut, Texas fawnsfoot, Texas heelsplitter, Texas pigtoe; and
- Trinity River and tributaries – creek chubsucker, smooth pimpleback, Texas heelsplitter, Texas pigtoe.

*Study Area 4*

Habitat

Study Area 4 overlaps with aquatic habitat in five watersheds (HUC 10), with approximately 70 miles of perennial stream habitat (see **Table 3.5-16**). Streams with the largest length of perennial habitat in Study Area 4 include Middle Yegua Creek (13 miles), Sandy Creek (12 miles), Cedar Creek (9 miles), Threemile Creek (8 miles), Sixmile Creek (7 miles), Allen Creek (7 miles), and the Little River (7 miles). One ecologically significant stream segment, Little River, is located within Study Area 4. In total, approximately 7 miles of this ecologically significant segment occurs in this study area. No lakes or reservoirs are located in this study area.

Game Fish/Commercial Species

Fifteen game fish species or species groups occur in the Study Area 4 watersheds (see **Table 3.5-16**). The game fish species include largemouth bass, spotted bass, Guadalupe bass, sunfishes, crappies, temperate bass, catfish, redfin pickerel, mullets, and skipjack herring. Commercial species such as smallmouth buffalo, mullets, and skipjack herring, occur in the Lower Brazos-Little Brazos and Lower Colorado-Cummins subbasins. The number of game fish species or species groups ranges from 2 in the Lower Little River watershed to 15 in the Cedar Creek-Brazos River watershed. There are no lakes or reservoirs with game species in Study Area 4.

Special Status Species

Potential occurrence in Study Area 4 was evaluated for 15 species, which includes three fish (blue sucker, sharpnose shiner, and smalleye shiner), six mussels (false spike mussel, smooth pimpleback, Texas fatmucket, Texas fawnsfoot, Texas pimpleback, and triangle pigtoe), six amphibians (Austin blind salamander, Barton Springs salamander, Georgetown salamander, Jollyville Plateau salamander, Salado Springs salamander, and Houston toad), and one reptile (alligator snapping turtle) (**Table 3.5-18**).

Potential habitat for the federally endangered Houston toad occurs in four counties in Study Area 4 (Bastrop, Burleson, Lee, and Milam). Critical habitat for Houston toad also exists in Bastrop and Burleson counties. Two federally listed fish species (sharpnose shiner and smalleye shiner) and two federally listed amphibian species (Barton Springs salamander and Georgetown salamander) were eliminated for further consideration due to a lack of occurrence records or suitable habitat (**Appendix B**).

The potential occurrence of the federal candidate and state listed species in Study Area 4 is listed below by river or stream. Potential county occurrence is shown in **Table 3.5-18**. Habitat and life history information is provided in **Appendix B**.

- Brazos River – false spike mussel, smooth pimpleback, Texas fawnsfoot, alligator snapping turtle;
- Colorado River – false spike mussel, smooth pimpleback, Texas fawnsfoot, Texas pimpleback, alligator snapping turtle; and
- Onion Creek – Texas fatmucket.

*Study Area 5*

<u>Habitat</u>

Study Area 5 contains approximately 27 miles of perennial stream habitat. Five watersheds (HUC 10) are located within the boundary of Study Area 5 including Borrego Creek-Atascosa River, La Jarita Creek-San Miguel Creek, La Jarita Creek-San Atascosa River, Lower Atascosa River, and San Miguel Creek-Frio River (see **Table 3.5-16**). Major rivers or streams in Study Area 5 include the Frio and Atacosa rivers and San Miguel and Lipan creeks. Streams with the largest lengths in Study Area 5 include San Miguel Creek (13 miles) and the Atascosa River (10 miles). No ecologically significant streams are located in this study area. One reservoir, Choke Canyon, occurs in Study Area 5.

<u>Game Fish/Commercial Species</u>

Game fish species are limited in Study Area 5, as indicated by three species each in the Atascosa and Lower Frio subbasins. Species or species groups include smallmouth buffalo, sunfishes, and bullhead species in the Atascosa basin and sunfishes, channel catfish, and bullhead species in the Lower Frio basin (see **Table 3.5-16**). One perennial stream, the Atascosa River, is part of the Lower Frio subbasin; while the Frio and Atascosa rivers and Lipan and San Miguel creeks are part of the Atascosa subbasin. One reservoir, Choke Canyon Reservoir, contains game fish species (see **Table 3.5-17**)

<u>Special Status Species</u>

Potential habitat in Study Area 5 was evaluated for three species (false spike mussel, golden orb mussel, and the black-spotted newt) (**Appendix B**). The evaluation resulted in the false spike mussel being eliminated from further consideration. Golden orb historically occurred throughout the Nueces-Frio and Guadalupe-San Antonio River basins and is now known from only nine locations in four rivers (USFWS 2013). The golden orb has been eliminated from nearly the entire Nueces-Frio River basin. As a result, golden orb does not currently exist in the Frio River or other streams within Study Area 5. However, historical habitat would represent potential habitat for this species. Recent records for black-spotted newt exist in McCullen County. The species does not occur in the portion of Live Oak County within Study Area 5. Potential habitat for the special status species are listed below. Potential county occurrence is provided in **Table 3.5-18**.

- Frio River – golden orb, smooth pimpleback; and
- Ponds, ditches, and swamps in McCullen County – black-spotted newt.

*Study Area 6*

Habitat

Study Area 6 contains has approximately 4 miles of perennial stream habitat and only one perennial stream, Elm Creek (see **Table 3.5-16**). No ecologically significant streams or lakes and reservoirs occur in this area.

Game Fish/Commercial Species

Elm Creek contains a relatively diverse mixture of game fish, as indicated by 11 species or species groups (see **Table 3.5-16**). The game fish species include smallmouth buffalo, largemouth bass, smallmouth bass, sunfishes, catfishes, and striped bass. There are no lakes or reservoirs with game species in Study Area 6.

Special Status Species

Potential habitat was evaluated for 16 federal or state listed species in Study Area 6, which included six fish (blue sucker, Devils River minnow, fountain darter, proserpine shiner, Rio Grande darter, and Rio Grande silvery minnow), three mussels (Mexican fawnsfoot mussel, Salina mucket, and Texas hornshell), and three amphibians (San Marcos salamander, Texas blind salamander, and South Texas siren) (**Appendix B**). Two species, Devils River minnow and Rio Grande silvery minnow, are federally listed and one mussel, Texas hornshell, is a federal candidate. Based on the evaluation, potential habitat occurs in Study Area 6 for five species: blue sucker, Mexican fawnsfoot mussel, Salina mussel, and Texas hornshell. These species potentially occur in tributaries to the Rio Grande River. The other species were eliminated from further consideration. Potential county occurrence is provided in **Table 3.5-18**.

## 3.5.2 Environmental Consequences

The primary issues related to terrestrial wildlife resources include the direct loss or alteration of terrestrial and aquatic habitats in the study areas, potential changes in wetland and riparian habitat as a result of groundwater level changes within the projected mine-related groundwater drawdown areas and mine-related discharges, noise and lighting effects on wildlife, and potential impacts to threatened and endangered species.

The study area for direct and indirect impacts to terrestrial wildlife resources (including special status species) includes the habitat and species within Study Areas 1 through 6.

### 3.5.2.1 Terrestrial Wildlife

The analysis area for direct and indirect impacts to terrestrial wildlife resources (including special status species) includes the land within the boundaries of Study Areas 1 through 6.

The primary issues related to terrestrial wildlife resources include the loss or alteration of terrestrial habitats and potential changes in wetland and riparian habitat as a result of groundwater level changes within the projected mine-related groundwater drawdown areas. Habitat would be recreated incrementally as concurrent reclamation proceeds after mining operations are completed. Other potential impacts to wildlife during mine construction and operations would include direct mortalities from construction activities, incremental habitat fragmentation, animal displacement, transmission line collisions, increased noise and light, additional human presence and associated habitat disruption, and the potential for increased vehicle-related mortalities. There is potential for incremental long-term and short-term habitat loss throughout the life of each mine that would affect big game, small mammals, upland game birds, waterfowl, raptors, songbirds, and reptiles. It is anticipated that the amount of habitat affected would be limited, relative to that available in the surrounding area, so the mine-relating habitat loss is not expected to result in substantial population reductions of local wildlife species. These populations would be expected to recover following mine reclamation.

The environmental consequences in this section are described in general and it is assumed that the impacts to species and wildlife habitat types would be in proportions similar to the distribution of species and habitat types or vegetation types described for each study area in the Affected Environment section, Section 3.5.1.

Proposed Action

Potential impacts to terrestrial wildlife as a result of development of a typical mine can be classified as short-term and long-term, direct and indirect. Short-term impacts are associated with habitat removal and disturbance as well as mining-related activities. These impacts would cease following mine closure and completion of successful reclamation. Direct impacts include wildlife mortality, habitat loss and alteration, habitat fragmentation, and displacement. Indirect impacts include increased noise, light, and human presence. Long-term impacts include permanent changes to, or loss of, habitats and the wildlife populations that depend on those habitats, irrespective of reclamation success. Even with successful reclamation, the plant communities would be altered from native conditions for a long time period.

Temporary and permanent loss or alteration of habitat due to land clearing and earth-moving would cause the greatest potential impact to terrestrial wildlife. Construction and operation of future mine expansion areas and satellite mines would result in habitat loss and alteration, and also would result in direct losses of smaller, less mobile wildlife species, such as small mammals and reptile species. It is anticipated that the larger species displaced from the disturbance areas to surrounding habitats during construction and operation would return following reclamation as long as the habitat returns. The disturbed areas would be reclaimed to achieve the post-mining land uses as required by RCT and discussed in Section 2.2.4.3. However, if surrounding habitats are already at carrying capacity, these species may be forced to use marginal habitat, migrate, or they may represent indirect mortality impacts.

**Table 3.5-3** details the acres of vegetation types that occur in each study area. Some of these vegetation types would be lost as a result of the development of a typical mine, but the specifics depend on the site-specific location of future mine expansion areas and satellite mine.

In the mine areas, a related direct loss of wildlife habitat would occur incrementally over the life of the mines. To minimize impacts to habitats and the species dependent on them, committed environmental protection measures include limiting the acreage of mining disturbance at any given time, limiting disturbance (to the extent possible) within high-value habitat, and prompt revegetation of disturbed areas in accordance with the mine-specific reclamation plan (as required by RCT) and Conceptual Mitigation Plan for waters of the U.S., including wetlands (as required by USACE).

The long-term reclamation goals for a typical mine include establishing a sustainable vegetative cover that would promote the identified post-mining land uses, returning the disturbed areas to productive post-mining land uses equal to or better than pre-mining conditions, and maintaining appropriate drainage patterns and water quality and quantity. Pending completion of reclamation, habitat impacts from surface disturbance in the mine areas would be both short-term and long-term depending on the type of land use impacted (i.e., short-term for grasslands and croplands and long-term for forestry).

Terrestrial wildlife species likely affected by reductions in surface water sources and associated habitats could include big and small game, upland game birds and mammals, waterfowl, nongame birds (e.g., raptors and passerines), mammals (e.g., bats), and reptiles. The extent of these indirect effects from the mine's dewatering activities would depend on the species' use and relative sensitivity, as discussed for each group below.

The potential loss or reduction in available surface water as a result of groundwater level change could cause long-term changes in wildlife habitats where the surface water sources are hydraulically connected to affected aquifers within the projected mine-related 5-foot groundwater drawdown area (see Section 3.2, Water Resources). The habitats associated with naturally occurring groundwater-fed perennial and intermittent stream reaches and associated perennial pools encompass riparian vegetation (both woody and herbaceous plant species) and wetland areas. Reduction or loss of riparian and wetland habitats supported by these water sources would adversely impact terrestrial wildlife dependent on these sources, resulting in a possible reduction or loss of cover, breeding sites, foraging areas, and changes in both plant and animal community structures. However, long-term impacts to riparian habitats and surface water sources would be minimized because reclamation typically would be achieved through creation, restoration, or enhancement techniques outlined in a mine-specific Conceptual Mitigation Plan, developed and submitted in accordance with the requirements of the USACE's Section 404 permitting process.

Naturally occurring perennial and intermittent streams provide important wildlife habitat within the study areas. Riparian habitat and its associated plant communities contribute to greater wildlife species diversity, compared to the adjacent upland areas. The loss of surface water and the associated riparian habitat would alter the available habitat for species that depend on these riparian areas, resulting in: 1) a reduction of available water for consumption; 2) a reduction in riparian vegetation for breeding, foraging, and cover; 3) a potential reduction in the regional carrying capacity (depending on the species and site-specific conditions); 4) displacement and loss of animals; and 5) reduction in prey availability. The degree of impacts to wildlife resources would depend on a number of variables, such as the existing habitat values and level of use; species' sensitivity (i.e., level of dependency on riparian areas); and the extent of the anticipated water and riparian habitat reductions.

A typical mine would result in adverse impacts to terrestrial wildlife species disruption due to increased human presence, noise, and light. The most common wildlife responses to noise and human presence are avoidance or acclimation. The total extent of habitat lost or affected as a result of wildlife avoidance response is impossible to predict because the degree of this response varies from species to species and even between individuals of the same species. However, it is anticipated that most of the terrestrial wildlife species known to occur in the vicinity of existing mines already are acclimated to human presence on some level, or that they have the ability to acclimate. During initial development stages, many species most likely would disperse from the area; however, as species become acclimated to human presence and noise, the majority most likely would return to reoccupy undisturbed habitats within and surrounding the disturbance areas.

Increased human/wildlife interactions during the construction and operation phases of mine development have the potential to result indirectly in wildlife harassment, poaching, and illegal harvest or accidental mortality. Increased human presence and related increases in traffic levels on mine access routes would increase the potential for wildlife/vehicle collisions, with the greatest potential occurring during peak operations.

Artificial light at night introduced to areas currently without lighting could adversely impact wildlife behaviors including mating, foraging, sleeping, and migratory behaviors (International Dark-sky Association [IDA] 2008). These behaviors are determined by the length of nighttime lighting. For example, birds can become disoriented by artificial light, disrupting migration routes and causing additional energy expenditure by staying near light sources. Tens of thousands of migrating birds die each year in collisions with buildings left illuminated at night (IDA 2008). Crepuscular and nocturnal mammals such as raccoons, bats, deer, coyotes, and mice may lose the nighttime ecosystem they depend on for food and protection against predators.

*Game Species*

Within Study Areas 1 – 6, impacts to big game species (primarily white-tailed deer and javelina) from surface disturbance would include the incremental, short-term reduction of potential foraging habitat during the life of the mines and the incremental increase in habitat fragmentation. These impacts may result in a short-term decrease in populations; however, it is anticipated that deer and javelina temporarily displaced by mining-related activities would be able to relocate to surrounding habitats and would re-inhabit the mining-related disturbed areas following the reestablishment of vegetation. Therefore, it is anticipated that adverse impacts to big game populations would be minimal.

Impacts to small game species would be similar to those for big game species. Direct impacts would include the short-term loss of potentially suitable breeding, nesting, and foraging habitat; habitat fragmentation; and displacement of species. Direct impacts also may include nest or burrow abandonment or the loss of eggs or young, resulting in reduced productivity for that breeding season. However, as detailed in the typical committed environmental protection measures in Section 2.2.5, clearing operations would be conducted during non-breeding periods to avoid the peak migratory bird breeding season to the extent possible. Many species' breeding seasons overlap with the migratory bird breeding season, thereby minimizing the adverse impacts to many breeding species within the study areas. Additionally, because most of the small game species within the study areas are considered habitat generalists, it is anticipated that displaced species would find suitable habitat surrounding the mine areas, and the population density within the mine area would be expected to increase following the reestablishment of vegetation.

White-tailed deer require water to satisfy physiological requirements. The reduction or loss of existing water sources within minerelated disturbance areas could affect white-tailed deer habitat use and movements. It is assumed that some individuals would be locally displaced due to the reduction of surface water and riparian vegetation. Displaced individuals could be lost from the population should they relocate to other areas; however, this loss cannot be quantified. Adverse impacts to regional deer populations from the potential mine-related reduction of surface water and riparian vegetation would be expected to be low, primarily due to compliance with permit requirements and environmental protection measures, including concurrent reclamation.

Javelina will freely utilize, but do not require an abundance of surface water, using prickly pear and other succulents as its main water source (Taylor and Synatzske 2008). Therefore, reductions in access to surface water are not likely to affect this species.

A reduction in riparian communities would adversely affect the amount of suitable habitat available for small game species, such as waterfowl and small fur-bearing mammals. A decline in surface water availability would reduce the extent of open water and riparian vegetation along portions of the streams and perennial ponds used by these species. Because most of the small mammal species within the study areas are considered habitat generalists, it is anticipated that nongame mammal species would find suitable habitat surrounding future mine areas during construction and operations, and population density within the mine area would increase following successful reclamation and revegetation.

The short- and long-term effects to waterfowl species that may be present within the study areas would vary, depending on the vegetative structure and habitat types associated with each study area that may support migrating and wintering birds. The impacts to waterfowl species that commonly occur within the study areas may include the reduction of ponds and intermittent and perennial streams within the projected mine-related 5-foot groundwater drawdown areas that support adequate riparian habitat used for foraging and cover. The reduction or loss of available surface water and associated emergent plants in these naturally occurring wetland areas currently used by waterfowl would result in the displacement of these birds to adjacent habitats. Required mitigation and reclamation activities would help to offset these adverse impacts and may provide enhanced habitat for wildlife utilization.

*Nongame Species*

A variety of nongame species, including migratory birds, are found within the study areas. It is probable that nesting birds occur within or adjacent to future mining-related disturbed areas. Potential direct impacts to migratory birds would include the short-term and long-term loss of potentially suitable breeding, roosting, and foraging habitat. However, based on the availability of potentially suitable breeding and foraging habitat in the areas adjacent to future mines, the adverse effects to local bird populations are anticipated to be low. If construction or ground-clearing activities were to occur during the breeding season, direct impacts to breeding birds could include the loss of active nest sites or abandonment of a nest site due to increased human presence and noise in proximity to a nest site. Loss of active nest sites of migratory birds, incubating adults, eggs, or young would be in violation of the Migratory Bird Treaty Act. To minimize adverse impacts to breeding birds, the typical environmental protection measures listed in Section 2.2.5 would be implemented, including: 1) clearing vegetation outside of the peak breeding season; 2) minimizing disturbance areas to the extent possible; 3) avoiding rookeries and raptor nest sites during the breeding season to the extent possible; and 4) increasing the availability of surface water resources for breeding or nesting migratory birds away from active mining areas. Assuming implementation of these environmental protection measures, adverse impacts to nongame species would be low, similar to the impacts described for game species.

Construction and operation of transmission lines (typically via 138-kV lines) would increase the collision potential for migrating and foraging bird species (e.g., raptors and waterfowl) (Avian Power Line Interaction Committee [APLIC] 2006) and bat species. Collision potential typically is dependent on variables such as the location in relation to high-use habitat areas (e.g., nesting, foraging, and roosting), line orientation to flight patterns and movement corridors (e.g., river corridors), species composition, visibility, and line design. To minimize collision potential for migrating and foraging bird species, transmission lines would be designed and constructed in accordance with the guidelines presented in Reducing Avian Collisions with Power Lines (APLIC 2012) (see Section 2.2.5.5). To minimize electrocution hazard for raptor species attempting to perch on the structures, raptor-deterring designs as presented in Suggested Practices for Raptor Protection on Power Lines (APLIC 2006) would be used (see Section 2.2.5.5).

A variety of bird species breed, forage, or roost in or near the study areas. Some bird species are closely associated with riparian habitats large enough to support trees and increased shrub density while other species may use these trees for roosting only. Potential long-term adverse impacts to bird species from mining-related activities could include loss of nesting, roosting, and foraging habitat along the reaches of intermittent and perennial drainages that if surface water is reduced within the projected mine-related 5-foot groundwater drawdown area in each study area (see Section 3.2.3). These losses would result from an incremental reduction in available habitat for both resident and migratory bird species. In addition, the regional carrying capacity may be reduced by the incremental loss of available nest and roost sites depending on the species affected and the site-specific conditions.

Potential impacts to reptile species associated with the perennial and intermittent water sources that may be affected by mine-related groundwater drawdown would parallel those discussed for other terrestrial wildlife species. The loss or reduction in surface water availability and associated riparian vegetation would result in an incremental loss of suitable breeding, foraging, and cover habitats for these species. Mine reclamation activities would help to offset these impacts and provide enhanced habitat for wildlife utilization.

The drainages within and immediately around the active mine areas in the study areas would flow primarily in response to local precipitation events, attenuated in lower stream reaches by the presence of sediment control ponds. Perennial and intermittent streams located in close proximity of mine areas, would be a receiving waterbody for water discharged from the mine dewatering activities. Although runoff volumes may increase during the mining period, releases to the waterbodies would be controlled by the stormwater control facilities onsite at mining operations. Discharges from temporary and permanent stormwater diversions would be monitored and controlled in terms of the volumes and water quality characteristics. Flow increases may occur below the TPDES outfalls, creating additional wetland and riparian habitat for terrestrial species. The relative increase in habitat would depend on the stream channel configuration, base flow conditions, and the duration of discharge. Although the change in habitat cannot be quantified, it is likely that discharges would increase the stream velocities and depth.

*Special Status Species*

The impact analysis for special status terrestrial wildlife focuses on those species that were identified in Section 3.5.1.2 as potentially occurring within the study areas and CESAs. In general, potential impacts to special status species as a result of future mine development would parallel those described for general wildlife. These potential direct and indirect impacts would depend on the species and its habitat affected, including: 1) loss of suitable habitat resulting from proposed construction and operations and associated habitat fragmentation; 2) effects of human presence, noise, and light; 3) collision potential for bird species (raptors and waterfowl) associated with proposed transmission lines; 4) effects of mine water discharge on aquatic habitats; and 5) effects of mine-related groundwater drawdown on surface waters and associated habitats.

The potential loss or reduction in available surface water as a result of groundwater level change could result in long-term changes in riparian and wetland habitats where the surface waters are hydraulically connected to affected aquifers within the projected mine-related 5-foot groundwater drawdown area. These indirect effects would be minimized through implementation of mine-specific Conceptual Mitigation Plans for waters of the U.S., including wetlands. Little or no direct effect to these habitats outside of the projected mine-related 5-foot groundwater drawdown area would be anticipated.

Mine water would be discharged from the sediment control ponds through TPDES-regulated outlets. Although runoff volumes would increase during mining, releases would be attenuated by a stormwater management system. The potential effects of mine-related water discharge, including increased sedimentation and flows, to the waterbodies are expected to be minimal.

The potential impacts to special status species from development of a typical mine are presented in the following sections based on the existence of suitable habitat. The size and location of potential future mine expansions or satellite mines within the study areas are not currently known, so the actual suitable habitat for each species cannot be accurately quantified. However, for analysis purposes, it is assumed that the percentage of the habitats projected to be impacted would be the same as the percentage of each general habitat category within each study area. Species are grouped in the following order: birds, mammals, and reptiles.

*American Peregrine Falcon/Peregrine Falcon*

American peregrine falcon or peregrine falcon occurrences would be limited to migratory individuals within all study areas and CESAs 1. Direct impacts to migrating individuals as a result of surface-disturbing activities could include the short-term, incremental loss of foraging habitat, including the acreages of potentially suitable open habitats associated with construction and operations over the life of the mines, as well as potential power line collisions as described for nongame species impacts. **Table 3.5-19** lists the acres of suitable habitat that may be affected in each study area. Precise acreage of habitat affected would depend on the location of each future mine expansion area or satellite mine.

**Table 3.5-19 American Peregrine Falcon/Peregrine Falcon—Potential Impacts to Suitable Habitat within the Study Areas**

| Study Area | Suitable Habitat in Study Areas (acres) | Estimated Percent of Study Area Potentially Disturbed under Anticipated Requests for Future Authorizations | Suitable Habitat Potentially Affected by Future Mining (acres) |
|---|---|---|---|
| 1 | 338,221 | 1.5 | 5,073 |
| 2 | 701,129 | 3.5 | 24,540 |
| 3 | 283,086 | 4.2 | 11,890 |
| 4 | 75,224 | 2.7 | 2,031 |

**Table 3.5-19 American Peregrine Falcon/Peregrine Falcon—Potential Impacts to Suitable Habitat within the Study Areas**

| Study Area | Suitable Habitat in Study Areas (acres) | Estimated Percent of Study Area Potentially Disturbed under Anticipated Requests for Future Authorizations | Suitable Habitat Potentially Affected by Future Mining (acres) |
|---|---|---|---|
| 5 | 179,388 | 5.3 | 9,508 |
| 6 | 252,326 | 9.9 | 24,980 |

Impacts would be minimized through implementation of approved reclamation plans and protection measures for special status species in accordance with RCT-required fish and wildlife plans. Additional applicable typical environmental protection measures include designing and constructing power line facilities as described under Nongame Species to reduce the potential for collisions.

Because projected mine-related groundwater drawdown would result in minor changes to surface water resources, it is anticipated that water quantity impacts would be minor. Based on this, the effects of mine water discharge and groundwater level changes are not expected to affect peregrine falcons and their associated habitat or the availability of food resources.

*Bachman's Sparrow*

The Bachman's sparrow is a permanent resident in Texas and Study Areas 1, 2, and 3 are within the known breeding range for this species (Arnold 2001). Direct adverse impacts to breeding and foraging individuals associated with construction and operations over the life of the mines could include power line collisions and collisions caused by artificial light as described for Nongame Species. Other impacts may include the short-term, incremental loss or alteration of breeding and foraging habitat (open pine forests and savannas), reduction in prey base, and increased human disturbance especially during the breeding season. If construction or ground-clearing activities were to occur during the breeding season, direct impacts to breeding birds could include the loss of active nest sites or abandonment of a nest site due to increased human presence and noise in proximity to a nest site. **Table 3.5-20** lists the acres of suitable habitat that may be affected in each study area. Precise acreage of habitat affected would depend on the location of each future mine expansion area or satellite mine.

**Table 3.5-20 Bachman's Sparrow—Potential Impacts to Suitable Habitat within the Study Areas**

| Study Area | Suitable Habitat (acres) | Estimated Percent of Study Area Potentially Disturbed under Anticipated Requests for Future Authorizations | Suitable Habitat Potentially Affected by Future Mining (acres) |
|---|---|---|---|
| 1 | 907,368 | 1.5 | 13,611 |
| 2 | 1,441,405 | 3.5 | 50,449 |
| 3 | 1,210,455 | 4.2 | 50,839 |

Impacts would be minimized through implementation of approved reclamation plans and protection measures for special status species in accordance with RCT-required fish and wildlife plans. Additional applicable typical environmental protection measures include designing and constructing power line facilities as described under Nongame Species to reduce the potential for collisions. To the extent possible, clearing operations would be conducted during non-breeding periods to avoid the peak migratory bird breeding season. If construction or ground-clearing activities were to occur during the breeding season for the Bachman's sparrow (mid-April to late July), impacts to this species would be anticipated.

The effects of mine water discharge and groundwater level changes are not expected to result in habitat changes that would affect the availability of food resources for this species, so no water-related impacts are anticipated.

*Bald Eagle*

Suitable bald eagle habitat is present within the study areas as listed in **Table 3.5-21** and **Table 3.5-22**. As such, foraging, roosting, and breeding pairs may be present within the study areas. Direct adverse impacts to the species, if present, could include the long-term, incremental loss of the suitable breeding, foraging, and roosting habitat (open water and adjacent floodplain forest) associated with construction and operations over the life of the mines and power line collisions as described for Nongame Species. If construction-related activities were to occur within the breeding season, direct impacts to breeding pairs, where present, may include the abandonment of a breeding territory or nest site or the potential loss of eggs or young, resulting in reduced productivity for that breeding season.

**Table 3.5-21 Bald Eagle—Potential Impacts to Suitable Forested and Riparian Habitat within the Study Areas**

| Study Area | Suitable Habitat (acres) | Estimated Percent of Study Area Potentially Disturbed under Anticipated Requests for Future Authorizations | Suitable Habitat Potentially Affected by Future Mining (acres) |
|---|---|---|---|
| 1 | 158,286 | 1.5 | 2,374 |
| 2 | 253,339 | 3.5 | 8,867 |
| 3 | 182,878 | 4.2 | 7,681 |
| 4 | 41,471 | 2.7 | 1,120 |

**Table 3.5-22 Potential Impacts to Suitable Aquatic Bald Eagle Habitat within the Study Areas**

| Study Area | Wetland Type[1] (acres) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Lacustrine | Lacustrine Limnetic | Lacustrine Littoral | Lake/Pond-Perennial | Reservoir-Treatment/ Other Uses | Reservoir-Water Storage | Swamp/ Marsh | Riverine Lower Perennial | Total Acres | Estimated Percent of Study Area Potentially Disturbed under Anticipated Requests for Future Authorizations | Suitable Habitat Potentially Affected by Fugure Mining |
| 1 | 77 | 19,353 | 340 | 2,034 | 3 | 107 | 45 | 317 | 22,276 | 1.5 | 334 |
| 2 | 0 | 14,585 | 363 | 2,021 | 6 | 76 | 83 | 1,763 | 18,897 | 3.5 | 661 |
| 3 | 0 | 18,825 | 449 | 2,118 | 0 | 85 | 61 | 458 | 21,996 | 4.2 | 924 |
| 4 | 0 | 1,178 | 0 | 701 | 29 | 10 | 6 | 477 | 2,401 | 2.7 | 65 |

Impacts would be minimized through implementation of approved reclamation plans and the implementation of protection measures for special status species in accordance with RCT- required fish and wildlife plans. Additional applicable typical environmental protection measures that would minimize impacts to this species include: 1) avoidance of raptor nest sites during the breeding season, to the extent possible; 2) increasing the availability of water sources away from active mining areas; 3) conducting clearing operations, to the extent possible, during non-breeding periods to avoid the peak migratory bird breeding season; and 4) designing and constructing transmission line facilities as described in for Nongame Species. Based on the species' known distribution and presence of suitable habitat within the study areas and CESAs, adverse impacts to this species as a result of future mine expansion areas or satellite mines would be anticipated.

The effects of mine water discharge and groundwater level changes are not expected to result in changes that would adversely affect bald eagles and their associated habitat or the availability of food resources.

*Black-capped Vireo*

The black-capped vireo is a breeding resident in Texas with potentially suitable habitat (areas containing various oak species) within the study areas as listed in **Table 3.5-23**. Where present, direct adverse impacts to breeding and foraging individuals associated with construction and operations over the life of the mines could include potential power line collisions and collisions caused by artificial light as described for Nongame Species. Other potential adverse impacts may include the short-term, incremental loss or alteration of breeding and foraging habitat and increased human disturbance, especially during the breeding season. If construction or ground-clearing activities were to occur during the breeding season for the black-capped vireo (early April to mid-July), direct impacts to breeding birds could include the loss of nearby active nest sites or abandonment of a nest site due to increased human presence and noise.

**Table 3.5-23 Black-capped Vireo—Potential Impacts to Suitable Habitat within the Study Areas**

| Study Area | Suitable Habitat (acres) | Estimated Percent of Study Area Potentially Disturbed under Anticipated Requests for Future Authorizations | Suitable Habitat Potentially Affected by Future Mining (acres) |
|---|---|---|---|
| 4 | 354,304 | 2.7 | 9,566 |
| 6 | 85,899 | 9.9 | 8,504 |

Impacts would be minimized through implementation of approved reclamation plans and the implementation of protection measures for special status species in accordance with RCT- required fish and wildlife plans. Additional applicable committed typical environmental protection measures include: 1) identification and avoidance of nest sites during the breeding season, to the extent possible; 2) conducting clearing operations, to the extent possible, during non-breeding periods to avoid the peak migratory bird breeding season; and 3) designing and constructing transmission line facilities as outlined in Section 3.5.2.1, Nongame Species.

The effects of mine water discharge and groundwater level changes are not expected to affect black-capped vireos and their associated habitat.

*Golden-cheeked Warbler*

This species is associated with ashe juniper (*Juniperus ashei*) (also known as cedar). **Table 3.5-24** identifies the amount of suitable habitat within the study areas that could be affected by surface-disturbing activities. Where present, direct adverse impacts to breeding and foraging individuals associated with construction and operations over the life of the mines could include potential power line collisions and collisions caused by artificial light as described for Nongame Species. Other potential adverse impacts may include the short-term, incremental loss or alteration of breeding and foraging habitat and increased human disturbance, especially during the breeding season. If construction or ground-clearing activities were to occur during the breeding season for the golden-cheeked warbler (late March through June), direct impacts to breeding birds could include the loss of nearby active nest sites or abandonment of a nest site due to increased human presence and noise.

**Table 3.5-24 Golden-cheeked Warbler—Potential Impacts to Suitable Habitat within the Study Areas**

| Study Area | Suitable Habitat (acres) | Estimated Percent of Study Area Potentially Disturbed under Anticipated Requests for Future Authorizations | Suitable Habitat Potentially Affected by Future Mining (acres) |
|---|---|---|---|
| 4 | 309,294 | 2.7 | 8,351 |
| 6 | 32,548 | 9.9 | 3,222 |

Impacts would be minimized through implementation of approved reclamation plans and the implementation of protection measures for special status species in accordance with RCT- required fish and wildlife plans. Additional applicable typical environmental protection measures include:
1) identification and avoidance of nest sites during the breeding season, to the extent possible;
2) conducting clearing operations, to the extent possible, during non-breeding periods to avoid the peak migratory bird breeding season; and 3) designing and constructing transmission line facilities as outlined in Section 3.5.2.1, Nongame Species.

The effects of mine water discharge and groundwater level changes are not expected to affect golden-cheeked warblers and their associated habitat.

*Interior Least Tern*

Based on TPWD (2015) information, interior least tern occurrences would be limited to migrating individuals within the study areas and CESAs. Direct adverse impacts to migrating individuals, if present in future mine areas, could include potential power line collisions and the short-term, incremental loss of foraging habitat resulting from surface-disturbing activities associated with construction and operations over the life of a future mine expansion area or satellite mine. **Table 3.5-25** lists the amount of suitable wetland habitat within each study area that could be affected by mining-related activities.

**Table 3.5-25 Interior Least Tern—Potential Impacts to Suitable Foraging Habitat within the Study Areas**

| Study Area | Suitable Habitat (acres) | Estimated Percent of Study Area Potentially Disturbed under Anticipated Requests for Future Authorizations | Suitable Foraging Habitat Potentially Affected by Future Mining (acres) |
|---|---|---|---|
| 1 | 75,600 | 1.5 | 1,134 |
| 2 | 105,506 | 3.5 | 3,693 |
| 3 | 66,931 | 4.2 | 2,811 |
| 4 | 7,243 | 2.7 | 196 |
| 5 | 2,106 | 5.3 | 112 |
| 6 | 1,588 | 9.9 | 157 |

Based on TPWD (2015) information, the six study areas are outside of the breeding range for interior least tern in Texas. However, as natural nesting sites become scarce, some breeding pairs have used manmade sites (e.g., sand and gravel pits, reservoir shorelines, etc.) (TPWD 2015). Breeding activity has been reported at some of the existing surface lignite mines in Study Area 2, with protection measures implemented in coordination with federal and state agencies (Luninant Mining Company LLC 2015). If breeding pairs nest in future mine-related disturbance areas, mining activities may result in direct adverse impacts, including the abandonment of a nest site and the potential loss of eggs or young or direct mortality as a result of crushing by equipment, unless protection measures are implemented.

Impacts to this species would be minimized through implementation of approved reclamation plans and the implementation of protection measures for special status species in accordance with RCT-required fish and wildlife plans, as well as the implementation of the USACE Fort Worth District-required compensatory mitigation plans. Additional applicable typical environmental protection measures include: 1) conducting clearing operations during non-breeding periods, to the extent possible, to avoid the peak migratory bird breeding season; 2) increasing the availability of water sources away from active mining areas; and 3) designing and constructing transmission line facilities as outlined in Section 3.5.2.1, Nongame Species.. On the whole, potential adverse impacts to migrating individuals as a result of a typical mine would be minimal. Potential impacts to breeding pairs, eggs, and young in future mine-related disturbance areas, if present, would be anticipated unless protection measures are implemented.

It is anticipated that the effects of mine water discharge and groundwater level changes on habitat and the availability of food resources for this species within the study areas would be minimal.

*Red-cockaded Woodpecker*

The red-cockaded woodpecker is a permanent resident in Texas, limited to open, mature pine forests within Study Area 2. Approximately 1,001,600 acres of habitat associated with forested areas occurs within the Study Area 2. Based on the estimated percent of study area potentially disturbed under anticipated requests for future authorizations, approximately 35,056 acres of suitable habitat for the red-cockaded woodpecker has the potential to be impacted. However, an analysis specific to old growth pine forests has not been conducted for the study areas and CESAs and it is assumed that, due to the rarity of old growth forests, potential occurrence of the red-cockaded woodpecker is unlikely even in Study Area 2.

Where present, direct adverse impacts to breeding and foraging individuals associated with construction and operations over the life of the mines could include potential power line collisions and collisions caused by artificial light as described for Nongame Species. Other potential adverse impacts may include the long-term, incremental loss or alteration of breeding and foraging habitat, reduction in prey base, and increased human disturbance, especially during the breeding season. If construction or ground-clearing activities were to occur during the breeding season for the red-cockaded woodpecker (April through July), direct adverse impacts to breeding birds could include the loss of nearby active nest sites or abandonment of a nest site due to increased human presence and noise.

Impacts would be minimized through implementation of approved reclamation plans and the implementation of protection measures for special status species in accordance with RCT-required fish and wildlife plans. Additional applicable typical environmental protection measures include:
1) identification and avoidance of nest sites during the breeding season, to the extent possible;
2) conducting clearing operations, to the extent possible, during non-breeding periods to avoid the peak migratory bird breeding season; and 3) designing and constructing transmission line facilities as outlined in Section 3.5.2.1, Nongame Species.

The effects of mine water discharge and groundwater level changes are not expected to affect red-cockaded woodpeckers. These activities may result in some localized changes in vegetation composition along some streams but are not expected to impact available habitat.

*Sprague's Pipit*

Sprague's pipit occurrences within the study areas would be limited to migratory and wintering individuals. The Sprague's pipit may occur in Study Areas 5 and 6, as shown in **Table 3.5-26**. Direct impacts to migrating and wintering individuals as a result of surface disturbing activities could include the short-term, incremental loss of foraging and wintering habitat (native prairie) associated with construction and operations over the life of the mines and collisions caused by artificial light as described for Nongame Species

**Table 3.5-26 Sprague's Pipit—Potential Impacts to Suitable Habitat within the Study Areas and CESAs**

| Study Area | Suitable Habitat (acres) | Estimated Percent of Study Area Potentially Disturbed under Anticipated Requests for Future Authorizations | Suitable Habitat Potentially Affected by Future Mining (acres) |
|---|---|---|---|
| 5 | 34,544 | 5.3 | 1,831 |
| 6 | 26,146 | 9.9 | 2,588 |

Impacts would be minimized through implementation of approved reclamation plans and the implementation of protection measures for special status species in accordance with RCT- required fish and wildlife plans. Additional applicable committed typical environmental protection measures include: 1) identification and avoidance of nest sites during the breeding season, to the extent possible; 2) conducting clearing operations, to the extent possible, during non-breeding periods to avoid the peak migratory bird breeding season; and 3) designing and constructing transmission line facilities as outlined in Section 3.5.2.1, Nongame Species.

The effects of mine water discharge and groundwater level changes are not expected to result in habitat changes that would change affect the availability of food resources for this species within the study area, so no water-related impacts are anticipated.

*Swallow-tailed Kite*

The swallow-tailed kite is a breeding resident in Texas with potential occurrence in Study Area 2. Direct impacts to breeding and foraging individuals associated with construction and operations over the life of the mines, as well as power line collision potential could result in the long-term, incremental loss or alteration of approximately 35,059 acres of suitable breeding and foraging habitat (bottomland forests associated with open water) within Study Area 2. Other adverse impacts may include the reduction in prey base and increased human disturbance, especially during the breeding season (late February to early July). If construction or ground-clearing activities were to occur during the breeding season, direct impacts to breeding birds could include the loss of nearby active nest sites or abandonment of a nest site due to increased human presence and noise. Impacts would be minimized through implementation of approved reclamation plans and the implementation of protection measures for special status species in accordance with RCT-required fish and wildlife plans. Additional applicable committed typical environmental protection measures include: 1) avoidance of raptor nest sites during the breeding season, to the extent possible; 2) increasing the availability of water sources away from active mining areas; 3) conducting clearing operations, to the extent possible, during non-breeding periods to avoid the peak migratory bird breeding season; and 4) designing and constructing transmission line facilities as outlined in Section 3.5.2.1, Nongame Species. Based on the species' known distribution and presence of suitable habitat within Study Area and CESA 2, potential impacts to this species as a result of future mine development would be anticipated.

The effects of mine water discharge and groundwater level changes are not expected to result in habitat changes that would affect swallow-tailed kites and their associated habitat or the availability of food resources.

*White-faced Ibis*

This species has the potential to occur within Study Area 3 as a breeding and foraging resident. Direct adverse impacts to the species, where present, could include the long-term, incremental loss of the suitable breeding and foraging habitat associated with construction and operations over the life of the mines. Approximately 66,931 acres of potential wetland habitat occurs within Study Area 3. Based on the estimated percent of study area potentially disturbed under anticipated requests for future authorizations, approximately 2,811 acres of suitable terrestrial foraging and breeding habitat (agriculture, floodplains, riparian, and swamplands) in Study Area 3 may be impacted by future mining.

Transmission line collision potential as described above for Nongame Species impacts would exist for this species. If construction-related activities were to occur within the breeding season, direct adverse impacts to breeding pairs, where present, may include the abandonment of a nearby breeding territory or nest site and the potential loss of eggs or young, causing reduced productivity for that breeding season.

Impacts would be minimized through implementation of approved reclamation plans and the implementation of protection measures for special status species in accordance with RCT- required fish and wildlife plans. Additional applicable committed typical environmental protection measures include: 1) avoidance of surface disturbance during the breeding season and/or conducting clearing operations, to the extent possible, during non-breeding periods to avoid the peak migratory bird breeding season, to the extent possible; 2) increasing the availability of water sources away from active mining areas; and 3) designing and constructing transmission line facilities as outlined in Section 3.5.2.1, Nongame Species. Based on the species known distribution and presence of suitable habitat within Study Area and CESA 3, potential impacts to this species as a result of future mine development would be anticipated.

The effects of mine water discharge and groundwater level changes are not expected to result in habitat changes that would affect white-faced ibises and their associated habitat or the availability of food resources within the study area and CESA, so no water-related impacts are anticipated.

*White-tailed Hawk*

The white-tailed hawk is a breeding and foraging resident with the potential to occur in Study Area5. Direct adverse impacts to the species, where present, could include the long-term, incremental loss of the suitable breeding and foraging habitat associated with construction and operations over the life of the mines. Approximately 176,295 acres of suitable terrestrial foraging and breeding habitat (prairie, mesquite, and oak savannas, and mixed savanna-chaparral) exists within Study Area 3. Based on the estimated percent of study area potentially disturbed under anticipated requests for future authorizations, approximately 7,404 acres of suitable foraging and breeding habitat for the white-tailed hawk has the potential to be impacted.

Transmission line collision potential as described for Nongame Species impacts also would exist for this species. If construction-related activities were to occur within the breeding season, direct impacts to breeding pairs, where present, may include the abandonment of a nearby breeding territory or nest site and the potential loss of eggs or young, resulting in reduced productivity for that breeding season.

Impacts would be minimized through implementation of approved reclamation plans and the implementation of protection measures for special status species in accordance with RCT- required fish and wildlife plans. Additional applicable typical environmental protection measures include: 1) avoidance of raptor nest sites during the breeding season, to the extent possible; and 2) designing and constructing transmission line facilities as outlined in Section 3.5.2.1, Nongame Species. Based on the species' known distribution and the presence of suitable habitat within Study Area and CESA 3, potential impacts to this species from future mine development would be anticipated.

The effects of mine water discharge and groundwater level changes are not expected to affect white-tailed hawks and their associated habitat.

*Wood Stork*

Wood stork occurrences would be limited to migratory individuals within most of the study areas and CESAs. Direct adverse impacts to the species, where present, could include the long-term, incremental loss of suitable breeding and foraging habitat associated with construction and operations over the life of the mines. **Table 3.5-27** lists the amount of suitable habitat within each study area where there is the potential for occurrence. Impacts from transmission line collisions as described for Nongame Species also would exist for this species.

**Table 3.5-27 Wood Stork—Potential Impacts to Suitable Habitat within the Study Areas**

| Study Area | Suitable Habitat (acres) | Estimated Percent of Study Area Potentially Disturbed under Anticipated Requests for Future Authorizations | Suitable Habitat Potentially Affected by Future Mining (acres) |
|---|---|---|---|
| 1 | 75,600 | 1.5 | 1,134 |
| 2 | 105,506 | 3.5 | 3,693 |
| 3 | 66,931 | 4.2 | 2,811 |
| 4 | 7,243 | 2.7 | 196 |
| 5 | 2,106 | 5.3 | 112 |

Impacts would be minimized through implementation of approved reclamation plans and the implementation of protection measures for special status species in accordance with RCT- required fish and wildlife plans. Additional applicable typical environmental protection measures include: 1) designing and constructing transmission line facilities as outlined in Section 3.5.2.1, Nongame Species and 2) increasing the availability of water sources away from active mining areas. Adverse impacts to this species as a result of future mine development would be considered minimal based on the lack of breeding records for the study areas and on the overall limited availability of suitable foraging habitat in the vicinity.

The effects of mine water discharge and groundwater level changes are not expected to adversely affect wood storks and their associated habitat or the availability of food resources.

*Whooping Crane*

Whooping crane occurrences would be limited to spring and fall migratory individuals within some of the study areas and CESAs. Direct adverse impacts to the migrating individuals, where present, as a result of surface-disturbing activities could include the short-term, incremental loss of foraging habitat (wetland and other habitats, including inland marshes, lakes, ponds, wet meadows and rivers, and agricultural fields) associated with construction and operations over the life of the mines. **Table 3.5-28** lists the amount of suitable wetland habitat within each study area that may be affected. In addition, the amount of agriculture that may be used for forage by migrating individuals is listed in **Table 3.5-29**. Transmission line collisions as described in the Nongame Species impacts also may result from mining-related impacts to this species.

Impacts would be minimized through implementation of approved reclamation plans and the implementation of protection measures for special status species in accordance with RCT- required fish and wildlife plans. Additional applicable typical environmental protection measures include: 1) the design and construction of transmission line facilities as outlined in Section 3.5.2.1, Nongame Species and 2) increasing the availability of water sources away from active mining areas.

The effects of mine water discharge and groundwater level changes are not expected to adversely affect whooping cranes and their associated stop-over habitat or the availability of food resources.

**Table 3.5-28 Whooping Crane—Potential Impacts to Wetland Habitat within the Study Areas**

| Study Area | Suitable Habitat (acres) | Estimated Percent of Study Area Potentially Disturbed under Anticipated Requests for Future Authorizations | Suitable Habitat Potentially Affected by Future Mining (acres) |
|---|---|---|---|
| 4 | 5,699 | 2.7 | 154 |
| 5 | 2,104 | 5.3 | 112 |

**Table 3.5-29 Whooping Crane—Potential Impacts to Agricultural[1] Habitat within the Study Areas**

| Study Area | Suitable Habitat (acres) | Estimated Percent of Study Area Potentially Disturbed under Anticipated Requests for Future Authorizations | Suitable Habitat Potentially Affected by Future Mining (acres) |
|---|---|---|---|
| 3 | 46,566 | 4.2 | 1,956 |
| 4 | 6,095 | 2.7 | 165 |
| 5 | 2,003 | 5.3 | 106 |

[1] Note: as described in Section 3.4, Vegetation, the agriculture vegetation class includes suitable whooping crane foraging habitat (i.e., croplands and hay meadows). However, it also includes habitat types not associated with whooping crane use such as areas dominated by Bermuda grass (*Cynodon dactylon*) like golf courses and grass farms, pine plantations mostly of loblolly pine (*Pinus taeda*), and barren areas).

*Zone-tailed Hawk*

The zone-tailed hawk is an uncommon summer resident in Texas and may occur within Study Area and CESA 6 (TPWD 2014). However, the current documented breeding range for this species is outside Study Area 6 (Tweit 2001b). Therefore, impacts from the development of future mine expansion areas or satellite mines would be limited to foraging individuals. Direct impacts to the species, where present, associated with construction and operations over the life of the mines could include the long-term, incremental loss of suitable foraging habitat (arid open country including open deciduous or pine-oak woodland, mesa or mountain county, often near watercourses, and wooded canyons and tree-lined rivers along middle-slopes of desert mountains). Approximately 246,634 acres of suitable foraging habitat exists within Study Area 6. Based on the estimated percent of study area potentially disturbed under anticipated requests for future authorizations, approximately 24,417 acres of suitable foraging habitat for the zone-tailed hawk has the potential to be impacted. Transmission line collision potential as described for Nongame Species impacts also would exist for this species.

Impacts would be minimized through implementation of approved reclamation plans and the implementation of protection measures for special status species in accordance with RCT- required fish and wildlife plans. Additional applicable typical environmental protection measures include: 1) avoidance of raptor nest sites during the breeding season, to the extent possible; and 2) designing and constructing transmission line facilities as outlined in Section 3.5.2.1, Nongame Species. Based on the species' known distribution and presence of suitable habitat within Study Area and CESA 6, potential impacts to this species as a result of future mining would be anticipated.

The effects of mine water discharge and groundwater level changes are not expected to adversely affect zone-tailed hawks and their associated habitat or the availability of food resources.

*Black Bear/Louisiana Black Bear*

Black bear or Louisiana black bear occurrences would be limited to transitory individuals within the study areas and CESAs but are considered unlikely to occur based on the species' known distribution. However, direct adverse impacts to the species, if present, resulting from surface-disturbing activities associated with construction and operations over the life of the mines could include the long-term, incremental loss of suitable forested habitat, shown in **Table 3.5-30**.

**Table 3.5-30 Louisiana Black Bear/Black Bear—Potential Impacts to Suitable Habitat within the Study Areas**

| Study Area | Suitable Habitat (acres) | Estimated Percent of Study Area Potentially Disturbed under Anticipated Requests for Future Authorizations | Suitable Habitat Potentially Affected by Future Mining (acres) |
|---|---|---|---|
| 2 | 1,001,460 | 3.5 | 35,051 |
| 3 | 1,118,936 | 4.2 | 46,995 |
| 4 | 331,594 | 2.7 | 8,953 |
| 5 | 22,726 | 5.3 | 1,204 |
| 6 | 27,211 | 9.9 | 2,694 |

Impacts would be minimized through implementation of approved reclamation plans and the implementation of protection measures for special status species in accordance with RCT-required fish and wildlife plans. Additional applicable typical environmental protection measures include conducting an employee awareness training, as applicable. Based on these measures and the overall availability of suitable foraging habitat in the vicinity, potential impacts to this species as a result of future mining would be minimal.

The effects of mine water discharge and groundwater level changes are not expected to result in habitat changes that would adversely affect the availability of food resources for this species within the study area, so little or no water-related impacts are anticipated.

*Jaguarundi and Ocelot*

Potential occurrence for the jaguarundi and ocelot based on known range and suitable habitat includes Study Areas and CESAs 5 and 6. Direct adverse impacts could include the long-term, incremental loss or alteration of breeding and foraging habitat (thick brushlands), reduction in prey base, and increased human disturbance, especially during breeding periods. Suitable habitat that could be affected is shown in **Table 3.5-31**.

**Table 3.5-31 Jaguarundi and Ocelot—Potential Impacts to Suitable Habitat within the Study Areas**

| Study Area | Suitable Habitat (acres) | Estimated Percent of Study Area Potentially Disturbed under Anticipated Requests for Future Authorizations | Suitable Habitat Potentially Affected by Future Mining (acres) |
|---|---|---|---|
| 5 | 176,295 | 5.3 | 9,344 |
| 6 | 246,634 | 9.9 | 24,417 |

Impacts would be minimized through implementation of approved reclamation plans and the implementation of protection measures for special status species in accordance with RCT-required fish and wildlife plans. Additional applicable typical environmental protection measures include conducting an employee awareness training. Based on these measures and the overall availability of suitable foraging habitat in the vicinity, potential impacts to this species as a result of future mining would be minimal.

Habitat selection for these species typically includes an association with a water source. Therefore, the loss or alteration of existing water sources could impact jaguarondi and ocelot use and movements. It is anticipated that projected mine-related groundwater drawdown would have minor impacts to surface water resources, so the effects of mine water discharge and groundwater level changes are not expected to adversely affect jaguarundis and ocelots and their associated habitat or the availability of food resources.

*Rafinesque's Big-eared Bat*

Species occurrence in the analysis area is unlikely based on the species' known distribution. However, suitable roosting and foraging habitat occurs within Study Areas 1 and 2. Direct impacts to the species, if present, could result from construction and operations through the long-term, incremental loss of suitable forested habitat where present. **Table 3.5-32** summarizes the amount of suitable habitat in the study areas.

**Table 3.5-32 Rafinesque's Big-eared Bat—Potential Impacts to Suitable Habitat within the Study Areas**

| Study Area | Suitable Habitat (acres) | Estimated Percent of Study Area Potentially Disturbed under Anticipated Requests for Future Authorizations | Suitable Habitat Potentially Affected by Future Mining (acres) |
|---|---|---|---|
| 1 | 732,561 | 1.5 | 10,988 |
| 2 | 1,001,460 | 3.5 | 35,051 |

Impacts would be minimized through implementation of approved reclamation plans and the implementation of protection measures for special status species in accordance with RCT-required fish and wildlife plans. Additional applicable typical environmental protection measures include conducting an employee awareness training. Based on these measures and the overall availability of suitable foraging habitat in the vicinity, potential impacts to this species as a result of future mining would be minimal.

The effects of mine water discharge and groundwater level changes are not expected to result in habitat changes that would change adversely affect the availability of food resources for this species within the study area, so little or no water-related impacts are anticipated.

*White-nosed Coati*

Potential occurrence for this species would most likely be limited to transient individuals through Study Area 6. Direct impacts could include the long-term, incremental loss or alteration of foraging habitat (woodlands, riparian corridors, and canyons), reduction in prey base, and increased human disturbance. Approximately 18,607 acres of suitable foraging habitat within Study Area 6 potentially could be impacted by future mining.

Impacts would be minimized through implementation of approved reclamation plans and the implementation of protection measures for special status species in accordance with RCT-required fish and wildlife plans. Additional applicable typical environmental protection measures include conducting an employee awareness training.

The effects of mine water discharge and groundwater level changes are not expected to result in habitat changes that would change adversely affect the availability of food resources for this species within the study area, so little or no water-related adverse impacts to white-nosed coati and their associated habitat or the availability of food resources are anticipated..

*Louisiana Pine Snake*

Direct impacts to the species as a result of surface-disturbing activities could include adult and juvenile mortality due to crushing from vehicles and equipment and the long-term, incremental loss of suitable forested habitat, where present, associated with construction and operation activities over the life of the mines. **Table 3.5-33** summarizes the suitable habitat in Study Areas 1 and 2.

**Table 3.5-33 Louisiana Pine Snake—Potential Impacts to Suitable Habitat within the Study Areas**

| Study Area | Suitable Habitat (acres) | Estimated Percent of Study Area Potentially Disturbed under Anticipated Requests for Future Authorizations | Suitable Habitat Potentially Affected by Future Mining (acres) |
|---|---|---|---|
| 1 | 732,056 | 1.5 | 10,981 |
| 2 | 999,483 | 3.5 | 34,982 |

Impacts would be minimized through implementation of approved reclamation plans and the implementation of protection measures for special status species in accordance with RCT-required fish and wildlife plans. Additional applicable committed typical environmental protection measures include conducting an employee awareness training.

The effects of mine water discharge and groundwater level changes are not expected to result in habitat changes that would change adversely affect the availability of food resources for this species within the study area, so little or no water-related impacts are anticipated.

*Northern scarlet snake*

Direct impacts to the species, if present, from construction and operations over the life of the mines could include adult and juvenile mortality due to crushing from vehicles and equipment and the long-term, incremental loss of potentially suitable habitat associated with sandy, loamy soils needed for burrowing (swamps, floodplains, woodlands, riparian zones, agriculture, and open areas). **Table 3.5-34** summarizes the potential habitat within the analysis area.

**Table 3.5-34 Northern Scarlet Snake—Potential Impacts to Suitable Habitat within the Study Areas**

| Study Area | Suitable Habitat (acres) | Estimated Percent of Study Area Potentially Disturbed under Anticipated Requests for Future Authorizations | Suitable Habitat Potentially Affected by Future Mining (acres) |
|---|---|---|---|
| 1 | 895,524 | 1.5 | 13,433 |
| 2 | 1,425,638 | 3.5 | 49,897 |
| 3 | 1,198,488 | 4.2 | 50,336 |

Impacts would be minimized through implementation of approved reclamation plans and the implementation of protection measures for special status species in accordance with RCT-required fish and wildlife plans. Additional applicable committed typical environmental protection measures include conducting an employee awareness training.

The effects of mine water discharge and groundwater level changes are not expected to result in habitat changes that would change adversely affect the availability of food resources for this species within the study area, so little or no water-related impacts are anticipated.

*Reticulate Collared Lizard*

Direct impacts to the species, if present, as a result of surface-disturbing activities associated with construction and operation activities over the life of the mines could include adult and juvenile mortality due to crushing from vehicles and equipment and the long-term, incremental loss of suitable habitat (open brush-grasslands with thorn-scrub vegetation) where present. **Table 3.5-35** summarizes suitable habitat within the analysis area.

**Table 3.5-35 Reticulate Collared Lizard—Potential Impacts to Suitable Habitat within the Study Areas**

| Study Area | Suitable Habitat (acres) | Estimated Percent of Study Area Potentially Disturbed under Anticipated Requests for Future Authorizations | Suitable Habitat Potentially Affected by Future Mining (acres) |
|---|---|---|---|
| 5 | 176,295 | 5.3 | 9,344 |
| 6 | 246,634 | 9.9 | 24,417 |

Impacts would be minimized through implementation of approved reclamation plans and the implementation of protection measures for special status species in accordance with RCT-required fish and wildlife plans. Additional applicable typical environmental protection measures include conducting an employee awareness training.

The effects of mine water discharge and groundwater level changes are not expected to adversely affect reticulate collared lizards and their associated habitat or the availability of food resources.

*Texas Horned Lizard*

Direct impacts to the species, if present, as a result of surface-disturbing activities associated with construction and operation activities over the life of the mines could include adult and juvenile mortality due to crushing from vehicles and equipment and the long-term, incremental loss of suitable habitat (open, arid and semi-arid regions), where present. **Table 3.5-36** summarizes suitable habitat within the analysis area.

**Table 3.5-36 Texas Horned Lizard—Potential Impacts to Suitable Habitat within the Study Areas**

| Study Area | Suitable Habitat (acres) | Estimated Percent of Study Area Potentially Disturbed under Anticipated Requests for Future Authorizations | Suitable Habitat Potentially Affected by Future Mining (acres) |
|---|---|---|---|
| 1 | 160,349 | 1.5 | 2,405 |
| 2 | 424,082 | 3.5 | 14,843 |
| 3 | 66,903 | 4.2 | 2,810 |
| 4 | 25,195 | 2.7 | 680 |
| 5 | 121,028 | 5.3 | 6,414 |
| 6 | 196,606 | 9.9 | 19,464 |

Impacts would be minimized through implementation of approved reclamation plans and the implementation of protection measures for special status species in accordance with RCT-required fish and wildlife plans. Additional applicable typical environmental protection measures include conducting an employee awareness training.

The effects of mine water discharge and groundwater level changes are not expected to adversely affect Texas horned lizards and their associated habitat or the availability of food resources.

*Texas Indigo Snake*

Direct adverse impacts to the species, if present, as a result of surface-disturbing activities associated with construction and operation activities over the life of the mines could include adult and juvenile mortality due to crushing from vehicles and equipment and the long-term, incremental loss of suitable habitat (riparian zones and irrigated croplands). **Table 3.5-37** summarizes suitable habitat within the analysis area.

**Table 3.5-37 Texas Indigo Snake—Potential Impacts to Suitable Habitat within the Study Areas**

| Study Area | Suitable Habitat (acres) | Estimated Percent of Study Area Potentially Disturbed under Anticipated Requests for Future Authorizations | Suitable Habitat Potentially Affected by Future Mining (acres) |
|---|---|---|---|
| 5 | 23,275 | 5.3 | 1,234 |
| 6 | 30,541 | 9.9 | 3,024 |

Impacts would be minimized through implementation of approved reclamation plans and the implementation of protection measures for special status species in accordance with RCT-required fish and wildlife plans. Additional applicable typical environmental protection measures include conducting an employee awareness training.

The effects of mine water discharge and groundwater level changes are not expected to adversely affect Texas indigo snakes and their associated habitat or the availability of food resources.

*Texas tortoise*

Direct adverse impacts to the species, if present, as a result of surface-disturbing activities associated with construction and operation activities over the life of the mines could include adult and juvenile mortality due to crushing from vehicles and equipment and the long-term, incremental loss and fragmentation of potentially suitable habitat (open brush with a grassy understory), and increased human disturbance. **Table 3.5-38** summarizes suitable habitat within the analysis area.

**Table 3.5-38 Texas Tortoise—Potential Impacts to Suitable Habitat within the Study Areas**

| Study Area | Suitable Habitat (acres) | Estimated Percent of Study Area Potentially Disturbed under Anticipated Requests for Future Authorizations | Suitable Habitat Potentially Affected by Future Mining (acres) |
|---|---|---|---|
| 5 | 141,750 | 5.3 | 7,513 |
| 6 | 220,488 | 9.9 | 21,828 |

Impacts would be minimized through implementation of approved reclamation plans and the implementation of protection measures for special status species in accordance with RCT-required fish and wildlife plans. Additional applicable typical environmental protection measures include conducting an employee awareness training.

The effects of mine water discharge and groundwater level changes are not expected to adversely affect Texas tortoises and their associated habitat.

*Timber/Canebrake Rattlesnake*

Direct adverse impacts to the species, if present, as a result of surface-disturbing activities associated with construction and operation activities over the life of the mines could include adult and juvenile mortality due to crushing from vehicles and equipment and the long-term, incremental loss of potentially suitable habitat (swamps, floodplains, upland pine and deciduous woodlands, riparian zones). **Table 3.5-39** summarizes suitable habitat within the analysis area.

**Table 3.5-39 Timber/Canebrake Rattlesnake—Potential Impacts to Suitable Habitat within the Study Areas**

| Study Area | Suitable Habitat (acres) | Estimated Percent of Study Area Potentially Disturbed under Anticipated Requests for Future Authorizations | Suitable Habitat Potentially Affected by Future Mining (acres) |
|---|---|---|---|
| 1 | 363,802 | 1.5 | 5,457 |
| 2 | 1,001,460 | 3.5 | 35,051 |
| 3 | 189,866 | 4.2 | 7,974 |
| 4 | 41,538 | 2.7 | 1,122 |

Impacts would be minimized through implementation of approved reclamation plans and the implementation of protection measures for special status species in accordance with RCT-required fish and wildlife plans. Additional applicable typical environmental protection measures include conducting an employee awareness training.

The effects of mine water discharge and groundwater level changes are not expected to result in habitat changes that would adversely affect the availability of food resources for this species within the study area, so little or no water-related impacts are anticipated.

<u>No Action Alternative</u>

The development of a typical surface coal or lignite mine under the No Action Alternative would be similar to the Proposed Action for purposes of potential impacts to wildlife. While a similar amount of surface disturbance would occur under the No Action Alternative, disturbance may be spread out over a longer period of time due to the difference in the permitting process. In general, future mine-related impacts to terrestrial wildlife and special status species would be similar to those described for the Proposed Action.

### 3.5.2.2 Fisheries and Other Aquatic Biological Resources

The following issues for fisheries and other aquatic biological resources are discussed as part of the impact analysis for construction, operation, and reclamation of coal mining.

- Loss or alteration of aquatic habitat removed or disturbed as a result of mining.
- Loss of aquatic species' populations or reductions in abundance and diversity of aquatic species in waterbodies removed or disturbed by mining.

- Effects of water quality changes such as increased sediment and other contaminants on aquatic habitat and species.
- Effects of water level changes in surface water on aquatic habitat and species due to potential groundwater drawdown. Impacts would depend on the magnitude and duration of the water level change and the type of waterbody affected (i.e., intermittent vs. perennial stream, reservoir, or lake).
- Effects of flow increases from mine discharges on aquatic habitat and species. Impacts would depend on the magnitude and duration of the flow change and the type of waterbody affected (i.e., intermittent vs. perennial stream, reservoir, or lake).
- Potential transfer of nuisance aquatic vegetation as a result of vehicle and equipment movement between drainages.
- Reclamation of aquatic habitat after mining is completed.

To complete the effects analysis for fisheries and other aquatic biological resources impacts were analyzed on a programmatic level because the specific locations of surface disturbance or affected stream segments could not be defined with more precision than the study area boundary. The focus of the impact analysis was for perennial streams, lakes, and reservoirs because these waterbodies provide habitat for aquatic species on a consistent basis throughout the year.

It was assumed that the perennial waterbodies located within the 5-foot drawdown contour potentially could be affected by mine dewatering and that direct effects on habitat for federal or state listed species could adversely affect population viability.

Proposed Action

Potential impacts to aquatic resources from development of a typical mine are described in this section with the understanding that the adverse effects would be minimized through the implementation of the typical environmental protection measures presented in Section 2.2.5 and those required by state and federal permits and regulatory requirements. If disturbance occurs in streams, rivers, lakes, or reservoirs that support fish and special status fish or mussel species, mine construction and operations would directly alter or remove aquatic habitat. Aquatic habitats could be removed on a permanent basis or replaced as part of reclamation after mining is completed. The magnitude of impact would depend on the aquatic species present, type of habitat removed or altered, and the duration of impact until reclamation is completed. The effects of habitat loss or alteration on fish or mussel species would be a reduction in population numbers in the affected area. The magnitude of effect on the population could range from a complete loss of the population to a partial reduction in numbers if the population extends beyond the affected area. The effect on the population also would be high if the affected habitat were used for critical life stages such as spawning and rearing of young fish.

Surface disturbance near waterbodies could remove riparian vegetation, which provides cover for fish along with providing shading, bank stability, and increased food and nutrient supply as a result of deposition of insect and vegetative matter into the watercourse. Riparian vegetation also contributes woody material that is used for fish cover in streams and can be part of habitat-forming features such as pools.

Direct disturbance to stream or river habitats could adversely affect fish movement or connectivity to areas used by the species. The impact would be considered high magnitude if complete blockage occurred in the stream particularly during critical movement periods such as spawning or accessing important habitat areas.

Implementation of the environmental protection measures described in Section 2.2.5 and those required by state and federal permits and regulatory requirements would serve to reduce the impacts to fish, mussel species, and special status fish. These measures include a fish and wildlife plan and a requirement to minimize the acreage of mining disturbance at any given time within high-value habitat. The plan would provide for the restoration, enhancement, and maintenance of natural riparian habitats associated with streams, lakes, and other wetland areas. Specific environmental protection measures for special status species would be included as part of the plan.

Mining companies also would be required to coordinate with the USACE to identify and inventory appropriate waters of the U.S. as reference sites for evaluating the reclamation success in developed water resources, at the time site-specific mine locations are proposed. The reference sites would include consideration of aquatic resource creation or restoration ratios. This information would be presented in the conditional or functional assessment prepared in support of each mine's Section 404 permit application.

Water quality could be affected during the construction of haul roads and mining activities due to surface disturbance within or near waterbodies that may increase sedimentation and turbidity. The extent of the sedimentation effects would depend on the flow conditions, substrate composition, stream configuration, and types of aquatic communities located within the affected areas. The indirect effects from sedimentation in waterbodies ranges from adverse effects on species behavior and physiological functions or important activities such as spawning (Waters 1995), depending on the species. In general, many of the warmwater fish species are more tolerant than coldwater species to suspended sediment concentrations. Sediment deposition in fish spawning areas or mussel beds could adversely affect reproduction and filter-feeding by mussel species. The duration of sediment effects could range from short-term to long-term depending on the duration of the mining-related surface-disturbing activities.

In compliance with required permits, surface water control facilities would be constructed in appropriate locations to control stormwater runoff. Temporary sediment control features also would be installed to minimize the effects on streams and lakes from accelerated erosion within and downstream of active mining areas.

Vehicle and equipment use or storage within or near waterbodies would pose a risk to aquatic biota from fuel or lubricant spills. If fuel reached a waterbody, aquatic species could be exposed to toxic conditions. Spills also could result in chemical residues within or on substrates in waterbodies. Impacts could include direct mortalities or reduced health of aquatic species. The magnitude of impacts would depend on the volume of spilled fuel, flow conditions, channel configuration, and species present in the affected area. Environmental protection measures that are part of a SPPC Plan would be implemented to reduce the potential effects from spills of contaminants that could reach waterbodies.

Mine disturbance and dewatering could require collection and diversion of groundwater and surface water during mining. As a result of these activities, there may be a reduction or an increase of surface water flows that could adversely affect the amount and quality of habitat for aquatic species. Dewatering of groundwater would pose the greatest risk to aquatic species in areas where an aquifer affected by mine-related groundwater drawdown is hydraulically connected to surface water.

Drainages located within and downstream of active mine areas could have increased flow if they receive water discharged from the TPDES-regulated discharge points. Although runoff volumes may increase during mining, releases to rivers and streams would be controlled by the stormwater water control facilities onsite at mining operations. Discharges from temporary and permanent stormwater diversions would be monitored and controlled in terms of the volumes and water quality characteristics. Flow increases may occur below the TPDES outfalls, creating additional wetted habitat for aquatic species. The relative increase in habitat would depend on the stream channel configuration, base flow conditions, and the duration of discharge. Although the change in habitat cannot be quantified, it is likely that discharges would increase stream velocities.

The importance of a stream's flow regime for sustaining biodiversity and ecological integrity of the aquatic community is well established (Poff and Zimmerman 2010). Flow regime is considered the primary determinant regarding the structure and function of aquatic ecosystems for streams and rivers (Poff et al. 2010). The effects of flow reductions on stream habitat and water quality include decreases in water velocity, water depth, and wetted channel width (Dewson et al. 2007). The magnitude of change in aquatic habitat depends on the quantity of flow reduction or increase. Although flow reductions result in decreased wetted habitat for aquatic species, the quantity of change is not a 1:1 relationship. Riffles and other shallow areas such as backwaters and shoreline areas can be more dramatically affected than pool habitats.

Water quality can be affected by flow reductions in terms of changes in sediment transport, thermal regimes, and concentrations of other water constituents. Sedimentation is often a consequence of reduced flow because lower stream velocities enable more sediment to settle out of the water column (Dewson et al. 2007). Water temperature usually increases with flow reductions in the summer, with the magnitude of change dependent on the volume of reduction compared to the stream volume and stream velocity.

Based on literature reviews by Poff and Zimmerman (2010) and Bradford and Heinonen (2008), flow reductions adversely affect fish habitat in terms of reductions in depths and velocities, potential loss of riparian vegetation, changes in the types and quantity of instream cover, and potential restrictions in fish movement or migration. The following indirect effects also could result from reduced flows or water levels:

- Adverse effects on fish growth due to changes in food sources consisting of macroinvertebrates;
- Adverse effects on physiological and ecological requirements as a result of water quality changes involving temperature and increased sedimentation;
- Potential increase in parasite infestation; and
- Potential shift to habitat conditions that favor exotic species such as carp (Bunn and Arthington 2002).

The effects of mine-related discharges on water quality are expected to be minor, because discharged water would need to comply with TPDES permit requirements for water quality.

Waterbody crossings by vehicles and equipment pose a risk of transferring invasive aquatic plant species between drainages during mining. Aquatic plant species of concern are identified in the *Aquatic vegetation Management in Texas: A Guidance Document* (Chilton, no date). Plant species can attach to vehicles and equipment and then be transferred to other waterbodies during mine construction or reclamation.

Because the locations of future mine expansion areas and satellite mines cannot be determined for this analysis, impact discussions are considered general in terms of applicability to aquatic biological resources in the study areas. Subsequent NEPA analyses will be required to describe specific impacts to aquatic habitat and species once the mine locations are known. The following sections describe potential impacts specific to each of the study areas. These potential adverse impacts would be minimized through compliance with state and federal permit requirements and the implementation of the environmental protection measures described in Section 2.2.5.

*Study Area 1*

Coal or lignite mine development in Study Area 1 could disturb a maximum of 13,500 acres, which could affect aquatic habitat and species in up to 11 watersheds and 831 miles of perennial streams. Mining also could potentially directly disturb up to 38 miles in four ecologically significant stream segments, including Big Cypress Creek, Little Cypress Creek, Little Sandy Creek, and the Sabine River. Mining could affect habitat for up to 12 game fish species or groups in Study Area 1. All of the perennial streams contain game fish species, with the most diverse fisheries located in Lake Winneboro-Big Sandy Creek, Old Sabine-River Channel-Sabine River, and Little Cypress Creek watersheds. The types of impacts to aquatic habitat and game fish species could include the direct loss or alteration of stream or lake habitat used by adult, juvenile, and young fish. Disturbance in waterbodies also could remove or alter spawning habitat for fish, and adversely affect recruitment to species' populations until reclamation is completed.

Future mine development could affect special status species, if mining occurs in Cypress Creek, Sabine River, or small streams in Camp, Franklin, Morris, and Upshur counties. These rivers and small perennial streams contain habitat for state-threatened species consisting of four fish (blackside darter, bluehead shiner, creek chubsucker, and paddlefish), five mussels (Louisiana pigtoe, sandbook pocketbook, southern hickorynut, Texas heelsplitter, and Texas pigtoe), and one reptile species (Alligator snapping turtle). No federally listed aquatic species would be affected by mine development in Study Area 1.

Mine dewatering and discharges could potentially alter aquatic habitat within the 5-foot drawdown contour in Area 1, which overlaps with approximately 831 perennial stream miles. The magnitude of effects on game fish and special status species would depend on whether there are flow reductions in perennial streams with connections to groundwater in the mine development area.

*Study Area 2*

The effects of coal or lignite mine development in Study Area 2 represent higher potential risks to aquatic habitat and species compared to Study Area 1 because more perennial habitat is present. Mining could disturb a maximum of 50,200 acres, which could affect aquatic habitat and species in up to 16 watersheds and 1,791 miles of perennial streams. Mining also could potentially directly disturb up to 133 miles in five ecologically significant stream segments, including Attoyoc Bayou, Irons Bayou, Sandy Creek, Sabine River, and West Creek. Mining could affect habitat for up to 13 game fish species or groups in Study Area 2. All of the perennial streams contain game fish species, with the most diverse fisheries located in Cherokee Bayou-Sabine River, Eightmile Creek-Sabine River, Socagee Creek-Sabine River, Flat Fork Creek, and Tenaha Creek watersheds.

Future mine development near or within the Angelina, Sabine, or Red River drainages could potentially affect habitat for special status fish (blue sucker, creek chubsucker, paddlefish, and pallid sturgeon), mussels (sandbank pocketbook, southern hickorynut, Texas heelsplitter, Texas pigtoe, and triangle pigtoe), and amphibians (alligator snapping turtle). These species are state-protected except for one federally listed fish species (pallid sturgeon). Loss or alteration of substrates used by mussel species could eliminate or substantially reduce the population numbers in a particular stream or river.

Mine dewatering and discharges could potentially occur in 16 watersheds and approximately 1,791 miles of perennial streams and lakes/reservoirs that are located within the 5-foot drawdown contour. Flow or water level reductions could occur in aquatic habitats, if surface water is connected to groundwater in the mine development area. Game fish and special status species could be adversely affected if their habitat is reduced especially during critical life stage periods such as spawning and early life stage development.

*Study Area 3*

In relative terms, coal development in Study Area 3 would represent a lower overall risk to aquatic habitat and species compared to Study Areas 1 and 2 due to the smaller amount of perennial habitat. Mining could disturb a maximum of 50,600 acres, which could affect aquatic habitat and species in up to 14 watersheds and 411 miles of perennial streams. Mining also could potentially directly disturb up to 74 miles in five ecologically significant stream segments, including Buffalo Creek, Catfish Creek, Linn

Creek, Purtis Creek, and the Trinity River. Mining could affect habitat for up to 13 game fish species or groups in Study Area 3. All of the perennial streams contain game fish species, with the most diverse fisheries located in the Cedar Creek-Brazos River, Little Brazos River-Brazos River, Walnut Creek-Navasota River, Christmas Creek-Navasota River, and Duck Creek-Navasota River watersheds.

Future mine development near or within the Brazos, Sabine, and Trinity rivers and their tributary streams could potentially affect habitat for special status fish (blue sucker and creek chubsucker), mussels (sandbank pocketbook, smooth pimpleback, southern hickorynut, Texas fawnsfoot, Texas heelsplitter, Texas pigtoe), and reptiles (Brazos River watersnake). Three of the mussel species (smooth pimpleback, Texas fawnsfoot, and Texas pimpleback) are federal candidates. All of the species are state-protected. One federally endangered and state endangered species, the Houston toad, could potentially be affected by mining in Freestone, Leon, and Robertson counties. Mining could disturb both terrestrial and aquatic habitat used by this species.

Mine dewatering and discharges could potentially occur in 14 watersheds and approximately 411 miles of perennial streams and lakes/reservoirs that are located within the 5-foot drawdown contour. Flow or water level reductions could occur in aquatic habitats, if surface water is connected to groundwater in the mine development area. Game fish and special status aquatic species could be affected as described for Study Areas 1 and 2.

*Study Area 4*

In relative terms, coal or lignite mine development in Study Area 4 would represent a lower risk to aquatic habitat and species compared to Study Areas 1, 2, and 3 due to a smaller amount of perennial habitat. Mining could disturb a maximum of 9,800 acres, which could affect aquatic habitat and species in up to 5 watersheds and 70 miles of perennial streams. Mining also could potentially directly disturb up to 7 miles in one ecologically significant stream segment in the Little River. Mining could affect habitat for up to 15 game fish species or groups in Study Area 4. All of the perennial streams contain game fish species, with the most diverse fisheries located in the Cedar Creek-Brazos River watershed.

Future mine development near or within the Brazos and Colorado rivers and their tributary streams and Onion Creek could potentially affect habitat for special status mussels (false spike mussel, smooth pimpleback, Texas fawnsfoot, Texas heelsplitter, Texas pigtoe) and reptiles (alligator snapping turtle). All of the mussel species except false spike mussel are federal candidate species. All of the species are state-protected.

Mine dewatering and discharges could potentially occur in 5 watersheds and approximately 70 miles of perennial streams and lakes/reservoirs that are located within the 5-foot drawdown contour. Flow or water level reductions could occur in aquatic habitats, if surface water is connected to groundwater in the mine development area. Game fish and special status aquatic species could be affected as described for Study Areas 1 and 2.

*Study Area 5*

An estimated maximum of 25,000 acres could be disturbed by future coal development in Study Area 5. The potential risk of effects on aquatic habitat and species in Study Area 5 would be low due to the low number of perennial stream miles (27) compared to Study Areas 1 through 4. Five watersheds overlap with Study Area 5, none of which contain ecologically significant stream segments. If future mine development occurred in any of these watersheds, habitat for game fish species could be adversely affected for up to three species. These species occur in the Frio and Atacosa rivers and their tributaries and San Miguel and Lipan creeks.

Future mine development near or within the Frio River and its tributary streams could potentially affect habitat for special status mussel species, golden orb and smooth pimpleback. These mussel species are state-protected. Coal or lignite mine development in McCullen County within pond, ditch, or swamp habitat potentially could affect the state threatened black-spotted newt.

Mine dewatering and discharges could potentially occur in 5 watersheds and approximately 27 miles of perennial streams and lakes/reservoirs that are located within the 5-foot drawdown contour. Flow or water level reductions could occur in aquatic habitats, if surface water is connected to groundwater in the mine development area. Game fish and special status aquatic species could be affected as described in Study Areas 1 and 2.

*Study Area 6*

An estimated maximum of 25,000 acres could be disturbed by future coal development in Study Area 6. Although the acres of potential disturbance are the highest of the six study areas, perennial habitat is limited in Study Area 6. Approximately 4 miles of perennial habitat in one watershed, Elm Creek, occurs in this study area and no ecologically significant streams or lakes and reservoirs would be affected by mining. Coal and lignite mine development in the portion of Elm Creek within the study area potentially could remove or alter habitat for up to 12 game fish species. No special status aquatic species would be affected if development occurs in or near Elm Creek.

Mine dewatering and discharges could potentially occur in one watershed and approximately four miles of perennial streams and lakes/reservoirs that are located within the 5-foot drawdown contour. Flow or water level reductions could occur in aquatic habitats, if surface water is connected to groundwater in the mine development area. Game fish and special status aquatic species could be affected as described in Study Areas 1 and 2.

<u>No Action</u>

Potential impacts under the No Action alternative would be the same as those described for the Proposed Action; however, they may occur over a longer period of time due to the difference in the permitting process.

### 3.5.3 Cumulative Impacts

#### 3.5.3.1 Terrestrial Wildlife

The CESA includes the area encompassed by the study areas, plus aquatic and riparian/wetland habitat within the 5-foot drawdown area defined in Section 3.2.3, Groundwater. The CESA boundaries are shown on **Figures A-2** through **A-7** in **Appendix A**.

The past and present actions and RFFAs are identified in Section 2.7. Past and present actions with the potential to contribute to cumulative impacts for terrestrial wildlife and special status species include activities associated with surface disturbance and permanent structures that eliminate or fragment habitat. The RFFA surface disturbance that has been identified within the CESAs is associated primarily with highway work from TxDOT and future mining activities. All future disturbances associated with mining activities are estimated to be less than ten percent of the total acreage disturbed by past and present actions in each study area. CESA 6 would have the greatest proportion of potential future mining-related surface disturbance compared to the existing surface disturbance.

Past and present actions contributing to surface disturbance within each study area and CESA is listed in **Table 3.5-40.** Mining-related surface disturbance has been, or would be, incrementally reclaimed over the life of these operations, completed at mine closure and reclamation. The future mine expansion areas and satellite mines within the CESAs incrementally would increase the cumulative disturbance, but would ultimately be reclaimed as described in Section 2.2.4.3, Typical Closure and Reclamation.

**Table 3.5-40 Past And Present Surface Disturbance In Each Study Area And CESA for Terrestrial Wildlife and Special Status Species**

| Study Area | Inside Study Area Boundary (acres) | Outside Study Area/Inside CESA (acres) | Total CESA (acres) |
|---|---|---|---|
| 1 | 52,238 | 56,683 | 108,922 |
| 2 | 40,132 | 149,693 | 189,825 |
| 3 | 38,569 | 120,045 | 158,614 |
| 4 | 5,846 | 57,722 | 63,568 |
| 5 | 3,603 | 27,100 | 30,702 |
| 6 | 2,363 | 3,596 | 5,959 |

Overall, cumulative impacts to terrestrial wildlife and special status species from surface-disturbing activities and development involving increased human activities would be the same as the impacts described for the Proposed Action. Consequently, the cumulative effects to wildlife resources would be directly related to habitat loss or alteration, fragmentation, and animal displacement. Cumulative habitat loss or alteration would result in direct loss of smaller, less mobile wildlife species (e.g., small mammals and reptiles), and the displacement of more mobile species into adjacent habitats that currently may be at or near carrying capacity. The proximity of future mine sites within the CESAs to past, present, and future mine operations and other development may affect nearby wildlife habitat value and availability.

Although wildlife populations that occur in the CESAs are likely to continue to occupy their respective habitats and breed successfully, species composition and population numbers may change relative to the amount of cumulative habitat loss and disturbance from the incremental development. Because subsequent reclamation of mine sites would restore habitats to post-mining land uses, it is expected that reclaimed areas would be capable of supporting wildlife; however, species composition and densities would be expected to change at least until native vegetation is fully restored. Revegetated areas would be planted with species appropriate to the proposed post-mining land uses, but natural processes of species competition and survival will modify these communities over time. Thus, it is expected that wildlife habitats on reclaimed areas gradually would more closely resemble the surrounding undisturbed habitats, leading to similar gradual changes in the wildlife populations using these areas. Where non-mining surface-disturbing projects leave permanent changes in the landscape through the establishment of roads and structures, permanent changes to wildlife habitat would persist. The contribution of future mine expansion areas or satellite mines to permanent changes in wildlife populations and habitat would be relatively small compared to the establishment of permanent structures. The total long-term contribution to adverse impacts to wildlife would be relatively small compared to the effects of permanent structures within each CESA because mined areas would be reclaimed.

During operations within the study areas, the drainages within and immediately around the active mine area would flow primarily in response to local precipitation events, attenuated in lower stream reaches by the presence of stormwater and sediment control ponds. It is possible that development of other actions in each CESA that alter surface water runoff could have a greater impact on surface water quantity than mining operations, depending on how well stormwater management is implemented.

### 3.5.3.2 Fisheries and Other Aquatic Biological Resources

The six CESAs include the 5-foot drawdown contours in combination with the watersheds that overlap with the area boundaries, which is the same as that defined in Section 3.2.4.3 for surface water and displayed on **Figures A-2** through **A-7** in **Appendix A**. Perennial habitat within the 5-foot drawdown contour indicates where potential flow or water level reductions could occur due to mine dewatering. The location of past and present actions that resulted in surface disturbance and construction that may have altered surface water flows for the six CESAs is shown in Section 2.4. Cumulative impacts would affect aquatic resources in a larger area, as described in the following sections for each CESA, but the types of impacts would be similar to those described for the Proposed Action.

CESA 1

CESA 1 overlaps with 12 watersheds and approximately 1,773 perennial stream miles. Ecologically significant stream segments in the Area 1 CESA include Big Cypress Creek, Little Cypress Creek, Little Sandy Creek, and the Sabine River. Game fish species are the same species or species groups identified for CESA 1 (see **Table 3.5-16**). Special status aquatic species for CESA 1 would include one additional fish species, bluehead shiner, that is only associated with streams in Morris and Upshur counties.

CESA 1 contains an additional 942 miles of perennial stream habitat that extends beyond the study area boundary. One additional watershed, Black Fork Creek-Neches River, is associated with the additional area in CESA 1 and there are 3 ecologically significant stream segments: Big Cypress Creek (16 miles), Little Cypress Creek (33 miles), and the Sabine River (12 miles).

CESA 2

CESA 2 overlaps with 12 watersheds and approximately 3,069 perennial stream miles. Ecologically significant stream segments in this CESA include Attoyac Bayou, Attoyac River, Bend About Creek, Irons Bayou, Mud Creek, Sandy Creek, Sabine River, and West Creek. The addition of the Wallace Bayou watershed in CESA 2 includes diverse game fisheries in the Red River, Bayou Pierre, and Wallace lakes. The game fisheries in the additional watershed (Wallace Bayou) associated with the Study Area 2 CESA is diverse, with 14 species or groups. Game fisheries occur in the Red River and Bayou Pierre and Wallace lakes. Special status aquatic species in CESA 2 includes one additional federally listed fish species, pallid sturgeon, which occurs in the Red River.

CESA 2 contains an additional 1,272 miles of perennial stream habitat with 1 additional watershed, Wallace Bayou in Louisiana. Ecologically significant stream segments that are located in the CESA portion that extends beyond the study area boundary include the Attoyac River (44 miles), Bend About Creek (2 miles), and Mud Creek (14 miles).

CESA 3

CESA 3 encompasses 14 watersheds and approximately 1,753 perennial stream miles. Ecologically significant stream segments in CESA 3 include Buffalo Creek, Catfish Creek, Linn Creek, Purtis Creek, Trinity River, upper Keechi Creek, and Wheelock Creek. Game fish species or groups are present in all of CESA 3, although diversity varies depending on the watershed. Two additional special status fish species, creek chubsucker and paddlefish, are only associated with the CESA 3 portion in Houston County.

CESA 3 that extends beyond the study area boundary encompasses an additional 1,342 miles of perennial stream habitat, with the addition of 2 watersheds: Lower Keechi Creek and Alligator Creek-Richland Creek. The Lower Keechi Creek watershed contains 12 game fish species or groups, while 3 species are present in the Alligator Creek-Richland Creek watershed. In total, an additional 218 miles of ecologically significant streams occur in the CESA extending beyond the study area boundary. The streams include Catfish Creek (26 miles), Trinity River (150 miles), upper Keechi Creek (31 miles), and Wheelock Creek (11 miles).

CESA 4

CESA 4 overlaps with 11 watersheds and approximately 644 perennial stream miles. Ecologically significant stream segments in CESA 4 include Colorado River, Little River, San Gabriel River, and Willis Creek. Game fish species or groups are present in all of CESA 4, although diversity varies depending on the watershed. The number of game fish species or species groups in the additional watersheds associated with the CESA 4 range from 2 in Big Elm Creek, Lower Elm Creek, and Upper Little River, to 11 in the Wickson Creek-Navasota River watershed. One additional special status fish species, blue sucker, is only associated with the CESA 4 portion in Burleson and Fayette counties.

CESA 4 that extends beyond the study area boundary overlaps with an additional 574 miles of perennial stream habitat, including 6 watersheds: Big Elm Creek, Lower Elm Creek, Upper Little River, Wickson Creek-Navasota River, Granger Lake-San Gabriel River, and Turkey Creek-Brushy Creek. In total, an additional 220 miles of ecologically significant streams occur in CESA 4 extending beyond the study area boundary. The streams include the Colorado River (75 miles), Little River (96 miles), San Gabriel River (31 miles), and Willis Creek (18 miles).

<u>CESA 5</u>

CESA 5 includes a total of 105 perennial stream miles and overlaps with seven watersheds. Development near or within the tributary streams to the Rio Grande could potentially affect habitat for up to 8 game fish. Two special status mussel species (golden orb and Texas pimpleback) and one amphibian (black-spotted newt) occur in CESA 5.

CESA 5 that extends beyond the study area boundary overlaps with an additional 78 miles of perennial stream habitat, including 2 watersheds: Rex Cabiniss Creek-Nueces River and LaJarita Creek-Atascosa River. The composition of game fish species or species groups in the additional watersheds of CESA 5 (Rex Cabiniss Creek-Nueces River and LaJarita Creek-Atascosa River) are slightly more diverse than the watersheds located within the study area boundary.

<u>CESA 6</u>

CESA 6 includes a total of 15 perennial stream miles and overlaps with five watersheds. Development near or within the tributary streams to the Rio Grande could potentially affect habitat for up to 12 game fish species. Game fish diversity varies in the watersheds beyond the study area boundaries in CESA 6, with 12 species or species groups present in the Rosita Creek-Rio Grande watershed and none in Chaparrosa Creek, Lower Turkey Creek, and Palo Blanco Creek-Comanche Creek watersheds.

Special status aquatic species in CESA 6 include one fish (blue sucker) and three mussel species (Mexican fawnsfoot mussel, Salina mussel, and Texas hornshell).

CESA 6 that extends beyond the study area boundary overlaps with an additional 11 miles of perennial stream habitat, including 4 additional watersheds: Rosita Creek-Rio Grande, Chaparrosa Creek, Lower Turkey Creek, and Palo Blanco Creek-Comanche Creek.

### 3.5.4 Monitoring and Mitigation Measures

#### 3.5.4.1 Terrestrial Wildlife

The following additional mitigation measures to protect for wildlife resources should be considered for future mining development, depending on the site-specific conditions.

- If vegetation clearing activities should be required during the migratory bird breeding season (March through July), pre-construction breeding bird surveys would be conducted prior to these activities.
- A qualified biologist would survey potentially suitable habitat for nesting activity and other evidence of nesting in the vicinity of future mining. If active nests are located or other evidence of nesting is observed, appropriate protection measures should be implemented, including the establishment of buffer areas and constraint periods, until the young have fledged and dispersed from the nest area.

- If interior least tern nesting activity is observed in mine-related disturbance areas, appropriate buffer areas and constraint periods would be implemented in coordination with the jurisdictional agencies.
- For the protection of wildlife and special status species, dark-sky lighting should be installed that is fully shielded to keep light from extending above the horizontal plane and is designed to provide the minimum amount of illumination necessary for safety and security purposes.

#### 3.5.4.2 Fisheries and Other Aquatic Biological Resources

The following measures should be considered to minimize adverse effects on aquatic resources, depending on site-specific conditions.

- Invasive Plant Species Protection: If direct disturbance occurs in a waterbody with invasive aquatic species, all vehicles and equipment must be cleaned and dried prior to working in adjacent drainages. The cleaning and drying process include the following steps.
  - Remove any visible plant or plant fragments, as well as mud or other debris.
  - Clean all parts and equipment that came in contact with water using one or more of the methods listed below.
  - Allow everything to completely dry before launching into new waters; five days in warm, dry weather and up to 30 days in cool, moist weather.
  - If sufficient drying time is not available, decontaminate all surfaces using one or more of the cleaning methods described below. Carefully inspect for invasive organisms before entering a new water body.
- Avoidance of Direct Effects to Protect Important Spawning or Nursery Areas for Special Status Fish Species: Important spawning or nursery areas for special status fish species would be avoided or restricted in terms of direct effects of mining construction or operation activities.
- Protection to Special Status Mussel Species: If construction or mining operations would result in disturbance to streams with potential habitat for special status mussel species, mussel surveys would be conducted by a qualified biologist within the proposed disturbance areas. If mussels are present, relocation to similar habitat would be considered in coordination with TPWD.
- Avoidance of Critical Habitat for Houston Toad: Construction or mining operations would be avoided in critical habitat for Houston toad in Study Area 4 (Bastrop and Burleson counties).

### 3.5.5 Residual Adverse Effects

#### 3.5.5.1 Terrestrial Wildlife

Residual adverse effects to terrestrial species, including special status species, would include the long-term net loss of terrestrial upland habitat resulting from the construction and operation of surface coal or lignite mining. Residual adverse effects to species using shrub and forested habitats would include long-term loss of habitat, as it would take up to 15 years for shrub species to fully reestablish and 20 plus years for tree species to reestablish. Assuming successful reclamation is achieved, these shrub and forested habitat residual adverse effects would be minimized over time.

#### 3.5.5.2 Fisheries and Other Aquatic Biological Resources

Successful implementation of environmental protection measures, compliance with permit and regulatory requirements, and implementation of additional mitigation would reduce effects on aquatic habitat and species within the six study areas. However, direct disturbance to aquatic habitat or reduced flows due to dewatering could result in a long-term loss of habitat for aquatic species. Habitat would be restored in areas affected by mining activities following successful reclamation, but a long-term recovery period is likely to occur at some aquatic locations. Therefore, unavoidable adverse impacts on aquatic habitat and species could occur at some locations for an extended time period.

## 3.6 Cultural Resources

The intention of federal and state historic preservation laws and regulations is to protect and preserve cultural resources, such as buildings, structures, sites, objects, districts, and landscapes. Because it is impractical to save everything that is old, the emphasis for preservation is on historic properties and those cultural resources that are culturally or traditionally sacred or sensitive, such as cemeteries and other burials. Any prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion on the NRHP may qualify as a “historic property" (16 United States Code [USC] Section 470[w][5]). The following discussion emphasizes the relationship of pertinent federal and state legislation and corresponding implementing regulations to historic properties in the six study areas. Unless otherwise cited, this information is excerpted from the Advisory Council on Historic Preservation’s (ACHP’s), Texas State Historic Preservation Office (SHPO), the THC, and the Texas Secretary of State.

### 3.6.1 Affected Environment

#### 3.6.1.1 Regulatory Framework

Federal

Federal preservation legislation began with passage of the Antiquities Act of 1906 (P.L. 59-209), which applies to cultural resources located on federal property. The goal of the National Historic Preservation Act (NHPA) enacted 60 years later and amended subsequently (P.L. 89-665) is to have federal agencies act as responsible stewards of the nation's resources when their actions affect historic properties. Section 106 of the NHPA requires federal agencies to consider the effects on historic properties of any project carried out by them or that receives federal financial assistance, permits, or approvals, and provides the ACHP or its representative an opportunity to comment on these projects prior to making a final decision. The NHPA also provides for the NRHP, which is the list of historic properties deemed worthy of preservation based on their historical significance and integrity.

Section 106 is carried out via a four-step review process by which cultural resources are given consideration during the evaluation of proposed federal undertakings. The four steps are:

- INITIATE the Section 106 process by defining the undertaking and determining if it has the potential to affect historic properties.
- IDENTIFY historic properties.
- ASSESS the effect of the project on identified historic properties.
- RESOLVE adverse effects by exploring alternatives to avoid, minimize, or mitigate the effects.

SHPOs administer the national historic preservation program at the state level and Tribal Historic Preservation Officers (THPOs) administer the national historic preservation program on tribal lands. Federal agencies conduct government-to-government consultation with federally recognized Indian tribes and Native Hawaiian organizations concerning the identification of cultural values, religious beliefs, and traditional practices of that may be affected by federally approved actions. Federal agencies also consult with SHPOs and THPOs when developing agreement documents (e.g., Programmatic Agreement). Programmatic Agreements are used when the effects of an undertaking are not fully known and as a tool for implementing approaches that do not follow the common Section 106 process. This is done to streamline and enhance historic preservation and project delivery efforts.

For undertakings that are site-specific, the identification of historic properties occurs within an Area of Potential Effects (APEs), defined as “the geographic area or areas within which an undertaking may directly or indirectly cause alterations in the character or use of historic properties by 36 CFR 800.16(d).” The APE is influenced by the scale and nature of an undertaking and may be different for different kinds of effects (e.g., direct or indirect). The four-step Section 106 process must be completed by or under close supervision by an individual who meets professional qualifications standards for archaeology and historic preservation as set forth by the U.S. Secretary of the Interior (48 FR 44716-44742).

The ACHP's regulations implementing Section 106 of the NHPA can be found in *Protection of Historic Properties*, 36 CFR 800. The USACE uses its Appendix C guidance document to implement Section 106 of the NHPA. Other federal regulations that assist with the implementation of the NHPA include the *National Register of Historic Places*, 36 CFR 60; *Procedures for State, Tribal, and Local Government Historic Preservation Programs*, 36 CFR 61; and *Determinations of Eligibility for Inclusion in the National Register of Historic Places*, 36 CFR 63.

The American Indian Religious Freedom Act (AIRFA) of 1978 (P.L. 95–341) protects and preserves for American Indians their inherent right of freedom to believe, express, and exercise traditional religions, including but not limited to access to sites, use and possession of sacred objects, and the freedom to worship through ceremonials and traditional rites. The law asserts that laws passed for other purposes were not meant to restrict the rights of American Indians.

The Native American Graves Protection and Repatriation Act (NAGPRA) of 1990 (PL 101-601) develops a systematic process for determining the rights of lineal descendants, Indian tribes, and Native Hawaiian organizations to certain American Indian human remains, funerary objects, sacred objects, or objects of cultural patrimony with which they are affiliated. The National Park Service (NPS) created the Native American Consultation Database (NACD) to be a tool for identifying consultation contacts for Indian tribes and Native Hawaiian organizations. Other federal agencies have developed similar tools, such as the U.S. Housing and Urban Development (HUD) Tribal Directory Assessment Tool (TDAT). *Native American Graves Protection and Repatriation Regulations*, 43 CFR Subtitle A 10 are used by federal agencies to implement this law.

Some EOs issued by U.S. presidents also need to be considered. "Protection and Enhancement of the Cultural Environment" (EO 11593) requires federal agencies to take a leadership role in preservation. Most relevant to this analysis is that for every action funded, permitted, licensed, or assisted by the federal government, the lead agency must ask the U.S. Secretary of the Interior to determine if any property in the APE is eligible for listing on the NRHP. It also provides for the recording of NRHP properties that will be unavoidably destroyed or altered as a result of federal action.

"Federal Support of Community Efforts along American Heritage Rivers," (EO 13061) was issued to assist with natural resources and environmental protection, economic revitalization, and historic and cultural preservation. Federal agencies were instructed to coordinate plans, functions, programs, and resources to preserve, protect, and restore rivers and their associated resources that are important to national history, culture, and natural heritage.

<u>State</u>

Texas Government Code Title 2 Chapter 442 Section 442.007 established the State Archaeology Program, which is directed by the State Archaeologist. Located within the THC, the Office of the State Archaeologist "is empowered to adopt rules and regulations concerning access to Restricted Cultural Resource Information contained within the Texas Historic Sites Atlas (THSA) database, and the libraries, documents, maps, and files of the commission" (TAC Title 13 Part 2 Chapter 24).

The State Historical Marker Program was established by Texas Government Code Title 2 Chapter 442 Section 442.006 to install and keep a register of markers recognizing districts, sites, individuals, events, structures, and objects significant in Texas or American history, architecture, archaeology, or culture. The THC Official Texas Historical Marker Program, inaugurated in 1962, includes both the Recorded Texas Historic Landmark (RTHL) and subject marker programs. RTHLs are properties judged to be historically and architecturally significant, such as buildings at least 50 years old that are worthy of preservation for their architectural and historical associations. This is a designation that comes with a measure of protection under state law. Today, historical markers can be found in all 254 Texas counties; more than 15,000 markers are located across the state, including 3,600 RTHL markers.

The Antiquities Code of Texas, otherwise known as the Texas Natural Resources Code (Title 9, Chapter 191), was enacted in 1969 to protect archaeological sites and historic buildings on public land. The Antiquities Code of Texas requires state agencies and political subdivisions of the state, including cities, counties, river authorities, municipal utility districts, and school districts, to notify the THC of ground-disturbing activity on public land.

Under the Antiquities Code of Texas, the THC is responsible for protecting and preserving State Antiquities Landmarks (SALs). SALS are defined as “an archaeological site, archaeological collection, ruin, building, structure, cultural landscape, site, engineering feature, monument or other object, or district that is eligible to be designated as a landmark or is already officially designated as a landmark” (TAC Title 13 Part 2 Chapter 26 Subchapter A Section 26.3[63]). TAC Title 13 Part 2 Chapter 26 Subchapter B Rule 26.7 describes rules for identifying and designating SALS. TAC Title 13 Part 2 Chapter 26 Subchapter C deals with rules pertaining to archaeology, such as criteria for evaluating archaeological sites, caches, and collections, as well as providing additional information important for the completion of archaeological work in the state. TAC Title 13 Part 2 Chapter 26 Subchapter D provides rules pertaining to historic buildings and structures, including, but not limited to, criteria for evaluating historic buildings and structures. TAC Title 13 Part 2 Chapter 26 Subchapter E consists of Memoranda of Agreement (MOAs) between the THC and other state agencies.

Texas Health and Safety Code Title 8 Chapter 711 protects cemeteries and authorizes penalties for desecrating cemeteries. TAC Title 13 Part 2 Chapter 22 provides rules related to cemeteries. For instance, under Rule 22.4(a), “A person discovering a previously unknown or abandoned cemetery should file notice of the cemetery with the county clerk of the county in which the cemetery lies within ten days of the date of discovery.” Under Rule 22.4(b), “If one or more graves are discovered during construction of improvements on a property, construction must stop and may only proceed in a manner that would not further disturb the grave or graves unless the graves are removed in accordance with this chapter.” Under Rule 22.4(c), “Agricultural, industrial, and mining operations may not be conducted in a manner that will disturb a grave or cemetery unless the graves and dedication of the cemetery are removed in accordance with this chapter.” In 2009, the Council of Texas Archaeologists (CTA) established guidelines for the identification of historic cemeteries and unmarked historic graves with the goal fostering respectful treatment of human graves, including unmarked cemeteries and graves currently not protected by state law. The CTA and THC also have published standards and guidelines for archaeological projects (CTA no date; THC no date[a,b]).

### 3.6.1.2 Overview of Texas Historic Contexts

The following prehistoric and historic summaries were derived from the *Handbook of Texas* (TSHA 2014b) and Texas Beyond History (University of Texas at Austin 2014), unless cited otherwise.

Texas’ recorded prehistory extends back at least 11,200 years and has been studied by both professional and avocational archaeologists for many decades. Some areas, such as central Texas, have been intensively studied, and detailed archaeological sequences have been established. In other regions, such as south Texas, research intensified in the 1970s, and much remains to be learned. Cultural change proceeded at somewhat different rates over different parts of what is now Texas. In some regions, hunting and gathering cultures persisted throughout prehistory. In other regions, cultures with farming and settled village life appeared. The Texas archaeological record is divided into four general periods—Paleoindian, Archaic, Late Prehistoric, and Historic. The cultural groups who lived across the Texas landscape are described in the following groupings by time period.

Paleoindian (9,200–6,000 B.C.)

Although some claims have been made for greater antiquity, the earliest known inhabitants of the state, during the late Pleistocene Epoch of the last Ice Age, can be linked to the Clovis Complex around 9,200 B.C. (11,150 Years Before Present [yr BP]). The distinctive Clovis fluted point is widespread and was used at least in some cases in mammoth hunting. The Gault Site (41BL323) in Central Texas, northwest of Study Area 4 in Bell County, has a Clovis occupation that includes incised pebbles, a blade core, and several Clovis points, including one made of Alibates material from the Canadian River quarries. The Folsom Complex, around 8,800 – 8,200 B.C. (10,750 – 10,150 yr BP), is distinguished by Folsom fluted points and is known from sites where now-extinct forms of bison were killed and butchered or from campsites where the points are found along with other stone tools.

Dalton and San Patrice points may date around 8,000 B.C. (9,950 yr BP) in east Texas; Plainview points found from the Panhandle into south Texas date from around 8,200 – 8,000 B.C. (10,150 – 9,950 yr BP) and are associated with kills of Pleistocene bison at a few sites.

By around 8,000 B.C. (9,950 yr BP), the end of the Pleistocene in Texas, remnants of the animals of that era—mammoth, bison, camel, horse, sloth—disappeared. Climates became more like those of modern times, yet in some regions, group mobility and stone toolmaking continue to follow the patterns of earlier times. There is a great diversification of point types, several of which cannot be precisely dated, in post-Pleistocene, late Paleoindian times. Excavations done in the 1980s and 1990s at the Wilson-Leonard Site (41WM235), west/southwest of Study Area 4 in Williamson County, in central Texas, may help to resolve some of these issues, as well as provide archaeologists with a broader view of the cultural patterns associated with distinctive Paleoindian points.

The Scottsbluff points in east Texas are from around 6,500 B.C. (8,450 yr BP); in south Texas, hunters and gatherers used Golondrina points, radiocarbon dated at 7,000 B.C. (8,950 yr BP). Excavations at Baker Cave (41VV213), a dry rockshelter on the Devils River drainage, northwest of Study Area 6 in Val Verde County, yielded a wide array of information on the climate, which was essentially similar to modern conditions although probably drier 9,000 years ago. A well-preserved cooking pit yielded the remains of small game, especially rabbits, rodents, and several species of snakes. The cave also yielded charred walnut and pecan hulls as well as other organic remains.

The Angostura projectile point marks the end of the Paleoindian period at around 6,800 B.C. (8,750 yr BP), based on radiocarbon dates from the Wilson-Leonard Site and the Richard Beene Site (41BX831) north of Study Area 5 in Bexar County. The peoples who made these points, like the peoples of the Golondrina Complex, were hunters and gatherers who used resources quite similar to those of the modern era.

Archaic (6000 B.C. to around A.D. 0)

Much of Texas prehistory falls within a long time span of hunting and gathering cultural patterns known collectively as the Archaic, beginning around 6,000 B.C. (7,950 yr BP). The period is important for changes in the style of projectile points and tools, the distribution of site types, and the introduction of grinding implements and ground-stone ornaments, all reflecting a gradually increasing population that utilized abundant plant and animal resources of environments similar to those of modern times. The primary weapon during the Archaic was the spearthrower or atlatl. Many prehistoric rock art sites in Texas date from the Archaic.

A dry, warm episode known as the Altithermal occurred about 5,000 – 3,000 B.C. (6,950 – 4,950 yr BP). The details of the Archaic sequence vary from region to region within the state. In general, the span can be divided into Early, Middle, Late, and Transitional eras. Each period is represented by changes in cultural patterns, often including specific artifact forms, hunting patterns, and types of site utilized. In some regions there is enough available information to subdivide these periods into phases or intervals.

The Early Archaic (6,000 – 2,500 B.C. or 7,950 – 4,450 yr BP) is poorly known in its earliest phases, though a number of point and tool types can be linked to that era. In general, settlement appears more scattered than in later times, and populations were still rather small and quite mobile. There are broader relationships among several regions, as indicated by the widespread occurrence of distinctive points, such as the Martindale, Uvalde, Early Triangular, Andice, and Bell (the latter two part of a cultural pattern known as Calf Creek, which encompasses Oklahoma and parts of Arkansas).

The Middle Archaic (2500 – 1000 B.C. or 4,450 – 2,950 yr BP) marks a time throughout the state of significant population increase, large numbers of sites, and abundant artifacts, especially projectile points of various forms. This appears to have been a time when Indian cultures became more specialized on a regional basis. For example, most regions appeared to be typified in the Middle Archaic by one or two distinctive points—Gary and Kent points in east Texas, Pedernales in central Texas, Langtry in the lower Pecos, and Tortugas in south Texas. In some regions, specific types of site are present, especially the burned-rock middens of central Texas. Large cemeteries began to appear late in the period, perhaps reflecting territoriality on the part of some hunting and gathering societies. Similarly, trade connections were established and artifacts of stone and shell were brought from distant areas, especially Arkansas.

Hunting and gathering continued in the Late Archaic (1000 – 300 B.C. or 2,950 – 2,250 yr BP) in most of Texas. In east Texas, pre-Caddo sites mark the beginning of settled village life shortly after 500 B.C. (2,450 yr BP). Bison appear to be an important game resource in central Texas during this period.

The Transitional Archaic (300 B.C.-A.D. 700 or 2,250 – 1,250 yr BP) marks an interval similar to the Late Archaic, but featuring distinctive point styles, such as Ensor, Darl, Frio, and Fairland. Although this period is important in the Archaic sequences of central Texas, it is not part of the east Texas archaeological record, where village sites such as the George C. Davis Site (41CE19) in the Caddo Mounds State Historic Site in Cherokee County, southwest of Study Area 2, make their initial appearance and fully develop during the subsequent Late Prehistoric period. These sites often have large, flat-top mounds sometimes used to support structures and conical mounds for burials. Such sites mark the introduction of, and reliance upon, agriculture which is related to population growth and the emergence of social and political systems more advanced than in previous periods.

Late Prehistoric (approximately A.D. 700 – 1600)

This period (A.D. 700 or 1,250 yr BP to historic times) is particularly noticeable in the archaeological record throughout the state. Bison hunting appears to be very important in most regions, although the occurrence of tiny arrow points marks the introduction and spread of the bow and arrow for hunting smaller game throughout the state. Pottery is present, even among hunters and gatherers in central and south Texas. Many local types of arrowheads were developed, including Friley and Catahoula on the Texas-Louisiana border. In some areas, distinct shifts are discerned in arrow point styles through time, especially with Scallorn (Austin Phase) and later, Perdiz (Toyah Phase) in central Texas. The Toyah Phase is of particular interest because it represents a widespread bison-hunting tradition in central and south Texas from around A.D. 1300 – 1600 (650 – 350 yr BP). In addition to Perdiz points, Toyah Phase material culture includes end scrapers for hideworking, beveled knives for bison butchering, and a distinctive bone-tempered ceramic.

Although a hunting and gathering continues in the Late Prehistoric as in the Archaic, the material culture, hunting patterns, settlement types, and other facets of the era mark a fairly distinctive break with the past. In east Texas, agriculture provides the base for the Gibson Aspect, which marks the earliest Caddoan culture. Mound-building, specific types of pottery and arrow points, sedentary villages, ceremonial centers, and an established social hierarchy are salient features.

Around A.D. 1200 (750 yr BP), Gibson transitioned to the Fulton Aspect, which continued into the Historic era and is clearly linked with the Caddo. Village sites with links to southeast New Mexico appear around the same time.

One distinctive aspect of the Late Prehistoric was widespread, long-distance trade, best reflected in the distribution of obsidian artifacts in parts of Texas. Artifact-quality obsidian (volcanic glass) does not occur naturally in Texas, but at sites in deep south Texas and across central Texas, obsidian artifacts are often reported. Some of the obsidians found in south and central Texas can be definitively traced to sources in southern Idaho, Wyoming, and central Mexico, reflecting long-distance trade networks. The Idaho and Wyoming obsidian were transported through a north-south trade system across the Great Plains that continued into Historic times.

The transition from Late Prehistoric to Historic is difficult to discern in many parts of the state. The initial French and Spanish expeditions had little, if any, effect on the native cultures, which were largely unchanged for another 100 to 150 years. Texas archaeologists refer to this brief span as the "Protohistoric" period, perhaps best exemplified by sites of the 16$^{th}$ and 17$^{th}$ centuries on Galveston Island and in south Texas. However, by the early 18$^{th}$ Century most peoples of these areas were affected by the Spanish missions, and their cultures began to change.

Historic (after A.D. 1600)

The Historic era (after ca. A.D. 1600 or 350 yr BP) brought change to both agriculturalists and hunter-gatherers, first by the French and then by the Spanish. Hunter-gatherer populations were decimated by the introduction of the Spanish mission system and the intrusion of Apache, and later, Comanche groups. Archaeologically, certain sites are recognized as Historic Caddo on the basis of their pottery and arrow points and some arrow point types (Harrell and Washita) are found with historic hunter-gatherers and village farmers in north-central Texas.

Rock art sites incorporate such historic motifs as churches and horse-borne Indian warriors or Spaniards. With the advent of the Spanish mission system, the Indians who adopted mission life continued for a while to make stone tools, and a distinctive point type, Guerrero, is often found in missions, ranchos, and Indian campsites of that era. However, by the late 18$^{th}$ Century, stone tools had been replaced by brass and iron.

The following sections briefly describe key features of the historic American Indian groups encountered in the study areas during the early part of the Historic period.

*Caddo*

As a people, the Caddo Indians were agriculturalists. Under the umbrella of “Caddo” are other “confederacies” or bands of kin-based (or affiliated in some other way) groups, such as the Hasinai, Kadohadacho, and Natchitoches. Most of the radiocarbon-dated Caddoan artifacts seem to date to the period A.D. 200 – 500 (1,750 – 1,450 yr BP) and A.D. 1400 – 1680 (55 – 270 yr BP) (Perttula 2004). Their communities tended to revolve around earthen mounds used as platforms for functions, both civic and religious, as well as for burials.

*Coahliltec/Coahuiltecan*

Not much is known about this group of American Indians who appear to have been organized into hundreds of small bands or groups (Moore 2012a). They were among the poorest and evidence points to them being displaced, absorbed by another nation, or killed off. Many intermarried with the Spanish. These factors led to a loss of Coahuiltecan identity (ca. A.D. 1600s – 1800s or 350-150 yr BP). The Coahuiltecans were bison hunters who traveled long distances to trade in camps in central Texas near modern San Marcos, Austin, La Grange, and Victoria (Moore 2012a).

*Comanche*

The Comanche are historically important in Texas, although they were almost as new to Texas as the Spanish. They originated in the mountains of Wyoming as a branch of the Northern Shoshone Indians, arriving in what became Texas by the early 1700s.

The Comanche were known as fierce warriors whose nomadic subsistence depended on hunting and gathering. Their migration and power began upon acquiring horses from the Spanish and Puebloan Indians of the southwestern U.S. (Moore 2012b), which allowed them to leave the mountains and move to the Southern Plains, where there was an abundance of large animals for hunting.

*Kickapoo*

Part of the Algonquian linguistic family, the Kickapoo Indians originated from the Great Lakes region where they were semi-nomadic and built wooden, bark covered structures for houses (Brush 2005). In 1775, the King of Spain granted land to the Kickapoo in what is now Texas, but it appears that most of them moved southward in the 1830s (Brush 2005). Upon Euro-American settlement, they unsuccessfully banded together twice with other Indian tribes, which not only had a negative effect on relations with the settlers, but fractured the Kickapoo tribe, dividing them into three groups—the Kansas Kickapoos, the Oklahoma Kickapoos, and the Mexican Kickapoos/Texas Band of the Oklahoma Kickapoos. The Texas Band wound up migrating to northern Mexico and working with the Mexican government in raiding the Texans.

*Lipan Apache and Mescalero Apache*

The Apaches migrated from Canada and arrived in the Texas panhandle sometime around 1528 (Moore 2000). The Lipan and Mescalero Indians are part of the larger group of Indians known as the Apache, whom they joined with after being displaced by the Comanche Indians. A nomadic people, they temporarily settled in areas which were the best “fit” at the time. Once a settled area was no longer useful, or another area would serve their purpose better, the Lipan and the Mescalero would go elsewhere. The Apache were hunters and gatherers, living mostly on bison, especially after they acquired horses from the Spanish and Puebloan Indians. However, they probably were semi-sedentary agriculturalists when they first arrived on the Southern Plains (Moore 2000).

*Tonkawa*

The Tonkawa Indians were made up of a group of smaller bands of Indians—the Tonkawa, Mayeye, and likely the Cava, Cantona, Emet, Sana, Toho, and Tohaha—that joined together in central Texas after French and Spanish explorers began surveying the area. The Tonkawa lived in central Texas near Austin; their historical territory was along the Balcones Escarpment between Austin and San Antonio. Originally the Tonkawa had a larger territory that included the hill country around Llano and Mason Texas in the Edwards Plateau region west of Austin and San Antonio. Around 1600, the Tonkawa were pushed by other American Indians out and east of the Edwards Plateau where they remained during most of the Spanish period and all of the Texan/American periods. They were friendly with the Karankawa and shared the lands between the Karankawa homelands and their homelands. They also shared land with the Coahuiltecan tribes to the south of them. Bexar County (San Antonio) was a mix of Tonkawa in the north and Coahuiltecan tribes in the south. Travis and Williamson counties shared land with the Wichita tribes.

Simultaneous to these Native American historical developments across the landscape, the region that is now Texas experienced many changes at an international scale. Following the War of Independence from Spain (1810-1821), Mexico faced many problems, including the need to guard its far northern possessions from United States expansion. The state of "Coahuila and Texas" was especially vulnerable to U.S. encroachment. Colonization offered the best deterrent. At the end of the Mexican War of Independence, the population of the vast area now known as Texas was only approximately 2,500.

Lacking sufficiently large numbers of citizens to settle the north. Mexico tried enticing European and American immigrants to the region. The *State Colonization Law of 1825* attempted to enable the settlement of the united state of Coahuila and Texas through “*empresario* contracts” designed to encourage the tilling of the soil and the growth of ranches, and facilitate commerce. Through the rest of the 1820s, the size of the immigrant population increased until the Law of April 6, 1830 voided the *empresario* contracts and curtailed immigration from the U.S., although officials did allow settlement to continue in the colonies of Stephen F. Austin (on the Brazos River) and Green DeWitt (on the Guadalupe River). This law was nullified in 1834.

By 1835, there were 21 urban sites in the state, and principal towns established by Americans were San Felipe de Austin, Gonzales, Velasco, Matagorda, Brazoria, San Augustine, and Liberty. Anglo-Texans generally lived in isolation since farms were quite spread out. Anglo-Texans set up schools and were able to circumvent Catholicism as the national religion, because of a shortage of priests and other complications. In 1834, the Mexican government granted the Anglo-Texans religious freedom with certain conditions. For African Americans, slavery came to be a way of life in the eastern settlements, in spite of the Mexican government's strong disapproval of the system. Most Hispanic Texans remained situated in central and southern Texas – on ranches and in the three urban settlements of San Antonio, Goliad, and Nacogdoches.

Frontier life was challenging in many ways. Manufacturing of basic items was hardly known, and lumbering and milling appeared in the timberlands of East Texas, although the lumber industry principally met only local needs. Trapping – primarily otters and beavers – was pursued to some degree, and Anglos sold the pelts at Nacogdoches yearly. Hispanic *rancheros* rounded up wild cattle and mustangs in the brush country, although raising livestock may not have been as important as in Spanish Texas. Farming among the Hispanic population took a subordinate position to ranching.

By the end of the Mexican period, great changes were apparent in Texas. Anglos had implemented a republican form of government, established a different language, introduced new Christian communions, created a social order wherein minorities, among them some Mexican Texans who assisted in the struggles of the 1830s, were subordinated, and, overall, given the region unique Anglo-American characteristics. However, the region remained an underdeveloped frontier that taxed the perseverance of settlers.

Although there were earlier clashes between Mexican forces and groups of colonists and later clashes between Mexican and Texan forces, the Texas Revolution began with the Battle of Gonzales (October 1835) and ended with the Battle of San Jacinto (April 1836). In late October 1835, Texas volunteers laid siege to the city of San Antonio, which was garrisoned by the Mexican army under Gen. Martín Perfecto de Cos. The city was retaken later by government forces commanded by Gen. Antonio López de Santa Anna during the Battle of the Alamo in March 1836. After the subsequent defeat of Santa Anna's army in the battle of San Jacinto, the area was still claimed by both sides and fighting continued. For instance, six years after Texas independence (March 1842), Gen. Rafael Vásquez briefly reoccupied San Antonio. As late as 1844, San Antonio had only some 1,000 residents, 90 percent of whom were of Mexican descent.

Just prior to the Republic of Texas, Mexico had divided the region into four departments. For instance, the Department of Bexar covered much of the western edge of settlement at that time from the Rio Grande to the Panhandle and as far west as El Paso. With the winning of Texas independence in 1836, the departments became counties. Subsequently, the original counties were subdivided. The original Bexar County, for example, was subdivided into 128 counties.

Despite steady population growth fueled by large numbers of immigrants from the Old South and from Germany, the economy remained based on ranching and subsistence agriculture. Most of the farms were small – generally smaller than 50 acres. In spite of continued low population densities, population sizes increased overall and small towns grew modestly during this period.

The annexation of Texas became a major issue in the United States election of 1844. The terms of annexation had to be accepted by January 1, 1846. The Constitution of 1845 was drafted in 1845 and annexation was approved in October 1845. The United States Congress approved the Texas state constitution, and President Polk signed the act admitting Texas as a state on December 29, 1845. The fledgling republic had existed only nine years, 11 months, and 17 days. The first State Legislature convened in Austin on February 19, 1846.

Bexar County, with its large German population, was a center for antislavery sentiment; however, a majority of county residents voted for secession. In February 1861, Gen. David E. Twiggs surrendered all U.S. forces, arms, and equipment to a committee of local secessionists backed by a large force of Texas Rangers under Major Benjamin McCulloch. Texas joined the Confederacy in March 1861, and by the end of the Civil War in 1865, Texans had paid a huge price, primarily in terms of lives lost and ruined in the Confederate Army and in the privations of families left at home. On the other hand, the state's approximately 200,000 black slaves gained freedom.

The aftermath of the Civil War also had a serious effect on the state's economy. Land prices fell significantly and many businesses suffered. Economic recovery did not begin until the late 1860s and early 1870s with the start of the great cattle drives. Bexar County, located at the northern apex of the diamond-shaped area that was the original Texas cattle kingdom, became an increasingly important center for the ranching industry. Sheep ranching became popularized in 1870-1880.

As late as 1850, the settled area of the state was largely confined to the river bottoms of East and South Texas and along the Gulf Coast. Although steamboat navigation was common on the lower stretches of a number of such rivers as the Rio Grande, Brazos, and Trinity, Texas rivers were not deep enough for dependable year-round transportation. Roads were either poor or nonexistent and virtually impassable during wet weather. Ox carts hauling three bales of cotton could only travel a few miles a day and the cost of wagon transport was twenty cents per ton mile. Many proposals to improve internal transportation were both considered and attempted during the period of the Republic of Texas and early statehood. These included river improvements, canals, and plank roads in addition to railroads. However, it was the railroads that made the development of Texas possible, and for many years railroad extension and economic growth paralleled each other.

Several railroads were chartered, but not built. Work on the Buffalo Bayou, Brazos and Colorado Railroad began in 1851, and the first locomotive arrived in late 1852. This was not only the first railroad to operate in Texas, it was also the second railroad west of the Mississippi River and the oldest component of the present Southern Pacific Railroad system. Additional railroads were built across the state throughout the rest of the 19$^{th}$ Century and provided reliable means for Texas to participate in the Industrial Revolution.

Like many other parts of the U.S. during the late 19$^{th}$-early 20$^{th}$ Century, many industrial facilities were established and employment in manufacturing swelled. The state's economy had diversified by 1890 from its agrarian roots to industrialization. However, in spite of the diversified economy, the Great Depression of the mid-1930s affected a great number of Texans, and the Roosevelt Administration's New Deal policies attempted to provide aid. For instance, at its peak in 1935, Civilian Conservation Corps had 27 camps in Texas constructing recreational parks and an additional 70 camps for work in forest and soil conservation.

Engaging in the patriotic fervor that swept much of the U.S. on the brink of World War I, Texas became a major military training center. More than $20 million was spent constructing camps Bowie (Fort Worth), Logan (Houston), Travis (San Antonio), and MacArthur (Waco) for new recruits. Forts Sam Houston (San Antonio) and Bliss (El Paso) also underwent major expansion. Likewise, military aviation found a warm reception in the state, where Fort Worth, San Antonio, Dallas, Houston, Waco, and Wichita Falls housed key flight and service training centers.

Numerous bases, availability of land, public support for the military, and an increasingly influential congressional delegation made Texas an important military training center in World War II. More than

200,000 airmen trained in Texas, which had more than fifty airfields and air stations, including naval air stations at Corpus Christi, Beeville, and Kingsville. Carswell Field, Fort Worth, was home to Air Force Training Command headquarters. Seventy camps in Texas held 50,000 prisoners of war. After the war the United States retained a much larger permanent military establishment in Texas.

The last five decades of the 20th Century witnessed the transformation of Texas from a rural and agricultural state to an urban, industrial one. Statisticians reported in 1945 that 500,000 Texans left 200 rural counties to join the wartime industrial workforce in the 54 urban counties. As with much of the rest of the country, migration in postwar Texas continued to flow from the countryside to the city. The 1950 census failed to show an expected return of the prewar workers to the farms. Instead, for the first time in the state's history, more Texans lived in the city than in the countryside. The farm population declined from 1,500,000 in 1945 to 215,000 in 1980, the number of farms from 384,977 to 186,000, and farmworkers from 350,000 (including part-time workers in the cotton fields) to 85,000. More than 80 percent of the state's population resided in urban areas in 1990, a figure that exceeded the national average.

### 3.6.1.3 Regional Overview

The APE for this analysis is divided into six study areas. Only those cultural resources located in the six study areas were reviewed to determine if future mine development would subject them to impacts that could affect their eligibility for the NRHP based on NRHP criteria for evaluation. The following sections describe the cultural resources, environmental settings, and historical contexts unique to each study area. Prehistoric and historic summaries were extrapolated from the TSHA (2014b), unless cited otherwise. It should be noted that the six study areas are spread throughout three ecological regions and eight river basins described in detail elsewhere in this report. These regions and surface waters directly affected and/or constrained prehistoric and historic culture history, and they also are factors in the preservation of historic properties in the Affected Environment.

<u>Cultural Resources in the Study Areas</u>

Several categories of cultural resources are located within all six study areas. For example, all six study areas possess historical markers comprised of cemeteries, churches, and schools, as well as SALs, most of which are county resources, such as courthouses and jails. Most of the study areas also are included in past neighborhood surveys and contain marked graves of a historically known individual which are exclusive of a cemetery, museums, and individual properties and districts listed on the NRHP. Each study area contains individualized sites which make the area unique partly due to the differences in ecological setting, climate, topography, and hydrology of each region.

A site, technically, is any spot on the landscape that has been modified by human beings. There are nearly a million archaeological sites recorded within the State of Texas, with over 2,500 sites being categorized as SALs (THC 2002). More than 90 percent of archaeological sites are privately owned, and countless sites and historic places throughout the state are as yet unidentified (THC 2002).

Texas prehistoric sites are dominated by artifacts of chipped stone, pottery, antler, bone, and shell. Common prehistoric archaeological site types in Texas are listed below, with special mention of geographic areas where applicable:

- Campsites, where daily life took place
- Quarries or lithic processing areas, the locales of stone-chipping
- Temporary campsites, representing brief hunting or gathering forays
- Kill-sites, where bison or other mammals were slaughtered and butchered
- Rock-art sites, overhangs, caves, or shelters with pictographs or petroglyphs

- Caves and rockshelters, protected overhangs in canyon walls, which some Indian groups, particularly in west Texas
- Mound sites, purposeful accumulations of earth found in east Texas, used as platforms for dwellings or for burials
- Burned-rock middens, incidental accumulations of fire-cracked rock, often in mounds, used for food-processing, and found associated with campsites in central and west Texas
- Cemetery sites, areas set aside for the disposal of the dead, found in the Late Archaic and Late Prehistoric eras in central and east Texas

The most common type of kill-site in Texas is the bison-kill of Paleoindian times. At kill-sites, proper excavation will usually discover projectile points and cutting or butchering tools in association with animal bones. At quarries or lithic processing areas, controlled surface collection will often yield great numbers of large, crudely chipped bifaces.

Campsites are found throughout the state along streams or other water sources; most are "open occupation" sites, though caves and rockshelters were also often used for habitation. Many represent the villages of hunters and gatherers, whose foraging was the main way of life throughout Texas until later times, when farming was introduced in east Texas and far west Texas. Campsites, the locales of daily life, were perhaps occupied for a few weeks or months before the group moved on to exploit the plant and animal foods of another area. These are the most common sites and contain great quantities of stone tools, flakes, and other debris.

According to the THC (2002), there are four general types of cultural landscapes:

- Historic sites
- Historic designed landscapes
- Historic vernacular landscapes
- Ethnographic landscapes

Included in the broad definition of cultural landscapes are cemeteries, ranch lands and farmsteads, public parks, industrial sites and processes, and historic districts.

The following sections describe cultural resources specific to each study area. **Table 3.6-1** provides spatial and temporal information from readily available sources for the major cultural affiliations by study area.

**Table 3.6-1 Spatial and Temporal Information for Major Cultures Across the Study Areas**

| County | Culture |
|---|---|
| ***Study Area 1*** | |
| Camp | Caddo, Cherokee, Choctaw, Creek, American, Euro-American, Mexican, Spanish |
| Franklin | Caddo, Delaware, Kickapoo, Shawnee, American, Euro-American, Mexican, Spanish |
| Hopkins | Prehistoric, including Paleoindian, Late Archaic, Early Ceramic, Middle Caddoan (10,000 yr BP onward), Caddo, Cherokee, American, Euro-American, Mexican, Spanish |
| Rains | Caddo, Comanche, American, Euro-American, Mexican, Spanish |
| Titus | Caddo, Cherokee, Creek, Choctaw, American, Euro-American, Mexican, Spanish |
| Wood | Caddo, American, Euro-American, Mexican, Spanish |

**Table 3.6-1 Spatial and Temporal Information for Major Cultures Across the Study Areas**

| County | Culture |
|---|---|
| ***Study Area 2*** | |
| Cherokee | Caddo, Cherokee, Delaware, Shawnee, Kickapoo, Nacachau, Neches, American, Euro-American, Mexican, Spanish |
| Gregg | Caddo, Cherokee, American, Euro-American, Mexican, Spanish |
| Harrison | Caddo, American, Euro-American, Mexican, Spanish |
| Panola | Caddo, Hasinai, American, Euro-American, French, Mexican, Spanish |
| Rusk | Prehistoric, including Archaic (7,950 yr BP onward), Caddo, Cherokee, American, Euro-American, Mexican, Spanish |
| Shelby | Caddo, American, Euro-American, Mexican, Spanish |
| Smith | Caddo, American, Euro-American, Mexican, Spanish |
| ***Study Area 3*** | |
| Anderson | Comanche, Kichai, Kickapoo, Tawakoni, Waco, American, Euro-American, Mexican, Spanish |
| Falls | Anadarko, Cherokee, Tawakoni, Waco, American, Euro-American, Mexican, Spanish |
| Freestone | Caddo, Kichai, Tawakoni, American, Euro-American, Mexican, Spanish |
| Henderson | Cherokee, Delaware, Hasinai, Kickapoo, Shawnee, American, Euro-American, Mexican, Spanish |
| Leon | Deadose, American, Euro-American, Mexican, Spanish |
| Limestone | Prehistoric (unspecified), Comanche, Kiowa, Tawakoni, Waco, American, Afro-American, Euro-American, Mexican, Spanish |
| Robertson | Prehistoric (unspecified), Comanche, Kiowa, Lipan Apache, Tawakoni, Tonkawa, Waco, American, Euro-American, Mexican, Spanish |
| Van Zandt | Caddo, Cherokee, American, Euro-American, Mexican, Spanish |
| ***Study Area 4*** | |
| Bastrop | Prehistoric (unspecified), Comanche, Tonkawa, American, Afro-American, Euro-American, Mexican, Spanish |
| Burleson | Caddo, Tonkawa, Wichita, American, Euro-American, Mexican, Spanish |
| Lee | Prehistoric (unspecified), Cherokee, Comanche, Tonkawa, American, Euro-American, Mexican, Spanish |
| Milam | Caddo, Lipan Apache, Tehuacana, Tonkawa, Waco, American, Euro-American, Mexican, Spanish |
| Williamson | Cherokee, Comanche, Tonkawa, American, Afro-American, Euro-American, Mexican, Spanish |
| ***Study Area 5*** | |
| Atascosa | Coahuiltecan, Comanche, Lipan Apache, Mescalero Apache, American, Euro-American, Mexican, Spanish |
| McMullen | Prehistoric (unspecified), Coahuiltecan, American, Euro-American, Mexican, Spanish |
| ***Study Area 6*** | |
| Dimmit | Coahuiltecan, Comanche, Lipan Apache, Mescalero Apache, American, Euro-American, Mexican, Spanish |
| Kinney | Coahuiltecan, Comanche,Jumano, Lipan Apache, Mescalero Apache, Tamaulipan, Tonkawa, American, Euro-American, Mexican, Spanish |
| Maverick | Prehistoric, including Early, Middle, Late Archaic, and Late Prehistoric (7,950 yr BP onward), Coahuiltecan, Comanche, Kickapoo, Lipan Apache, Mescalero Apache, American, Euro-American, Mexican, Spanish |
| Zavala | Coahuiltecan, Comanche, Lipan Apache, Mescalero Apache, Tonkawa, American, Euro-American, Mexican, Spanish |

### 3.6.1.4 Study Areas

Study Area 1

There are no federally recognized American Indian tribes with NAGPRA claims to Camp, Franklin, Hopkins, Rains, Titus, or Wood counties, according to the NACD (NPS 2014). However, the HUD's TDAT identifies the Comanche Nation as a federally recognized tribe with a historical interest in Rains County (HUD no date). According to available maps (showing the distribution of American Indian groups by linguistic family as recreated from historical accounts by early Europeans, this study area was formerly populated by the Caddo (Sturtevant 1967).

No State Historic Sites are located in this study area, according to the THC's *Historic Sites Atlas* (THC no date[c]).

A cultural resources investigation was completed for a previously proposed mine in Hopkins County within Study Area 1 (Smith et al. 2005). However, the report by Smith et al. (2005) discusses previous archaeological investigations in the vicinity of their investigation, including extensive investigations at Lake Fork Reservoir (Hopkins, Rains, and Wood counties) as well as at Cooper Lake (Hopkins and Delta counties) and excavations at Hurricane Hill (41HP106). Hurricane Hill is a multicomponent site with occupations dating to 10,000 yr BP. The most intensive occupations there occurred during the Late Archaic to Early Ceramic and Middle Caddoan periods. During the Late Archaic/Early Ceramic period, the site appears to have been occupied by hunters and gatherers who returned to the site repeatedly over the years, as evidenced by a small cemetery, numerous pits, and two substantial midden deposits. Results from Smith et al. (2005) are presented below under "Hopkins County."

*Camp County*

In the earliest of the historic times, the Caddo Indians inhabited Camp County. During Mexico's occupation of Texas, the area was briefly settled by groups of Indians from the Creek, Choctaw, and Cherokee who were displaced by Euro-American settlers. The population center of Pittsburg was built up around the intersection of two perpendicular railway lines - the north/south Texas and St. Louis [Southwestern] Railway and the east/west East Line and Red River [Louisiana and Arkansas] Railway.

In addition to several museums, properties on the NRHP, historic districts, and historic structures (e.g., courthouses and buildings in neighborhood surveys) in densely populated areas, there are a number of cultural resources recorded in the THC *Atlas* in more rural settings (THC no date[c]). These include historical markers, such as the Cherokee Trace and the Center Point Community as well as cemeteries, churches, and schools.

*Franklin County*

Artifacts within Franklin County point to American Indian occupation as the Late Archaic Period. As of the beginning of the recorded history in the area, the Caddo Indians were the local inhabitants. During Mexico's occupation of Texas, the Shawnee, Delaware, and Kickapoo Indians settled the area briefly before abandoning their settlements. Euro-American settlement began around the time the Republic of Texas was established in 1836.

In addition to several historic structures (e.g., courthouses and buildings in neighborhood surveys) in densely populated areas, there are a number of cultural resources recorded in the THC *Atlas* in more rural settings (THC no date[c]). These include historical markers, such as the site of the Ripley Massacre and the burial site of Captain F. Marion Hastings as well as cemeteries, churches, and properties on the NRHP.

*Hopkins County*

The original historical inhabitants of Hopkins County were the Caddo Indians, followed by the Cherokee Indians. After the establishment of the Republic of Texas, republic troops defeated the Cherokee, allowing Euro-American settlers to inhabit the area.

In addition to several museums and historic structures (e.g., courthouses and buildings in neighborhood surveys) in densely populated areas (e.g., Sulphur Springs, Reilly Springs, and Martin Springs), there are a number of cultural resources recorded in the THC *Atlas* in more rural settings (THC no date[c]). These include cemeteries and historical markers, such as churches.

The cultural resources investigation for a previous mine expansion in Study Area 1 (Smith et al. 2005) documented 15 newly identified archaeological sites. Site types found include prehistoric surface and/or subsurface lithic scatters and campsites, historic surface and/or subsurface scatters, a historic homestead and a historic domestic residence. Setting types include floodplains, uplands, level hilltop, open pasture, and low hill/upland rise above unnamed drainages. Furthermore, the investigation included backhoe trenching to assess the likelihood of deeply buried, intact, and significant archaeological sites. It was concluded that the following four environmental settings possibly could have buried remains:

- Floodplains of Kennedy and Rock creeks, although low rises in floodplain settings were seasonally flooded and not conducive to short-term human habitation.
- Natural levees of these creeks were relatively dry, but prone to potential seasonal flooding; therefore, levees were moderately conducive to short-term human habitation.
- Ridge slopes which extend into these floodplains were high enough to be above most of the seasonal flooding; therefore, they were moderately conducive to short-term human habitation.
- Upland ridge tops were dry year-round; therefore, they were conducive to human habitation (both short-term and long-term).

Smith et al. (2005) also reference a 1983 investigation for another previous mine in Study Area 1 from which the distribution of Caddo sites was recognized:

> …regional Caddo populations utilized the upland areas extensively. Caddo domestic occupations, however, were concentrated primarily along major drainages. The largest Caddo sites recorded during this survey were found along the upland edges of the major Lake Fork tributaries. Smaller sites with high-density artifact scatters, interpreted as hamlets, tended to be located on level upland inter[-]stream divides. These sites also tended to be found in association with Wolfpen loamy fine sand and Freestone fine sandy loam, soils that may have a connection to prehistoric agricultural practices. Small sites with low artifact densities were located along the base of the uplands, within the major tributary valleys, floodplains of these valleys, and floodplain knolls.

*Rains County*

The earliest occupants of Rains County were hunters and gatherers, and there are seventy two recorded prehistoric sites within the county, half of them from the Archaic Period. Caddo Indians seem to have inhabited the area around A.D. 800 (1,150 yr BP), as seen by the unearthed small villages, many near springs. Euro-American settlement did not begin until after the Republic of Texas had been established (ca. 1836).

There are no densely populated areas within the study area in this county. As such, there are no historical markers and only one cemetery is located within Study Area 1 (THC no date[c]).

*Titus County*

Titus County has a rich prehistory and history. Artifacts from the Archaic Period have been found, indicating that the Caddo Indians, who were the initial historic inhabitants, may not have been the prehistoric occupants. During Mexico's occupation of Texas (ca. 1821-1836), other Indian tribes such as the Creeks, Choctaws, and Cherokees also settled the area. Once the Republic of Texas was established, Euro-American settlers displaced the Indian tribes.

In addition to several historic structures (e.g., courthouses and buildings in neighborhood surveys) in densely populated areas, there are a number of cultural resources recorded in the THC *Atlas* in more rural settings(THC no date[c]). These include historical markers, such as the Caddo Indian Communities in Cypress Creek Drainage as well as cemeteries, churches, and gravesites.

*Wood County*

Caddo Indians inhabited Wood County historically and for centuries prior to Euro-Americans settling the area, which started during Mexico's occupation of Texas (ca. 1824). However, the county did not see a boon in settlement from Euro-Americans until nearly a decade after the Republic of Texas was established.

In addition to properties on the NRHP, historic districts, and historic structures (e.g., courthouses and buildings in neighborhood surveys) in densely populated areas, there are a number of cultural resources recorded in the THC *Atlas* in more rural settings (THC no date[c]). These include historical markers, such as the Caddo Indian Communities in Wood County, the Indian Cemetery and Villages, other cemeteries, churches, historical homes, communities, and schools.

<u>Study Area 2</u>

According to the NPS (no date) and HUD (no date), no federally recognized American Indian tribes with historical interest in this study area are listed in the NACD or TDAT, respectively.

According to available maps showing the distribution of American Indian groups by linguistic family as recreated from historical accounts by early Europeans, this study area was formerly populated mostly by the Caddo (Sturtevant 1967). There is also evidence that a small part of this study area within Cherokee County was formerly populated by the Tonkawa.

One State Historic Site is potentially located in this study area, according to the *Historic Sites Atlas* (THC no date[c]).

Recent cultural resources investigation reports for two mines in Panola and Rusk counties were readily available for Study Area 2 (Dockall et al. 2009; Sherman et al. 2011). These reports refer to many additional previous cultural resources investigations completed in the study area. Results are summarized below under "Rusk County."

*Cherokee County*

There is a great deal of evidence of Indian habitation within the county, going back almost 12,000 years. The Caddo arrived around A.D. 780 (1,170 yr BP) and built Mound Prairie, which had three mounds and was used as a ceremonial center during the Early Caddoan Period. The Caddo continued to occupy the county, along with other incoming tribes (i.e., the Caddoan Hasinai Confederacy, Neches, Nacachau, Cherokee, Delaware, Shawnee, and Kickapoo), until they were all expelled during the Cherokee War in 1839.

In addition to historical markers in densely populated areas, there are a number of cultural resources recorded in the THC *Atlas* in more rural settings (THC no date[c]). These include cemeteries and historical markers, such as churches and a public school.

### *Gregg County*

The early inhabitants of Gregg County were the Caddo Indians and various other tribes. Later, once the Cherokees were displaced westward, they drove the Caddo out of the general area. Cherokee Trace, which was used by the Cherokee, after the Cherokee War in 1838, as an exodus from East Texas, crosses the county from north to south. Land grants were first issued to Euro-American settlers in 1835.

There are no densely populated areas within the study area in this county. There are a few cultural resources recorded in the THC *Atlas* in more rural settings (THC no date[c]). These include cemeteries and historical markers, such as churches.

### *Harrison County*

The Caddo Indians inhabited the area for centuries prior to the arrival of Spanish explorers (ca. 1500s), and were likely wiped out by disease or displaced by Euro-American settlers (ca. 1830s).

There are no densely populated areas within the study area in this county. There are a few cultural resources recorded in the THC *Atlas* in more rural settings (THC no date[c]). These include cemeteries and historical markers, such as churches.

### *Panola County*

There does not seem to be significant evidence to show prehistoric occupation within Panola County. However, there does seem to have been French and Spanish occupation from the 1600s through the 1800s. There is knowledge of the Caddo Indians and the Hasinai Indians (aligned as the Timber Tribes) having lived around the Sabine River Basin, with the river being the line of demarcation between them; however, the burial mounds which were once visible are no longer, and this evidence of their occupation has disappeared. Euro-American settlement began in 1833.

In addition to several museums and historic structures (e.g., courthouses, jails, libraries, a watchman, buildings in neighborhood surveys, properties on the NRHP) in densely populated areas, there are a number of cultural resources recorded in the THC *Atlas* in more rural settings (THC no date[c]). These include historical markers such as the International Boundary Marker, cemeteries, churches, and schools. See discussion of Dockall et al. (2009) under “Rusk County” since their investigation includes a portion of Panola County.

### *Rusk County*

Archaeological evidence shows that this area has been inhabited since the Archaic Period. There also is evidence of prehistoric Caddo occupation. Euro-American settlement began in 1829 with the issuance of the first land grant in the area. The Cherokee occupied the western portion of the county throughout Mexico’s occupation of the area (ca. 1820s-1830s), but were removed after the Cherokee War in 1839.

In addition to several museums, historic districts and structures (e.g., historic homes, buildings in neighborhood surveys, properties on the NRHP) in densely populated areas, there are a number of cultural resources recorded in the THC *Atlas* in more rural settings (THC no date[c]). These include cemeteries and historical markers, such as churches, schools, and historical homes.

The cultural resources investigation completed by Dockall et al. (2009) resulted in the identification of 53 previously unrecorded sites and collection of additional information on four previously recorded sites. Of the sites, 19 are prehistoric, 35 are historic, and three are both prehistoric and historic. . Site types include prehistoric lithic scatters and occupation sites; a potential Caddo campsite; historic farmsteads and houses/homes, including artifact scatters; undetermined historic use or occupation areas; historic cemeteries; historic Trammel’s Trace, the first road into Texas from the north, with origins back to 1813, and other historic roads; and improved natural springs. Setting types include uplands, floodplains, Pleistocene terraces, and ridges.

The cultural resources investigation conducted by Sherman et al. (2011) for a mine in Rusk County focused on the evaluation of 55 archaeological sites – 16 with prehistoric components, 36 with historic components, and three with both historic and prehistoric components. Site types include prehistoric lithic and artifact scatters, including an Archaic campsite and a multicomponent Middle Archaic-Transitional Archaic/Late Prehistoric site; historic houses/homes/domestic sites/homesteads; historic stores; historic farmsteads; a surface and subsurface scatters of historic domestic and structural debris; and a historic [garbage] dump. Setting types include floodplains, shoulder-slopes, toeslopes, ridges, and lowlands. Some isolated artifacts also were located.

*Shelby County*

Shelby County has been occupied by humans since the Archaic Period, with the Caddo habitation beginning in historic times. The first reputed Euro-American settler settled in the county in 1818, though Mexican restrictions forbade settlement in certain areas.

In addition to a museum, historical district, and historic structures (e.g., courthouse) in densely populated areas, there are a number of cultural resources recorded in the THC *Atlas* in more rural settings (THC no date[c]). These include the historical marker at the Truitt Community, cemeteries, and churches.

*Smith County*

The earliest known occupants of Smith County were the Caddo Indians, specifically the Anadarko tribe, who seem to have lived there for centuries prior to the first Euro-American settlers' arrival. However, late in the Spanish occupation of the area (ca. late 1700s), the Caddo left the area due to disease and threats from other Indian tribes. When Mexico began its occupation of the area, they began issuing land grants to Euro-American settlers.

In addition to several historic structures (e.g., buildings in neighborhood surveys) in densely populated areas, there are a number of cultural resources recorded in the THC *Atlas* in more rural settings (THC no date[c]). These include cemeteries and historical markers, such as churches, a community, and a homestead.

<u>Study Area 3</u>

There are no federally recognized American Indian tribes with NAGPRA claims in this study area, according to the NACD (NPS 2014). However, the TDAT cites the Comanche Nation as a federally recognized tribe with a historical interest in Falls, Leon, Anderson, Freestone, Limestone, and Robertson counties (HUD no date). According to available maps showing the distribution of American Indian groups by linguistic family as recreated from historical accounts by early Europeans, this study area was formerly populated by the Tonkawa (Sturtevant 1967).

No State Historic Sites are located in this study area, according to the *Historic Sites Atlas* (THC no date[c]).

Recent cultural resources investigations for two mine locations in Limestone and Robertson counties were readily available for Study Area 3 (Sherman et al. 2007; Turpin 2001). Sherman et al. (2007) references many additional previous cultural resources investigations completed in the study area. Results are summarized below under "Limestone County" (Sherman et al. 2007) and "Robertson County" (Turpin 2001).

*Anderson County*

The early inhabitants in Anderson County were the historical Comanche, Waco, Tawakonis, Kickapoo, and Kichai Indians, all having migrated to the area from more northern areas. The area was settled by Euro-Americans in 1826 when Mexico issued a land grant for colonization.

There are no densely populated areas within the study area in this county. There are a few cultural resources recorded in the THC *Atlas* in more rural settings. These include historical markers, such as the Early Settlement of Northwestern Anderson County, cemeteries, and churches.

*Falls County*

There doesn't seem to be much evidence of early habitation in Falls County, nor is there a permanent historic presence from any tribes. However, the area was a hunting ground for the Waco, Tawakoni, and Anadarko. The Cherokees settled in the area (ca. early 1830s) and Euro-American settlers began colonizing soon afterward.

There are no densely populated areas within the study area in this county. There are a few cultural resources recorded in the THC *Atlas* in more rural settings. These include markers, such as Sarahville de Viesca, cemeteries, and churches.

*Freestone County*

The earliest inhabitants of Freestone County arrived in the late Holocene Epoch. Historically, the Caddo, Kichai, and Tawakoni lived there, and many other tribes seem to have used the area for hunting and trading. Land grants allowed for Euro-American colonization beginning ca. 1825.

In addition to a museum and historic structures (e.g., a railroad depot, houses and buildings on the NRHP, and neighborhood surveys) in densely populated areas, there are a number of cultural resources recorded in the THC *Atlas* in more rural settings. These include historical markers, such as the burial sites of Generals Joseph Burton Johnson and John Gregg, cemeteries, churches, schools, and ghost towns.

*Henderson County*

There is archaeological evidence that the area was inhabited by Indians in prehistoric times. Historic Indian cultures in the area were the Hasinai, Cherokee, Shawnee, Delaware, and Kickapoo. Euro-American settlement in the region began after the Texas Revolution (ca. 1836).

In addition to a museum and historical structures (e.g., a hospital) in densely populated areas, there are a number of cultural resources recorded in the THC *Atlas* in more rural settings. These include cemeteries and historical markers, such as churches, a campground/tabernacle, and ghost towns.

*Leon County*

There is archaeological evidence that there was human occupation in Leon County as early as 4000 B.C. (5,950 yr BP), as Padilla points have been excavated and dated from this region. When Euro-American settlers arrived in the area, the Deadose Indians inhabited it.

There are no densely populated areas within the study area in this county. There are a few cultural resources recorded in the THC *Atlas* in more rural settings. These include historical markers, such as Long Hollow Community, cemeteries, and churches.

*Limestone County*

The inhabitants in Limestone County were the Tawakoni and the Waco Indians. The history of the area is a bloody one for the first Euro-American settlement, which was attacked by the Comanche and Kiowa in 1836.

There are no densely populated areas within the study area in this county. There are a few cultural resources recorded in the THC *Atlas* in more rural settings. These include historical markers, such as the Union Community, Fort Parker, cemeteries, churches, schools, shops, a kiln, and ghost towns.

The cultural resources investigation conducted by Sherman et al. (2007) involved revisiting 40 sites and newly recording 95 sites and 32 isolated finds. Sites revisited include 22 with only historic components, three with only prehistoric components, three multicomponent historic/prehistoric sites, two historic sites with prehistoric isolated finds, one prehistoric site with a historic isolated find, and four historic cemeteries. Twelve of the isolated finds are historic and 20 are prehistoric. Site types include surface and subsurface prehistoric and historic archaeological sites, some multicomponent and one with a standing structure; prehistoric isolated finds; historic churches/ cemeteries; historic houses/homes/farmsteads; and a historic residential/industrial site. Setting types include floodplains, ridges, shoulder-slopes, terraces, and toeslopes.

*Robertson County*

Robertson County has a rich archaeological history. Its first inhabitants were from the Paleoindian Period. Historically, the county was inhabited by the Tawakoni, Tonkawa, and Waco Indians, and hunted and raided by the Comanche, Kiowa, and Lipan-Apaches. Unofficially, the area was first settled temporarily by Euro-Americans in 1823.

In addition to historical structures (e.g., courthouse and jail) in densely populated areas, there are a number of cultural resources recorded in the THC *Atlas* in more rural settings. These include historical markers, such as the Harvey Massacre, cemeteries, churches, schools, and ghost towns.

The cultural resources investigation conducted by Turpin (2001) included evaluating two prehistoric sites and revisiting 15 historic sites. Recorded site types are multicomponent (prehistoric and historic) artifact scatter; prehistoric lithic scatters, including Archaic open camps; and historic farmsteads/hamlet/ barns/church/cemeteries. All the historic sites were affiliated with Nesbitt/Beck Prairie, a dispersed rural hamlet that coalesced in the 1870s and was abandoned in the 1950s. One farmhouse at 41RT313, built entirely of recycled utility poles in the 1930s, was recommended eligible for the NRHP because of its unique architecture. Setting types include ridges and floodplains.

Also see “Limestone County” (above) for the discussion of Sherman et al. (2007) since their investigation includes a portion of Robertson County.

*Van Zandt County*

Van Zandt County also has a rich archaeological history and its first inhabitants also were Paleoindians. Historically, the county was inhabited by several Caddoan tribes, but the first European explorers brought diseases, decimating the tribes by the time the first Euro-American settlers arrived. After the decline of the Caddoan tribes in the area, the Cherokee occupied the area (ca. 1820s-1830s).

There are no densely populated areas within the study area in this county. There are a few cultural resources recorded in the THC *Atlas* in more rural settings. These include cemeteries and historical markers, such as churches.

Study Area 4

There are no federally recognized American Indian tribes with NAGPRA claims in this study area, according to the NACD (NPS 2014). However, the TDAT cites the Comanche Nation as a federally recognized tribe with a historical interest in all the study area's counties (HUD 2014). According to available maps showing the distribution of American Indian groups by linguistic family as recreated from historical accounts by early Europeans, this study area was formerly populated by the Tonkawa (Sturtevant 1967).

No State Historic Sites are located in this study area, according to the *Historic Sites Atlas* (THC no date[c]).

*Bastrop County*

There is archaeological evidence that humans lived in Bastrop County since ca. A.D. 1000 (950 yr BP). Historically, the Tonkawa Indians occupied the area, and the Comanche hunted by the river seasonally. Euro-American settlement began in 1827, when Stephen F. Austin received a land grant to colonize the area.

There are no densely populated areas within the study area in this county. There are a few cultural resources recorded in the THC *Atlas* in more rural settings. These include historical markers, such as the Rock Front Saloon, cemeteries, and a church.

As reported by USACE (2003), cultural resources surveys were conducted from 1999 to 2000 for the development of a previously proposed mine in Bastrop County. Approximately 12,500 acres were investigated, with 194 archaeological sites discovered - 75 prehistoric, 111 historic, and eight multicomponent.

*Burleson County*

While there is very little that has been uncovered by archaeological excavations in this county, there is enough evidence that humans first inhabited the area during the Middle Archaic. Historically, the earliest occupants were the Tonkawa, and they were likely descendants of the earliest prehistoric inhabitants. The area was also a hunting ground for the Caddo. The Euro-American settlements (ca. 1827) became subject to raids by the Wichita tribes prior to full Indian expulsion (ca. 1840s).

There are no sites in the THC *Atlas* within the study area in this county.

*Lee County*

Evidence shows that humans have occupied the area since at least 4,500 B.C. (6,450 yr BP). Historically, the earliest occupants were the Tonkawa, who, while friendly to the Euro-American settlers (ca. 1835), contracted their diseases, which thinned their numbers. They were also subject to Comanche and Cherokee raids. Those who survived were displaced in 1855, and sent to the Brazos Indian Reservation.

There are no densely populated areas within the study area in this county. There are a few cultural resources recorded in the THC *Atlas* in more rural settings. These include cemeteries and historical markers, such as a church, a school, and a masonic lodge.

See "Bastrop County" for a discussion of earlier cultural resources investigations conducted for a previously proposed mine, which included a portion of Lee County (USACE 2003).

*Milam County*

Milam County had been inhabited by humans for at least 10,000 years. Among the early residents were likely ancestors of the Tonkawa. Sometime many years later (ca. A.D. 1300 or 650 yr BP), the Lipan Apaches migrated into the area. By the 1700s, the Caddo, Tehuacana, and Waco Indians had migrated, during which time the earliest Spanish explorers arrived and built missions with the hope of converting the Indians.

In addition to historical structures (e.g., train depot and buildings on the NRHP and neighborhood surveys) in densely populated areas, there are a number of cultural resources recorded in the THC *Atlas* in more rural settings. These include historical markers, such as the Salty Community, cemeteries, churches, and towns.

*Williamson County*

This area also has been occupied by humans since at least 4,500 B.C. (6,450 yr BP), as burned rock middens [near Round Rock along Brushy Creek] contain evidence that humans lived there during the Archaic Period. Historically, the earliest occupants were the Tonkawa, who, while friendly to the Euro-American settlers (ca. 1835), contracted their diseases, which thinned their numbers. They were also subject to Comanche and Cherokee raids. Those who survived were displaced in 1855, and sent to the Brazos Indian Reservation.

There are no densely populated areas within the study area in this county. There are a few cultural resources recorded in the THC *Atlas* in more rural settings. These include cemeteries and historical markers, such as a church, a school, a house, and a fraternal organization.

<u>Study Area 5</u>

There are two federally recognized American Indian tribes, the Mescalero Apache Tribe of the Mescalero Reservation, and the Lipan Apache Tribe and Bands Thereof with NAGPRA claims in both Atascosa and McMullen counties, according to the NACD (NPS no date). The TDAT cites the Comanche Nation, and the Mescalero Apache Tribe of the Mescalero Reservation as federally recognized tribes with a historical interest in both counties (HUD no date). According to available maps showing the distribution of American Indian groups by linguistic family as recreated from historical accounts by early Europeans, this study area was formerly populated by the Lipan (Sturtevant 1967).

No State Historic Sites are located in this study area, according to the *Historic Sites Atlas* (THC no date[c]).

Cultural resources investigations were discussed recently by HDR Engineering, Inc. (HDR 2012) for the development of the San Miguel Lignite Deposit in McMullen County. Results are summarized below under “McMullen County.”

*Atascosa County*

The earliest inhabitants of Atascosa County were likely the Coahuiltecans, who occupied the area for several thousands of years prior to the Spanish explorers arriving. The first Euro-American settlements were not formed here until the late 1840s.

There are historical structures (e.g., county courthouse, cemeteries, county jail, church, and buildings on the NRHP) in densely populated areas. There are no cultural resources recorded in the THC *Atlas* in more rural settings.

*McMullen County*

Archaeological evidence shows that McMullen County has been inhabited by humans for approximately 11,000 years. The historic people who inhabited the area, the Coahuiltecans, were likely the descendants of the prehistoric inhabitants. While land grants were awarded starting in 1825, the first Euro-American settlements were not formed until 1858.

In addition to historic structures (e.g., jail, store) in densely populated areas, there are a number of cultural resources recorded in the THC *Atlas* in more rural settings. These include historical markers, such as the first gas pipeline to San Antonio, the Yarbrough Bend settlement, San Caja Hill, Camp Rio Frio, and cemeteries.

The readily available recent cultural resources investigation for the proposed San Miguel South Expansion Area Lignite Deposit (HDR 2012) states the majority of the study area had been surveyed in the 1970s and 1980s, but resurvey of all, or selected, areas of the study area may be necessary to comply with current survey standards. According to the THC *Atlas*, 53 archaeological sites are in the study area. Forty-nine of the sites contain prehistoric components, and four contain both prehistoric and historic components. Settings include alluvial floodplains, uplands, and terrace. Twenty-six of the sites were recommended for additional testing, 15 sites needed no further testing, and 12 sites received no recommendations whatsoever.

<u>Study Area 6</u>

There are two federally recognized American Indian tribes, the Mescalero Apache Tribe of the Mescalero Reservation, and the Lipan Apache Tribe and Bands Thereof with NAGPRA claims in this study area, with a third additional federally recognized American Indian tribe, the Kickapoo Traditional Tribe of Texas, with NAGPRA claims in Maverick County, according to the NACD (NPS 2014). The TDAT cites the Comanche Nation, and the Mescalero Apache Tribe of the Mescalero Reservation as federally recognized tribes with a historical interest in these counties, with a third additional federally recognized tribe, the Kickapoo Traditional Tribe of Texas, with a historical interest in Maverick County (HUD no date). According to available maps showing the distribution of American Indian groups by linguistic family as recreated from historical accounts by early Europeans, this study area was formerly populated by the Lipan and Coahliltec (Sturtevant 1967).

No State Historic Sites are located in this study area, according to the *Historic Sites Atlas* (THC no date[c]).

There is one readily available cultural resources investigation for Study Area 6. Results are summarized below under “Maverick County.”

*Dimmit County*

There is archaeological evidence that shows Dimmit County has been inhabited by humans for around 11,000 years as Paleoindian artifacts have been recorded. The Spanish explorers passed through the area on the historic Camino Real. The Coahuiltecan Indians were displaced by the Apache and Comanche as well as the Spanish. Euro-Americans did not settle the area until after the Civil War.

There are no sites in the THC *Atlas* within the study area in this county.

*Kinney County*

Archaeologically recovered artifacts show that earliest inhabitants to Kinney County could have been between 6,000 and 10,000 years ago. Historically, the Lipan Apache, Coahuiltecan, Jumano, Tamaulipan, and Tonkawa inhabited the area. Later, the Comanche and the Mescalero Apache inhabited the area. The area was settled by Franciscans in the late 1700s, and in lieu of a true Euro-

American settlement, Fort Riley (the name was changed to Fort Clark a month later) was established in 1852.

There are no sites in the THC *Atlas* within the study area in this county.

*Maverick County*

Evidence of prehistoric inhabitation, such as *metates*, *manos*, and projectile points, has been uncovered around former water sources around Maverick County, indicating that the Coahuiltecan Indians inhabited the area. The county is rich in history as it has the Camino Real and was one of the most-traveled areas by early Spanish explorers and Euro-American settlers. The first Euro-American settlement was established in 1834.

In addition to historic structures (e.g., county courthouse, Fort Duncan, buildings in the NRHP, and neighborhood surveys) in densely populated areas, there are no cultural resources recorded in the THC *Atlas* in more rural settings.

Several cultural investigations were conducted between 1981 and 2011 for a previously proposed mine in Maverick County (Center for Archaeological Research 1992; Eagle Pass Mine 2011; Espey, Huston & Associates, Inc. 1981; Houk and Warren 1994; Turpin et al. 2010; Uecker and Warren 1995). The surveys identified a multitude of sites. Several of the sites have undergone testing for evaluation of eligibility for nomination to the NRHP (Iruegas 2004; Iruegas et al. 2009a,b; Uecker 1994; Watkins and Nash 2009a,b) and some of the NRHP-eligible sites have undergone data recovery (Stahman et al. 2011).

*Zavala County*

More than 100 prehistoric archaeological sites have been identified within Zavala County. Among the historic tribes who have lived in this area are the Coahuiltecan, Tonkawa, and Lipan and Mescalero Apaches. The county is part of an area of Texas that was disputed post-Texas Revolution by the Mexicans and the Texans. The first Euro-American settlement was not established until 1870.

There are no sites in the THC *Atlas* within the study area in this county.

### 3.6.2 Environmental Consequences

Potential impacts to NRHP-eligible sites are assessed using the “criteria of adverse effect” (36 CFR 800.5[a][1]): “An adverse effect is found when an undertaking may alter, directly or indirectly, any of the characteristics of a historic property that qualify the property for inclusion in the National Register in a manner that would diminish the integrity of the property’s location, design, setting, materials, workmanship, feeling, or association.” There are five broad categories of effect:

1. Physical destruction or alteration of a property or relocation from its historic location;
2. Isolation or restriction of access;
3. Change in the character of the property’s use or of physical features within the property’s setting, or the introduction of visible, audible, or atmospheric elements that are out of character with the significant historic features of the property;
4. Neglect that leads to deterioration or vandalism; and
5. Transfer, sale, or lease from federal to non-federal control, without adequate and legally enforceable restrictions or conditions to ensure the preservation of the historic significance of the property.

Under NEPA, effects to NRHP-eligible sites can be direct or indirect. Direct effects are caused by an undertaking and occur at the same time and place (40 CFR 1508.8[a]). These types of effects to NRHP-eligible sites include physical damage resulting from surface-disturbing activities and can occur to both known sites and subsurface sites. Indirect effects are caused by an undertaking and are later in time or farther removed in distance, but are still reasonably foreseeable (40 CFR 1508.8[b]). These types of effects often are not quantifiable and can occur both within and outside of the APE. Indirect effects to NRHP-eligible sites include, but are not limited to, changes in erosion patterns due to construction activities, inadvertent damage due to off-road maintenance traffic, and illegal artifact collection due to increased access to an area.

The potential adverse effects to historic properties from future mine-related activities are discussed in the following sections, divided into direct effects and indirect effects. The primary concern for adverse impacts to cultural resources relate to any disturbance, damage, or disruption of sites or landscapes associated with those sites that are eligible for the NRHP, protected under the Antiquities Code of Texas, or cemeteries protected under TAC Title 13 Part 2 Chapter 22.

### 3.6.2.1 Proposed Action

Overview of Direct Effects

Large-scale earth-moving activities would occur during all phases of typical mine development, including construction, operations, and reclamation. Some of the surface-disturbance footprints would be landscape-scale (e.g., mine pits, spoil stockpiles, and borrow areas), whereas others may be relatively small (e.g., roads and ancillary facilities). Individual historic properties, including historical markers, as well as collections of sites and structures (historic districts) and whole cultural/historical landscapes may be destroyed or demolished within the footprints of areas in which earth-moving occur. In addition to the historic properties themselves, landscape-scale attributes such as viewsheds that are integral to the NRHP eligibility of individual and collective historic properties may be affected by surface-disturbing activities.

Earth-moving activities would permanently and irreversibly alter archaeological stratigraphy, which comprise the context for buried historic properties. If the in-situ context of an archaeological property is no longer evident, its research potential is lost, and it would become ineligible for listing on the NRHP.

Mining-related activities may result in the direct destruction or demolition of above-ground historic properties and their contexts. Additionally, vibrations associated with earth-moving activities and blasting could undermine the integrity of nearby above-ground historic properties. Furthermore, ongoing movements of crews, equipment, and mining commodities (coal or lignite) and byproducts during the operations phase could cause impacts from sustained vibrations, especially within and immediately surrounding the footprint of future mines. Structural integrity is necessary for the preservation of above-ground historic properties for them to retain eligibility for or to remain listed on the NRHP.

The potential for the discovery of unanticipated archaeological deposits during construction activities exists within disturbance areas and could result in direct effects through displacement or loss of the discovered material.

Overview of Indirect Effects

The construction, operations, and reclamation phases are likely to result in alteration of the direction and amount of surface water runoff, potentially exposing nearby cultural resources to the effects of flowing surface water. The exposure of large surface areas for long durations may result in adverse effects to nearby cultural sites from accelerated erosion or sedimentation. Looting or vandalism of historic properties may increase during all phases due to the increase in public access from roads in large areas that are difficult to patrol against trespassing.

It is possible that increased noise and vibrations from mining-related activities that are uncharacteristic of the baseline immediate surroundings may adversely affect the character, feel, setting, and association of above-ground historic properties.

Direct and Indirect Effects of the Proposed Action

Under both REIS alternatives, the primary adverse impacts to historic properties would occur in the form of activities that physically alter or destroy historic properties or their contexts, either directly or indirectly. Implementation of the environmental protection measures required by federal and state regulations and permits would minimize those adverse effects. For example, construction of erosion and sediment control measures in compliance with the Construction General Permit under National Pollutant Discharge Elimination System (NPDES) would minimize offsite damage to nearby cultural sites. Cultural resources surveys and tribal consultation in advance of surface-disturbing activities would identify NRHP-eligible sites or those protected under state law, and require avoidance or mitigation before sites are damaged.

Compliance with the requirements of a mine-specific Programmatic Agreement would minimize adverse effects to cultural resources. A Programmatic Agreement template is presented in **Appendix C**.

**Table 3.6-2** summarizes the types of historic properties that could be adversely impacted directly and indirectly by future mine-related construction, operations, and reclamation within the six study areas.

### 3.6.2.2 No Action Alternative

Under the No Action Alternative, development of a future surface coal or lignite mine expansion area or satellite mine would be the same as under the Proposed Action alternative. Therefore, the direct and indirect impacts to cultural resources would be the same as described for the Proposed Action; however, impacts may be spread over a longer period of time due to the possibly lengthier permitting process.

## 3.6.3 Cumulative Impacts

The CESA boundaries for cultural resources was delineated by determining the area encompassed by outer boundary of each study areas plus three miles from the outer boundaries, which is assumed to be the area within which surface-disturbing activities related to mining may be visible by visitors to cultural sites and historic markers. Depending on terrain and vegetative cover the visible area may be less in certain locations. The CESA boundaries for cultural resources are shown on **Figure A-23** in **Appendix A.**

The past and present actions and the RFFAs within each CESA are described in Chapter 2.0, Section 2.4. These actions involve surface-disturbance, which could result in similar effects on cultural resources as the direct and indirect effects from mining activities described in Section 3.6.2. Although difficult to quantify, the cumulative impacts to cultural sites would include natural impacts such as erosion and dilapidation, as well as direct disturbance and removal of sites and indirect effects such as vandalism, accelerated erosion and sedimentation, noise, and vibrations located within each CESA.

**Table 3.6-3** lists the acreage of past and present surface disturbance that may have resulted in direct and indirect effects from surface disturbing activities such as mining, reservoirs, road construction, urban development, power generation, and oil and gas development. This disturbance contributed to the current conditions of cultural resources within each CESA.

**Table 3.6-2 Historic Properties Potentially Affected by Mining Activities**

| Study Area and County | Types of Historic Properties Potentially Affected |
|---|---|
| ***Study Area 1*** | |
| Camp | *Direct:* Caddo, Spanish, Mexican, Euro-American, and American sites; historic standing structures (HSS); historic districts.<br>*Indirect:* HSS; historic districts; historical markers, including Cherokee Trace and Center Point Community; museums; cemeteries; churches; schools. |
| Franklin | *Direct:* Caddo, Shawnee, Delaware, Kickapoo, Spanish, Mexican, Euro-American, and American sites; HSS; historic districts; cemeteries.<br>*Indirect:* HSS; historic districts; historical markers, including Ripley Massacre and Capt. Hastings burial; cemeteries; churches. |
| Hopkins | *Direct:* Caddo, Cherokee, Spanish, Mexican, Euro-American, and American sites; HSS; historic districts.<br>*Indirect:* HSS; historic districts; historical markers; museums; cemeteries; churches. |
| Rains | *Direct:* Comanche, Caddo, Spanish, Mexican, Euro-American, and American sites; HSS; historic districts.<br>*Indirect:* HSS; cemetery. |
| Titus | *Direct*: Caddo, Creek, Choctaw, Cherokee, Spanish, Mexican, Euro-American, and American sites; HSS; historic districts.<br>*Indirect:* HSS; historic districts; historical markers, including Caddo Indian Communities in Cypress Creek Drainage; cemeteries; churches; gravesites. |
| Wood | *Direct*: Caddo, Spanish, Mexican, Euro-American, and American sites; HSS; historic districts.<br>*Indirect:* HSS; historic districts; historical markers, including Caddo Indian Communities in Wood County, Indian Cemetery and Villages; cemeteries; churches; schools. |
| ***Study Area 2*** | |
| Cherokee | *Direct*: Caddo, Neches, Nacachau, Cherokee, Delaware, Shawnee, Kickapoo, Spanish, Mexican, Euro-American, and American sites; HSS; historic districts.<br>*Indirect:* HSS; historic districts; cemeteries; churches; a school. |
| Gregg | *Direct*: Caddo, Cherokee, Spanish, Mexican, Euro-American, and American sites; HSS; historic districts.<br>*Indirect:* HSS; historic districts; historical markers; cemeteries; churches. |
| Harrison | *Direct*: Caddo, Spanish, Mexican, Euro-American, and American sites; HSS; historic districts.<br>*Indirect:* HSS; historic districts; historical markers; cemeteries; churches. |
| Panola | *Direct*: Caddo, Hasinai, French, Spanish, Mexican, Euro-American, and American sites; HSS; historic districts.<br>Indirect: HSS; historic districts; museums; historical markers, including the International Boundary Marker; cemeteries; churches; schools. |
| Rusk | *Direct*: Caddo, Cherokee, Spanish, Mexican, Euro-American, and American sites; HSS; historic districts.<br>*Indirect:* HSS; historic districts; museums; historical markers; cemeteries; churches; schools; historical homes. |

**Table 3.6-2 Historic Properties Potentially Affected by Mining Activities**

| Study Area and County | Types of Historic Properties Potentially Affected |
|---|---|
| Shelby | *Direct*: Caddo, Spanish, Mexican, Euro-American, and American sites; HSS; historic districts.<br>*Indirect:* HSS; historic districts; historical marker at the Truitt Community; cemeteries; churches. |
| Smith | *Direct*: Caddo, Spanish, Mexican, Euro-American, and American sites; HSS; historic districts.<br>*Indirect:* HSS; historic districts; historical markers; cemeteries; churches. |
| ***Study Area 3*** | |
| Anderson | *Direct*: Comanche, Waco, Tawakoni, Kickapoo, Kichai, Spanish, Mexican, Euro-American, and American sites; HSS; historic districts.<br>*Indirect:* HSS; historic districts; historical markers, including Early Settlement of Northwestern Anderson County; cemeteries; churches. |
| Falls | *Direct*: Waco, Tawakoni, Anadarko, Cherokee, Spanish, Mexican, Euro-American, and American sites; HSS; historic districts.<br>*Indirect:* HSS; historic districts; historical markers, including Sarahville de Viesca; cemeteries; churches. |
| Freestone | *Direct*: Caddo, Kichai, Tawakoni, Spanish, Mexican, Euro-American, and American sites; HSS; historic districts.<br>*Indirect:* HSS; historic districts; historical markers, including burials of Generals Joseph Burton Johnson and John Gregg; cemeteries; churches; schools; ghost towns; a museum. |
| Henderson | *Direct*: Hasinai, Cherokee, Shawnee, Delaware, Kickapoo, Spanish, Mexican, Euro-American, and American sites; HSS; historic districts.<br>*Indirect:* HSS; historic districts; historical markers; cemeteries; churches; ghost towns; a museum; a campground/tabernacle. |
| Leon | *Direct*: Deadose, Spanish, Mexican, Euro-American, and American sites; HSS; historic districts.<br>*Indirect:* HSS; historic districts; historical markers, including Long Hollow Coummunity; cemeteries; churches. |
| Limestone | *Direct*: Tawakoni, Waco, Comanche, Kiowa, Spanish, Mexican, Euro-American, Afro-American, and American sites; HSS; historic districts.<br>*Indirect:* HSS; historic districts; historical markers, including the Union Community and Fort Parker; cemeteries; churches; schools; ghost towns. |
| Robertson | *Direct*: Tawakoni, Tonkawa, Waco, Comanche, Kiowa, Lipan Apache, Spanish, Mexican, Euro-American, and American sites; HSS; historic districts.<br>*Indirect:* HSS; historic districts; historical markers, including the Harvey Massacre; cemeteries; churches; schools; ghost towns. |
| Van Zandt | *Direct*: Caddo, Cherokee, Spanish, Mexican, Euro-American, and American sites; HSS; historic districts.<br>*Indirect:* HSS; historic districts; historical markers; cemeteries; churches. |
| ***Study Area 4*** | |
| Bastrop | *Direct*: Comanche, Tonkawa, Spanish, Mexican, Euro-American, Afro-American, and American sites; HSS; historic districts.<br>*Indirect:* HSS; historic districts; historical markers, including the Rock Front Saloon; cemeteries; a church. |
| Burleson | *Direct*: Tonkawa, Caddo, Wichita, Spanish, Mexican, Euro-American, and American sites; HSS; historic districts.<br>*Indirect:* HSS; historic districts. |

**Table 3.6-2 Historic Properties Potentially Affected by Mining Activities**

| Study Area and County | Types of Historic Properties Potentially Affected |
|---|---|
| Lee | *Direct*: Tonkawa, Comanche, Cherokee, Spanish, Mexican, Euro-American, and American sites; HSS; historic districts.<br>*Indirect:* HSS; historic districts; historical markers; a church; a school; a masonic lodge. |
| Milam | *Direct*: Tonkawa, Lipan Apache, Caddo, Tehuacana, Waco, Spanish, Mexican, Euro-American, and American sites; HSS; historic districts.<br>*Indirect:* HSS; historic districts; historical markers, including the Salty Community; cemeteries; churches. |
| Williamson | *Direct*: Tonkawa, Comanche, Cherokee, Spanish, Mexican, Euro-American, Afro-American, and American sites; HSS; historic districts.<br>*Indirect:* HSS; historic districts; historical markers; a church; a school; a fraternal organization. |
| ***Study Area 5*** | |
| Atascosa | *Direct*: Coahuiltecan, Mescalero Apache, Lipan Apache, Comanche, Spanish, Mexican, Euro-American, and American sites; HSS; historic districts.<br>*Indirect:* HSS; historic districts; cemeteries; a church. |
| McMullen | *Direct*: Coahuiltecan, Spanish, Mexican, Euro-American, and American sites; HSS; historic districts.<br>*Indirect:* HSS; historic districts; historical markers, including first gas pipeline to San Antonio, the Yarbrough Bend Settlement, San Caja Hill, Camp Rio Frio; cemeteries; a church. |
| ***Study Area 6*** | |
| Dimmit | *Direct*: Coahuiltecan, Mescalero Apache, Lipan Apache, Comanche, Spanish, Mexican, Euro-American, and American sites; HSS; historic districts.<br>*Indirect:* HSS; historic districts. |
| Kinney | *Direct*: Coahuiltecan, Jumano, Tamaulipan, Tonkawa, Mescalero Apache, Lipan Apache, Comanche, Spanish, Mexican, Euro-American, and American sites; HSS; historic districts.<br>*Indirect:* HSS; historic districts. |
| Maverick | *Direct*: Coahuiltecan, Mescalero Apache, Lipan Apache, Kickapoo, Comanche, Spanish, Mexican, Euro-American, and American sites; HSS; historic districts.<br>*Indirect:* HSS; historic districts; Fort Duncan. |
| Zavala | *Direct*: Coahuiltecan, Tonkawa, Mescalero Apache, Lipan Apache, Comanche, Spanish, Mexican, Euro-American, and American sites; HSS; historic districts.<br>*Indirect:* HSS; historic districts. |

Note: HSS = historic standing structure.

**Table 3.6-3 Acreage of Past and Present Surface Disturbance in Cultural Resources CESAs**

| Study Area | Disturbed Inside Study Area (acres) | Disturbed Outside Study Area/Inside CESA (acres) | Total CESA Disturbed (acres) |
|---|---|---|---|
| 1 | 52,238 | 76,387 | 128,626 |
| 2 | 40,132 | 176,911 | 217,044 |
| 3 | 38,569 | 137,544 | 176,112 |
| 4 | 5,846 | 38,085 | 43,931 |
| 5 | 3,603 | 35,698 | 39,301 |
| 6 | 2,363 | 14,598 | 16,961 |

Future mining and other activities such as those listed in Section 2.4.2 may occur within the CESA, presumably in similar proportions to the types of current activities. The effects of future developments would be direct and indirect, similar to the impacts described for mining-related activities. In all but CESA 6, the past, present, and non-mining foreseeable future acreage of surface-disturbing activities are less than 30 percent of the estimated percentage of future mining authorizations, shown in **Table 2-3**. The impacts from all of these surface-disturbing activities would combine to modify the visual landscape of cultural resources and have the potential to adversely affect cultural resources unless sites are avoided or mitigated.

### 3.6.4 Monitoring and Mitigation Measures

In accordance with Section 106, site records searches and field investigations would be performed prior to any ground disturbing activities. Any identified NRHP-eligible sites would be treated in accordance with a site-specific Programmatic Agreement that would describe the actions to be taken to monitor, avoid, or mitigate sites. The following additional monitoring and mitigation measures are recommended.

- Monitoring of mine-related construction activities (i.e., new surface disturbance) would be conducted by knowledgeable professionals to avoid recorded NRHP-eligible or state protected cultural resources and minimize the chance for damage to previously unknown sites. Any identified NRHP-eligible sites would be treated in accordance with the site-specific Programmatic Agreement.
- To minimize the potential for indirect effects to cultural resources as a result of illegal collection or vandalism, each mining company should educate mine personnel as to the sensitive and confidential nature of cultural resources and implement a strict policy against illegal collection and against revealing the location of any cultural resources located in the permit area of each mine.

### 3.6.5 Residual Adverse Effects

Both the Proposed Action and the No Action alternatives are likely to result in the loss of cultural resources that are not eligible for the NRHP. Although these sites would be recorded to USACE and THC standards and the information integrated into local and state-wide databases, the sites ultimately would be destroyed by future construction. NRHP-eligible sites identified within future proposed disturbance areas would be avoided or, if avoidance is not feasible, mitigated in accordance with the guidelines of the Programmatic Agreement and treatment plans developed in coordination with the USACE and THC. Although NRHP-eligible sites would be mitigated through implementation of data recovery or other forms of mitigation, some of the cultural value associated with these sites cannot be fully mitigated; therefore, it is anticipated that residual adverse impacts to these resources would occur.

## 3.7 Air Quality and Climate

### 3.7.1 Affected Environment

Air quality is defined by the concentration of various pollutants and their interaction in the atmosphere. Pollution effects on receptors have been used to establish a definition of air quality. Measurement of pollutants in the atmosphere is expressed in units of parts per million (ppm) or micrograms per cubic meter ($\mu g/m^3$). Both long-term climatic factors and short-term weather fluctuations are considered part of the air quality resource, because they control dispersion and affect concentrations. Physical effects of air quality depend on the characteristics of the receptors and the type, amount, and duration of exposure. Under the federal Clean Air Act (CAA) and Texas CAA, the USEPA and TCEQ establish acceptable air quality standards and upper limits of pollutant concentrations and duration of exposure. Air pollutant concentrations below the standards generally are not considered to be detrimental to public health and welfare.

#### 3.7.1.1 Regulatory Framework

The U.S. Congress established the framework for air quality regulations through passage of the CAA of 1970. The CAA requires the administrator of the USEPA to establish National Ambient Air Quality Standards (NAAQS) (40 CFR part 50) for air contaminants for which emissions, in the judgment of the USEPA, cause or contribute to air pollution that reasonably may be anticipated to endanger public health or welfare. The presence of emissions in the ambient air results from numerous and diverse mobile and stationary sources as well as natural sources.

<u>National Ambient Air Quality Standards</u>

The NAAQS establish maximum acceptable concentrations for criteria pollutants, including nitrogen dioxide ($NO_2$), carbon monoxide (CO), sulfur dioxide ($SO_2$), particulate matter with an aerodynamic diameter of 2.5 microns or less ($PM_{2.5}$), particulate matter with an aerodynamic diameter of 10 microns or less ($PM_{10}$), ozone, and lead. For criteria pollutants, acceptable levels have been established through the national and state Ambient Air Quality Standards (AAQS). The AAQS are concentrations established by law to protect public health and welfare from air pollutants.

The primary NAAQS set limits to protect public health, including the health of "sensitive" populations such as asthmatics, children, and the elderly. The secondary NAAQS set limits to protect public welfare, including protection against decreased visibility and damage to animals, crops, vegetation, and buildings (USEPA 2015). For the most part, Texas has adopted the NAAQS set by the USEPA Office of Air Quality Planning and Standards for criteria pollutants (see **Table 3.7-1**). In addition to the NAAQS, Texas has established additional restrictions on $SO_2$ concentrations in specific counties, as noted in the table. "No person in the State of Texas may cause, suffer, allow, or permit emissions of $SO_2$ from a source or sources operated on a property or multiple sources operated on contiguous properties to exceed a net ground-level concentration of 0.4 part per million by volume averaged over any 30-minute period" (TAC 2014c). The main health-based standards applicable for surface coal and lignite mining operations are the federal $PM_{10}$ and $PM_{2.5}$ standards.

All counties that overlap with the study areas and associated CESAs currently are classified as attainment/unclassifiable for all criteria pollutants, with the exception of Kaufman County in the Study Area 3 CESA that are designated as non-attainment for 8-hour ozone.

**Table 3.7-1 State and National Ambient Air Quality Standards**

| Pollutant | Averaging Time | Ambient Air Quality Standards | |
|---|---|---|---|
| | | Primary | Secondary |
| CO | 8-hour (1) | 9 ppm<br>(10 mg/m$^3$) (2) | None |
| | 1-hour (1) | 35 ppm<br>(40 mg/m$^3$) | None |
| Lead | Rolling 3-month Average | 0.15 µg/m$^3$ (3) | Same as Primary |
| | Quarterly average | 1.5 µg/m$^3$ | Same as Primary |
| $NO_2$ | Annual (arithmetic mean) | 0.053 ppm (100 µg/m$^3$) | Same as Primary |
| | 1-hour (4) | 0.100 ppm (189 µg/m$^3$) | None |
| $PM_{10}$ | 24-hour (5) | 150 µg/m$^3$ | Same as Primary |
| $PM_{2.5}$ | Annual (6) (arithmetic mean) | 12 µg/m$^3$ | 15 µg/m$^3$ |
| | 24-hour (7) | 35 µg/m$^3$ | Same as Primary |
| Ozone | 8-hour (8) | 0.075 ppm | Same as Primary |
| $SO_2$ | 3-hour (1) | None | 0.5 ppm (1,300 µg/m$^3$) |
| | 1-hour (9) | 0.075 ppm | None |
| | 30-minute (10) | 0.27 ppm | None |

1 Not to be exceeded more than once per year.

2 mg/m$^3$ = milligrams per cubic meter.

3 Not to be exceeded. Final rule signed October 15, 2008.

4 To attain this standard, the 3-year average of the 98th percentile of the daily maximum 1-hour average at each monitor within an area must not exceed 0.100 ppm (effective January 22, 2010).

5 Not to be exceeded more than once per year on average over 3 years.

6 To attain this standard, the 3-year average of the weighted annual mean $PM_{2.5}$ concentrations from single or multiple community-oriented monitors must not exceed 15.0 µg/m$^3$.

7 To attain this standard, the 3-year average of the 98th percentile of 24-hour concentrations at each population-oriented monitor within an area must not exceed 35 µg/m$^3$ (effective December 17, 2006).

8 To attain this standard, the 3-year average of the fourth-highest daily maximum 8-hour average ozone concentrations measured at each monitor within an area over each year must not exceed 0.075 ppm (effective May 27, 2008). This standard is being reconsidered by USEPA, which has proposed to set it somewhere between 0.065 and 0.070 ppm.

9 Effective August 23, 2010.

10 Texas AAQS 30-minute $SO_2$ standard. Applies only to specific counties, and different counties have differing standards. Of all counties, 0.27 ppm is lowest standard and is not to be exceeded.

Prevention of Significant Deterioration

For areas that have attained the NAAQS, the CAA provides for a New Source Review (NSR) program to ensure that no significant deterioration of the existing air quality would result from the construction and operation of new emission sources or from the modification of existing emission sources. Pursuant to the CAA, the USEPA has promulgated Prevention of Significant Deterioration (PSD) regulations that provide for a pre-construction review by the state air quality agency of "major" emission sources of air pollutants that are regulated under the CAA. For 28 designated types of sources of air contaminants, a major stationary source is defined as a stationary source that has the potential to emit 100 or more tons per year (tpy) of any of the pollutants regulated under the CAA, including any fugitive emissions (non-stationary source). Other stationary sources of pollutants are defined as major if the proposed emissions of any pollutant regulated by the CAA are 250 or more tpy. Fugitive emissions are included in the "major source" determination only for sources subject to the 100-tpy threshold and for sources being regulated by a new source performance standard (NSPS) (40 CFR 60) as of August 7, 1980. Coal\lignite mining operations are not one of the 28 designated types of sources that are considered major at 100 tpy; however, they potentially could be a major source if point sources emit more than 250 tpy of a regulated pollutant.

Allowable deterioration to air quality can be expressed as the incremental increase to ambient concentrations of criteria pollutants, also referred to as a "PSD increment." The PSD increments for criteria pollutants are based on the PSD classification of an area. All of the study areas are either designated as a "Class II" area under the PSD regulations or are not designated. The Class II designation allows for moderate growth or some degradation of air quality within certain limits above baseline air quality. Areas that do not have a PSD designation are evaluated with respect to Class II increments. These limits include the NAAQS and Texas AAQS discussed above and identified in **Table 3.7-1**, as well as other incremental limits set by the USEPA and TCEQ that are not to be exceeded. Under the PSD provisions, Congress established a land classification scheme for those areas of the country with air quality better than the NAAQS. Class I allows very little deterioration of air quality; Class II allows moderate deterioration, as discussed above; and Class III allows more deterioration. However, in all cases, the pollution concentrations shall not violate any of the NAAQS or other federal or state limits. Congress designated certain existing areas as mandatory Class I, which precludes re-designation to a less restrictive class, in order to acknowledge the value of maintaining these areas in relatively pristine condition. These mandatory Class I areas include international parks, national wilderness areas, national memorial parks in excess of 5,000 acres, and national parks in excess of 6,000 acres existing as of August 7, 1977.

<u>Air Quality Related Values</u>

Air quality related values (AQRVs) are resources sensitive to air quality and include vegetation, soils, water, fish and wildlife, and visibility. Federal Land Managers (FLMs), such as the U.S. Forest Service, track and manage the AQRVs. The NSR permitting program (described above) includes an analysis of impacts to AQRVs as a component of all PSD permit applications. Impacts to AQRVs can include changes in visibility or atmospheric deposition of pollutants to soil and bodies of water. To assess atmospheric deposition impacts to sensitive waterbodies, the change in the acid neutralizing capacity (ANC) of sensitive lakes is evaluated as part of AQRVs. Current FLM guidance requires an assessment of the potential AQRV impacts if the source is within 300 kilometers (km) of a PSD Class I area. Portions of Study Areas 1, 2, and 3 are within 300 km of Caney Creek Wilderness Area, Arkansas, and Study Area 6 is within 300 km of Big Bend National Park, Texas.

FLMs review the issuance of any PSD permits required under the NSR program to evaluate any impacts that exceed established thresholds for AQRVs. The monitoring stations within the vicinity of the analysis area that collect data useful for assessment of AQRVs are shown in **Figure 3.7-1**.

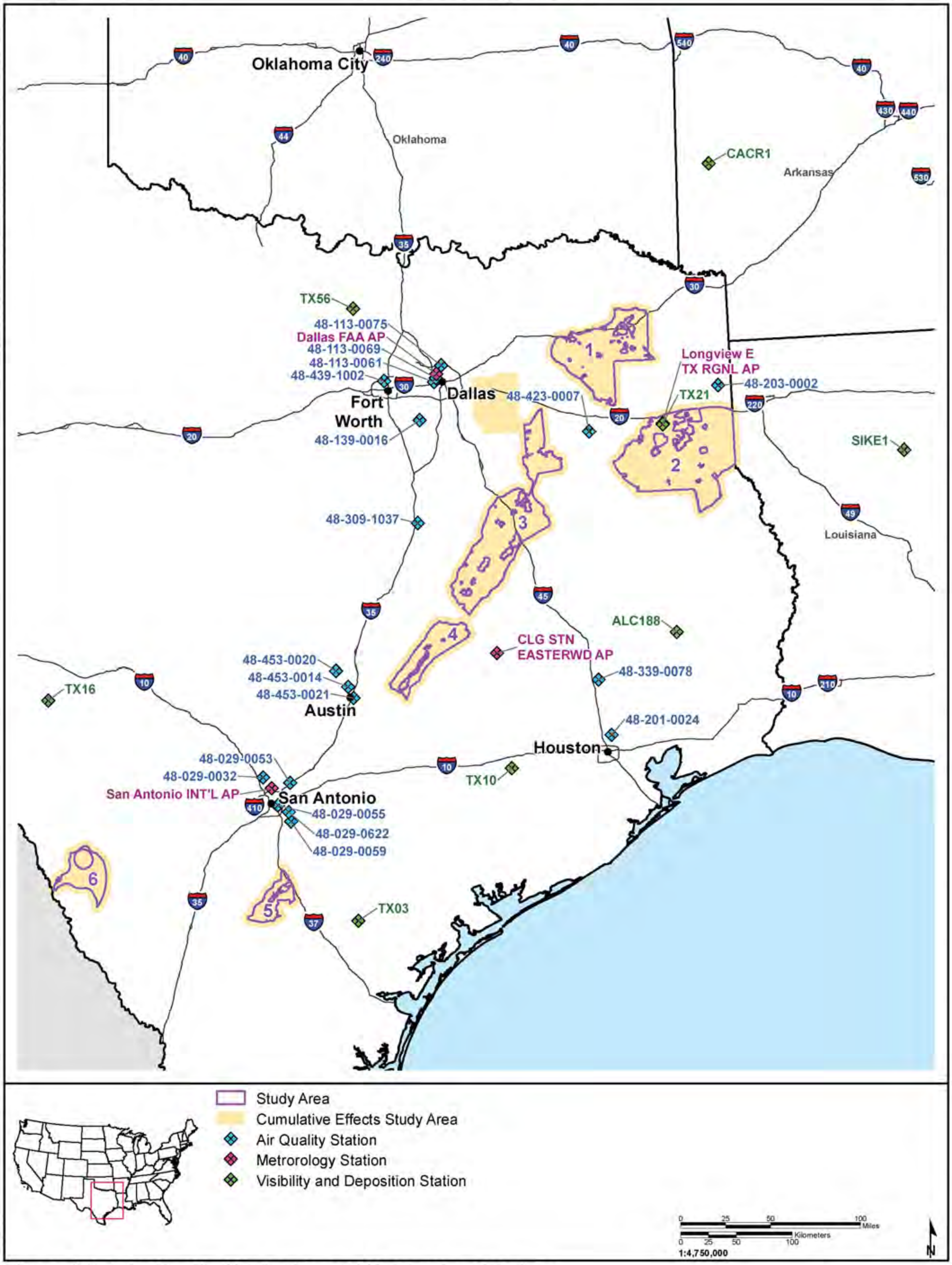



Figure 3.7-1 Air Quality Monitoring and Meteorology Stations

New Source Performance Standards

The CAA requires the USEPA to publish a list of categories of stationary sources that, in its judgment, cause or contribute to air pollution that reasonably may be anticipated to endanger public health or welfare. The USEPA then is required to establish NSPS within each category that reflect the degree of emission limitation and the percent reduction achievable through application of the best technological system of continuous emission reduction. The USEPA must determine whether the emission reduction technology has been adequately demonstrated, taking into consideration the costs of achieving the emission reductions, any air quality health and environment impacts, and energy requirements. Thus far, the USEPA has promulgated performance standards for over 60 source categories for air pollutants. Although there are no NSPS for mining operations, if a mining operation also has a coal drying, cleaning, screening, or crushing operation that is new, modified, or reconstructed, then such operations are subject to NSPS requirements under 40 CFR 60, Subpart Y, Standards of Performance for Coal Preparation Plants. Crushing, screening, and conveying equipment located at a mine face are not considered to be part of a coal preparation and processing plant that might otherwise be subject to the NSPS.

National Emission Standards for Hazardous Air Pollutants

Prior to the 1990 Clean Air Act Amendment (CAAA), the CAA required the USEPA to publish a list of hazardous air pollutants (HAPs), which are defined as those pollutants for which no ambient air quality standard is applicable and, which in the judgment of the USEPA, cause or contribute to air pollution that may reasonably be anticipated to result in an increase in mortality or an increase in serious, irreversible, or incapacitating reversible illness. The USEPA then was required to establish standards for those HAPs that, in its judgment, provide an ample margin of safety to protect public health. The initial national emission standards for HAPs were promulgated under 40 CFR 61 for specific types of processes and operations. However, none of the promulgated national emission standards for HAPs are applicable to coal or lignite mining operations.

As part of the 1990 CAAA, the list of HAPs was increased to 189 contaminants (currently reduced to 187 contaminants), and a list of additional emission source categories, for which new emission standards were to be written, was promulgated by the USEPA. The new standards are being proposed and promulgated by the USEPA under 40 CFR 63 and are known as Maximum Achievable Control Technology (MACT) standards. None of the MACT standards proposed or promulgated to date apply to coal or lignite mining operations.

Control of Air Pollution Episodes

TCEQ Regulation 118 provides for control of air pollution episodes. It defines a Level 1 air pollution episode for $PM_{10}$ as 24-hour average concentrations equal to or greater than 420 $\mu g/m^3$. A Level 2 air pollution episode for $PM_{10}$ is defined as a 24-hour average concentration equal to or greater than 500 $\mu g/m^3$. A Level 1 air pollution episode exists if the following criteria are met: 1) the concentration of any of the air contaminants is equal to or greater than the levels specified for Level 1; and 2) in the case of all air contaminants except ozone, meteorological conditions conducive to high levels of air contamination are predicted to continue for at least 12 hours. (For ozone, the criteria include meteorological conditions that would be conducive to the likely recurrence of high ozone levels within the next 24 hours.) A Level 2 air pollution episode exists if the commission determines that emergency reductions of emissions must be initiated to prevent ambient concentrations specified for Level 2. The requirements of Regulation 118 do not apply to episodes caused by naturally occurring dust storms (TAC 2015).

Greenhouse Gases

Greenhouse gases (GHGs) include carbon dioxide ($CO_2$), methane, nitrous oxide, and some halogenated compounds. GHGs are naturally occurring in the atmosphere. Their status as a pollutant is not related to toxicity, but to the long-term impacts they may have on climate due to increased levels in the earth's atmosphere. As they are non-toxic and non-hazardous at normal ambient concentrations, there are no applicable ambient standards or emission limits for GHG under the major environmental regulatory programs described above.

*Federal Greenhouse Gas Reporting Requirements*

On October 30, 2009, the USEPA issued the reporting rule for major sources of GHG emissions (40 CFR Part 98). The rule requires reporting of GHG emissions from large sources and suppliers in the U.S. and is intended to collect accurate and timely emissions data to inform future policy decisions.

Under the rule, certain suppliers of fossil fuels or industrial GHGs, manufacturers of vehicles and engines, and stationary sources that emit 25,000 metric tons or more per year of GHG emissions are required to submit annual reports to the USEPA. The final rule was signed by the Administrator on September 22, 2009.

*Greenhouse Gas Tailoring Rule*

On June 3, 2010, the USEPA issued the Prevention of Significant Deterioration and Title V Greenhouse Gas Tailoring Rule. The rule provides criteria to determine which stationary sources become subject to permitting requirements for GHG emissions under the PSD and Title V programs of the CAA. The rule is based on calculation of carbon dioxide equivalents ($CO_2e$), which factors in the global warming potential of each GHG and normalizes this to an equivalent of $CO_2$ emissions. Under the rule, facilities with GHG emissions of 100,000 or more tpy $CO_2e$ are required to obtain PSD permits if they are making changes resulting in increased GHG emissions of 75,000 tpy $CO_2e$ or more. Facilities seeking to obtain a PSD permit to cover other regulated pollutants, also must address GHG emissions increases of 75,000 tpy $CO_2e$ or more. New and existing sources with GHG emissions above 100,000 tpy $CO_2e$ also must obtain operating permits. On June 23, 2014, the Supreme Court ruled that the USEPA lacked the authority to require PSD and Title V Permits based on the $CO_2e$ emissions thresholds for sources that would not otherwise require such a permit. This ruling will prompt regulatory changes that will impact future permitting actions; interim guidance is available to provide direction in regard to current permitting actions (USEPA 2014a). The USEPA rules do not require any controls or establish any standards related to GHG emissions for minor sources.

*Texas Greenhouse Gas Legislation*

In June 2013, Texas House Bill (HB) 788 was passed giving TCEQ the authority to develop rules to authorize major sources of GHG emissions to the extent required by federal law. Until rulemaking is complete, USEPA is the permitting authority for GHG. TCEQ will be coordinating with USEPA during this transition.

### 3.7.1.2 Study Areas

The existing air quality conditions for each of the study areas were based on monitoring data over the past 3 years for criteria pollutants, deposition, and visibility. Meteorological information also is presented and climate change discussed. The monitoring station locations and the type of data collected at each site are summarized by study area in **Tables 3.7-2** and **3.7-3**. The station locations in relation to the study areas are in **Figure 3.7-1**.

**Table 3.7-2 Monitoring Sites Utilized for Criteria Pollutants**

| Network/Station[1] | AQS Site Number | County | Monitored Criteria Pollutants Monitored | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | $PM_{2.5}$ | $PM_{10}$ | Ozone | $SO_2$ | $NO_2$ | CO |
| **Study Area 1** | | | | | | | | |
| Karnack[2] | 48-203-0002 | Harrison | Y | Y | Y | | Y | |
| Dallas North #2[3] | 48-113-0075 | Dallas | | Y | Y | | Y | |
| Dallas Hinton[3] | 48-113-0069 | Dallas | Y | | Y | Y | Y | Y |
| Fort Worth Northwest[2] | 48-439-1002 | Tarrant | Y | | Y | | Y | Y |
| **Study Area 2** | | | | | | | | |
| Karnack[2] | 48-203-0002 | Harrison | Y | Y | Y | | Y | |
| Dallas Hinton[3] | 48-113-0069 | Dallas | Y | | Y | Y | Y | Y |
| **Study Area 3** | | | | | | | | |
| Midlothian OFW[2] | 48-139-0016 | Ellis | Y | | Y | Y | Y | |
| East of Bickers and Furey Streets[3] | 48-113-0061 | Dallas | | Y | | | | |
| Tyler Airport (Relocated)[2] | 48-423-0007 | Smith | | | Y | | Y | |
| Waco Mazane | 48-309-1037 | McLennan | | | Y | Y | Y | Y |
| Dallas Hinton[3] | 48-113-0069 | Dallas | Y | | Y | Y | Y | Y |
| Fort Worth Northwest[2] | 48-439-1002 | Tarrant | Y | | Y | | Y | Y |
| **Study Area 4** | | | | | | | | |
| Austin Audubon Society[2] | 48-453-0020 | Travis | Y | Y | Y | | Y | |
| Austin Webberville Road[3] | 48-453-0021 | Travis | Y | Y | | | | |
| Conroe (Relocated) | 48-339-0078 | Montgomery | | | Y | | Y | |
| Austin Northwest[2] | 48-453-0014 | Travis | | | Y | | | Y |
| Waco Mazanec | 48-309-1037 | McLennan | | | Y | Y | Y | Y |
| Houston Aldine[2] | 48-201-0024 | Harris | Y | Y | Y | | Y | Y |

**Table 3.7-2 Monitoring Sites Utilized for Criteria Pollutants**

| Network/Station[1] | AQS Site Number | County | Monitored Criteria Pollutants Monitored | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | $PM_{2.5}$ | $PM_{10}$ | Ozone | $SO_2$ | $NO_2$ | CO |
| **Study Area 5** | | | | | | | | |
| Calaveras Lake[3] | 48-029-0059 | Bexar | Y | | Y | | Y | |
| Camp Bullis[2] | 48-029-0032 | Bexar | Y | | Y | | | |
| Selma[3] | 48-029-0053 | Bexar | | Y | | | | |
| Unamed | 48-029-0622 | Bexar | | | | Y | | Y |
| **Study Area 6** | | | | | | | | |
| Calaveras Lake[3] | 48-029-0059 | Bexar | Y | | Y | | Y | |
| Camp Bullis[2] | 48-029-0032 | Bexar | Y | | Y | | Y | |
| Selma | 48-029-0053 | Bexar | | Y | | | | |
| Unamed[3] | 48-029-0622 | Bexar | | | Y | Y | Y | Y |

[1] All stations are within the AQS network. Data obtained from USEPA's AirDAta (USEPA 2014c). AQS designated measurement scales of Urban, Regional, and Middlescale were used unless otherwise noted.

[2] Measurement scales designated by AQS was Urban, Neighborhood,or,Microscale. Data from these stations may have been compromised due to local source effects.

[3] AQS designated measurement scales were not available.

**Table 3.7-3 Visibility and Deposition Monitoring Sites**

| | | Variables Monitored at Site | | | Distance to Study Area (km) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Monitoring Network** | **Monitoring Site ID** | **Wet Deposition** | **Dry Deposition** | **Visibility** | **Study Area 1** | **Study Area 2** | **Study Area 3** | **Study Area 4** | **Study Area 5** | **Study Area 6** |
| CASTNET[1] | ALC188 | | Y | Y | 209.9 | 109.0 | 148.4 | 185.1 | 410.5 | 552.5 |
| IMPROVE[2] | CACR1 | | | Y | 142.9 | 217.6 | 265.7 | 466.0 | 737.7 | 824.9 |
| | SIKE1 | | | Y | 237.7 | 151.5 | 306.3 | 421.6 | 669.9 | 805.2 |
| NADP[3] | TX03 | Y | | | 512.1 | 457.5 | 290.9 | 202.9 | 60.3 | 228.5 |
| | TX10 | Y | | | 335.8 | 271.5 | 142.2 | 112.5 | 222.2 | 374.5 |
| | TX16 | Y | | | 545.6 | 548.7 | 373.8 | 305.5 | 258.4 | 134.3 |
| | TX21 | Y | | | 46.2 | 0.0 | 95.7 | 251.8 | 523.8 | 634.8 |
| | TX56 | Y | | | 181.0 | 270.2 | 185.0 | 290.3 | 505.6 | 536.2 |

[1] USEPA 2014d.

[2] Interagency Monitoring of Protected Visual Environments (IMPROVE) 2012.

[3] National Atmospheric Deposition Program 2014.

Only monitoring stations within approximately 200 km (approximately 125 miles) of the study areas were selected for purpose of providing representative data. Monitoring sites which are classified as "Regional" or "Middlescale" by air quality standards (AQS) are expected to be more representatives of the study areas than "Urban" sites. Therefore, sites with "Regional" or "Middlescale" classifications were preferentially selected for assessment. Not all study areas had stations that matched this criteria for all pollutants analyzed. Priority also was given to stations with more recent data with at least 3 years of consecutive data.

Study Area 1

*Criteria Pollutants*

**Tables 3.7-4** through **3.7-9** present monitored criteria pollutant levels from selected air quality monitoring stations within or near Study Area 1 and the associated CESA for the period of 2011 through 2013. Monitoring stations used for this analysis included one in Harrison County, two in Dallas County, and one in Tarrant County (see **Figure 3.7-1**). These stations are used in part to determine attainment status for the criteria pollutants. All counties in the study area are designated as attainment or unclassifiable for all criteria pollutants.

**Table 3.7-4 Ozone Monitoring Data for Study Area 1**

| Monitoring Station | Year | Fourth Highest 8-hour Concentration (ppm) | | | Location | County |
|---|---|---|---|---|---|---|
| | | Monitored Value | 3-year Average | NAAQS | | |
| AQS 48-203-0002 | 2011 | 0.076 | 0.073 | 0.075 | Karnack | Harrison County |
| | 2012 | 0.072 | | | | |
| | 2013 | 0.070 | | | | |
| AQS 48-113-0075 | 2011 | 0.088 | 0.084 | 0.075 | Dallas North #2 | Dallas County |
| | 2012 | 0.086 | | | | |
| | 2013 | 0.077 | | | | |
| AQS 48-113-0069 | 2011 | 0.084 | 0.084 | 0.075 | Dallas Hinton | Dallas County |
| | 2012 | 0.087 | | | | |
| | 2013 | 0.081 | | | | |
| AQS 48-439-1002 | 2011 | 0.082 | 0.081 | 0.075 | Fort Worth Northwest | Tarrant County |
| | 2012 | 0.077 | | | | |
| | 2013 | 0.084 | | | | |

Source: USEPA 2014c.

**Table 3.7-5 Nitrogen Dioxide Monitoring Data for Study Area 1**

| Monitoring Station | Year | Annual Concentration (ppm) | | Location | County |
|---|---|---|---|---|---|
| | | Monitored Value | NAAQS | | |
| AQS 48-203-0002 | 2011 | 0.0111 | 0.053 | Karnack | Harrison County |
| | 2012 | 0.0095 | | | |
| | 2013 | 0.0078 | | | |
| AQS 48-113-0075 | 2011 | 0.0111 | 0.053 | Dallas North #2 | Dallas County |
| | 2012 | 0.0095 | | | |
| | 2013 | 0.0078 | | | |
| AQS 48-113-0069 | 2011 | 0.0262 | 0.053 | Dallas Hinton | Dallas County |
| | 2012 | 0.0245 | | | |
| | 2013 | 0.0248 | | | |
| AQS 48-439-1002 | 2011 | 0.0246 | 0.053 | Fort Worth North | Tarrant County |
| | 2012 | 0.0243 | | | |
| | 2013 | 0.0236 | | | |

Source: USEPA 2014c.

**Table 3.7-6 Carbon Monoxide Monitoring Data for Study Area 1**

| Monitoring Station | Year | Second Highest 8-hour Concentration (ppm) | | Location | County |
|---|---|---|---|---|---|
| | | Monitored Value | NAAQS | | |
| AQS 48-113-0069 | 2011 | 1.3 | 9 | Dallas Hinton | Dallas County |
| | 2012 | 1.7 | | | |
| | 2013 | 1.7 | | | |
| AQS 48-439-1002 | 2011 | 1.2 | 9 | Fort Worth North | Tarrant County |
| | 2012 | 1.2 | | | |
| | 2013 | 1.0 | | | |

Source: USEPA 2014c.

**Table 3.7-7 Sulfur Dioxide Monitoring Data for Study Area 1**

| Monitoring Station | Year | $99^{th}$ Percentile 1-hour Concentration (ppm) | | Location | County |
|---|---|---|---|---|---|
| | | Monitored Value | NAAQS | | |
| AQS 48-113-0069 | 2011 | 0.0077 | 0.075 | Dallas Hinton | Dallas County |
| | 2012 | 0.0059 | | | |
| | 2013 | 0.0050 | | | |

Source: USEPA 2014c.

**Table 3.7-8 24-hour $PM_{10}$ Monitoring Data for Study Area 1**

| Monitoring Station | Year | Second-Highest 24-hour Concentration (µg/m³) | | Location | County |
|---|---|---|---|---|---|
| | | Monitored Value | NAAQS | | |
| AQS 48-203-0002 | 2011 | 32 | 150 | Karnack | Harrison County |
| | 2012 | 36 | | | |
| | 2013 | 53 | | | |
| AQS 48-113-0075 | 2011 | 31 | 150 | Dallas North #2 | Dallas County |
| | 2012 | 53 | | | |
| | 2013 | 39 | | | |

Source: USEPA 2014c.

**Table 3.7-9 24-hour $PM_{2.5}$ Monitoring Data for Study Area 1**

| Monitoring Station | Year | 98th-percentile 24-hour or Annual Concentration (µg/m³) | | Location | County |
|---|---|---|---|---|---|
| | | Monitored Value | NAAQS | | |
| AQS 48-203-0002[1] | 2005 | 19.2 | 35 | Karnack | Harrison County |
| | 2006 | 23.6 | | | |
| | 2007 | 23.3 | | | |
| AQS 48-113-0069[1] | 2005 | 23.0 | 35 | Dallas Hinton | Dallas County |
| | 2006 | 19.9 | | | |
| | 2007 | 23.2 | | | |
| AQS 48-203-0002[1] | 2005 | 22.1 | 35 | Fort Worth Northwest | Harrison County |
| | 2006 | 22.1 | | | |
| | 2007 | 26.4 | | | |
| AQS 48-203-0002[2] | 2005 | 11.9 | 12 | Karnack | Harrison County |
| | 2006 | 10.4 | | | |
| | 2007 | 9.3 | | | |
| AQS 48-113-0069[2] | 2005 | 10.4 | 12 | Dallas Hinton | Dallas County |
| | 2006 | 9.7 | | | |
| | 2007 | 9.6 | | | |
| AQS 48-203-0002[2] | 2005 | 10.7 | 12 | Fort Worth Northwest | Harrison County |
| | 2006 | 10.5 | | | |
| | 2007 | 10.4 | | | |

[1] Reflects 98th percentile 24-hour data.

[2] Reflects annual data.

Source: USEPA 2014c.

*Visibility and Deposition*

**Table 3.7-10** presents wet and dry deposition data from selected air quality monitoring stations within or nearest to Study Area 1 and the associated CESA for the period of 2011 through 2013. Visibility data for the same time period are presented in **Table 3.7-11**. The monitoring station locations are presented in **Figure 3.7-1**.

**Table 3.7-10 Average Annual Wet and Dry Deposition of Ammonium, Sulfate, and Nitrate for Study Area 1**

| Monitoring Station | Year | Ammonium (kg/ha) | Nitrate (kg/ha) | Sulfate (kg/ha) |
|---|---|---|---|---|
| **Wet Deposition** | | | | |
| TX21 | 2011 | 2.36 | 5.85 | 8.27 |
| | 2012 | 2.64 | 7.6 | 10.64 |
| | 2013 | 2.13 | 6.11 | 10.72 |
| TX56 | 3.73 | 6.72 | 7.87 | 3.73 |
| | 2.29 | 6.04 | 4.86 | 2.29 |
| | 2.94 | 6.6 | 6.73 | 2.94 |
| ACL 188 | 0.29 | 0.77 | 1.06 | 0.29 |
| | 0.25 | 0.68 | 0.86 | 0.25 |
| | 0.21 | 0.59 | 0.86 | 0.21 |
| **Dry Deposition** | | | | |
| ALC188 | 2011 | 0.26 | 1.32 | 0.39 |
| | 2012 | 0.21 | 1.08 | 0.28 |
| | 2013 | 0.19 | 0.94 | 0.26 |

Note: kg/ha = kilograms per hectare.

Sources: NADP 2014; USEPA 2014d.

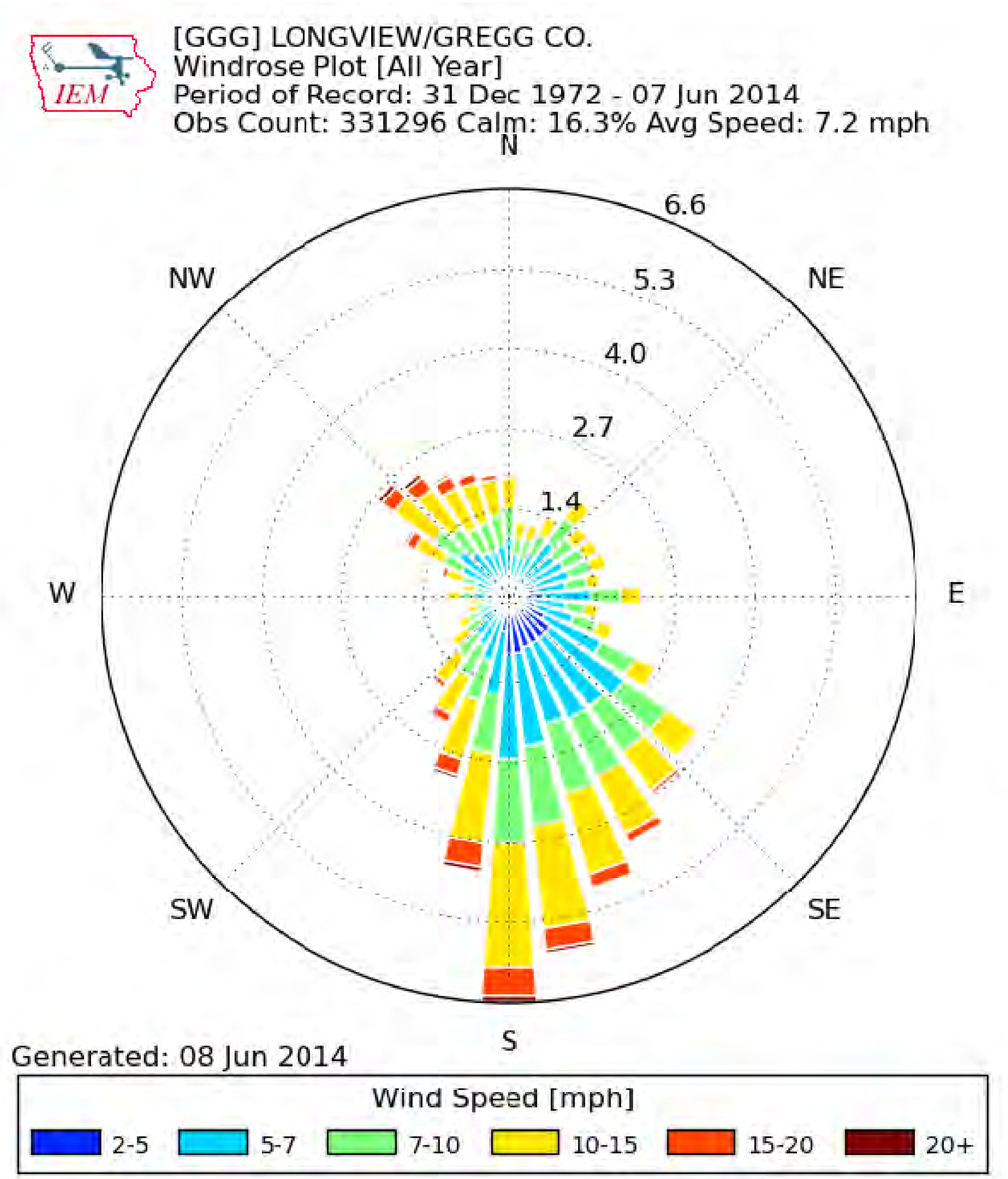
**Table 3.7-11 Visibility – Study Area 1**

| Monitoring Station | Year | 20 Percent Best Days (deciviews) | 20 Percent Worst Days (deciviews) | Average All Days (deciviews) |
|---|---|---|---|---|
| CACR1 | 2011 | 11.70 | 22.67 | 17.49 |
| | 2012 | 9.54 | 21.49 | 16.09 |
| | 2013 | 8.61 | 21.35 | 15.36 |

Source: IMPROVE 2014.

*Climate*

Northeast Texas is characterized by warm humid summers and relatively mild winters. Due to its proximity to the Gulf of Mexico, it is typically humid throughout the year. **Table 3.7-12** represents typical temperature and precipitation data for Study Area 2, based on data for the Longview Regional Airport. A wind rose showing typical wind conditions is presented in **Figure 3.7-2**.




**Source: Iowa Environmental Mesonet 2014.**

**Figure 3.7-2 Wind Rose for Longview Regional Airport**

**Table 3.7-12 Average Monthly Temperature and Precipitation Data for Longview Regional Airport for the Period of 1981-2010**

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sept | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average Maximum Temperature (°F) | 57.3 | 61.7 | 69.1 | 76.3 | 83.6 | 89.8 | 93.4 | 94.0 | 87.7 | 78.0 | 67.5 | 58.5 |
| Average Temperature (°F) | 46.5 | 50.3 | 57.6 | 64.8 | 73.0 | 79.6 | 83.4 | 82.8 | 76.1 | 66.1 | 56.3 | 48.0 |
| Average Minimum Temperature (°F) | 35.7 | 38.8 | 46.2 | 53.3 | 62.3 | 69.5 | 73.5 | 71.5 | 64.5 | 54.1 | 45.1 | 37.4 |
| Average Precipitation (inches) | 3.3 | 4.0 | 4.4 | 3.2 | 4.8 | 5.0 | 2.9 | 3.0 | 3.3 | 4.6 | 4.5 | 4.5 |

Source: Texas Office of the State Climatologist 2014.

*Greenhouse Gases, Climate Change, and Changes in Air Quality*

Greenhouse Gases

GHGs have been cited as a contributing factor to climate change; however, there currently are no ambient standards or emission limits for GHG emissions under the major environmental regulatory programs. The Intergovernmental Panel on Climate Change (IPCC) reports that since 1750, the largest contributor to changes in the earth's energy budget associated with climate change is caused by the increase in the atmospheric concentration of $CO_2$ (IPCC 2013). In addition, "the atmospheric concentrations of $CO_2$, methane, and nitrous oxide have increased to levels unprecedented in at least the last 800,000 years. $CO_2$ concentrations have increased by 40 percent since pre-industrial times, primarily from fossil fuel emissions and secondarily from net land use change emissions" (IPCC 2013).

According to the National Climate Assessment (Melillo et al*.* 2014), U.S. average temperatures have increased from 1.3 to 1.9°F since record keeping began in 1895, and most of this increase has occurred since about 1970. As compared to the 1901 to 1960 average, east central Texas has experienced temperature changes from 1991 to 2012 of 0 to 1.0°F, while central and southeast Texas has experienced temperature changes from 0.5 to greater than1.5°F.

While the earth has had many episodes of warming/cooling in the past, the IPCC recently concluded that this recent warming of the climate system is very unique when compared to those past episodes. Additionally, most of the observed increase in globally average temperatures since the mid-20$^{th}$ Century is due to the observed increase in anthropogenic GHG concentrations (IPCC 2013). Anthropogenic activities can influence climate, and many studies have been conducted to assess how the climate could change in the next century as a result of varying human activity.

Climate Change Trends

The National Academy of Sciences (NAS) (2010) reported that the IPCC estimates global average surface temperatures will rise 2.0 to 11.5°F relative to the 1980-1999 average by the end of the 21$^{st}$ Century. NAS (2010) also indicated that there are uncertainties regarding how climate change may affect different regions. Computer model predictions indicate that increases in temperature would not be equally distributed, but are likely to be accentuated at higher latitudes. Models results also indicate that average temperature changes are likely to be greater in the Northern Hemisphere. Warming during the winter months is expected to be greater than during the summer. Although large-scale spatial shifts in precipitation distribution may occur, these changes are more uncertain and difficult to predict.

Climate models with different assumptions relative to future GHG emissions are used to assess potential changes in climate response to varying amounts of GHG emissions. Some modeling scenarios assume that development will continue at current rates, and GHG emissions will continue to increase rapidly into the foreseeable future. Other models assume that GHG emissions will be curbed due to rapid technological advances and aggressive climate adaptation strategies.

In modeling scenarios that assume carbon emissions will increase from approximately 10 to 12 gigatonnes of carbon (GtC) by 2040 and then slowly decrease to approximately 3 GtC by 2100, a 4 to 5°F increase in surface air temperature by later this century is predicted. In models where emissions continue to increase, temperature increases of 7 to 8°F or more are predicted (Melillo et al. 2014; Walsh et al. 2014).

Modeling scenarios which assume continued increases in GHG emissions suggest that an approximate10 to 20 percent increase in the number of consecutive dry days (days with precipitation of less than 0.01 inch) could be expected by mid- century as compared to the1971-2000 average (Shafer et al. 2014). Also, an approximate 8 to 14°F increases in average temperatures could occur in portions Texas (Walsh et al. 2014). If this occurs, there would be a much higher likelihood for extended severe drought across the area. Such impacts are less severe in modeling scenarios where reductions in GHG are assumed.

Changes in Air Quality

Increasing temperatures can affect air quality. While research has been conducted to evaluate how meteorological conditions affect air quality, the relationship is complex because pollutants chemically interact with each other, and pollution is highly dependent on local conditions, including topography, wind conditions, and the vertical structure of the lower atmosphere.

Based on the National Climate Assessment (Melillo et al. 2014), climate warming has the potential to decrease background surface ozone globally. However, high methane levels can offset this decrease, raising background surface ozone. It is estimated that by year 2100, background surface ozone will increase by approximately 0.008 ppm (which is 25 percent of current background levels) relative to modeling scenarios with small methane changes.

Increases in surface ozone have been documented during heat wave episodes (Hodenberg et al. 2012). Research also has shown ozone concentrations are strongly dependent on temperature (Weaver et al. 2009). As drought and duration of heat waves increase, ozone concentrations will likely increase.

Additional air pollution challenges include particulate matter emissions from forest fires, which are likely to increase due to higher temperatures which allow for drying out of vegetation and a resulting longer fire season (Peterson et al. 2014). Increases in windblown dust from burned areas also may occur. Such events will lead to more common exceptional air quality events and overall decreased air quality in the region. While such events may increase particulate matter emissions by altering natural sources, particulate matter is removed from the air through precipitation. Since precipitation patterns are predicted to change as well, the confidence behind overall future particulate matter levels is still relatively low.

Many of the projected changes associated with climate change may not be measurably discernible within the reasonably foreseeable future. Existing climate prediction models are global and regional in nature; therefore, they are not at the appropriate scale to identify site-specific climate changes. However, such regional predictions can provide clues to potential climate changes. Evidence suggests that background ozone and particulate matter values may increase (all else being equal) due to climate change, making compliance with the NAAQS more challenging.

Due to the potential negative effects of climate change, measures have been implemented (e.g., federal mandates relative to fuel efficiency for cars, energy upgrades to homes, etc.) and additional strategies are being formulated to decrease GHG emissions to minimize climate change impacts. These strategies are being addressed at federal, state, and local levels.

Study Area 2

*Criteria Pollutants*

**Tables 3.7-13** through **3.7-18** present monitored criteria pollutant levels from selected air quality monitoring stations within or near Study Area 2 and the associated CESA for the period of 2011 through 2013. Monitoring stations used for this analysis included two located near the study area, one in Harrison County, and one in Dallas County (see **Figure 3.7-1**). These stations are used in part to determine attainment status for the criteria pollutants. All counties in the study area are designated as attainment or unclassifiable for all criteria pollutants, with the exception of $PM_{2.5}$ which was designated as attainment, pending, or unclassifiable.

**Table 3.7-13 Ozone Monitoring Data for Study Area 2**

| Monitoring Station | Year | Fourth Highest 8-hour Concentration (ppm) | | | Location | County |
|---|---|---|---|---|---|---|
| | | Monitored Value | 3-year Average | NAAQS | | |
| AQS 48-203-0002 | 2011 | 0.076 | 0.073 | 0.075 | Karnack | Harrison County |
| | 2012 | 0.072 | | | | |
| | 2013 | 0.070 | | | | |

Source: USEPA 2014c.

**Table 3.7-14 Nitrogen Dioxide Monitoring Data for Study Area 2**

| Monitoring Station | Year | Annual Concentration (ppm) | | Location | County |
|---|---|---|---|---|---|
| | | Monitored Value | NAAQS | | |
| AQS 48-203-0002 | 2011 | 0.0111 | 0.053 | Karnack | Harrison County |
| | 2012 | 0.0095 | | | |
| | 2013 | 0.0078 | | | |
| AQS 48-113-0069 | 2011 | 0.0262 | 0.053 | Dallas Hinton | Dallas County |
| | 2012 | 0.0245 | | | |
| | 2013 | 0.0248 | | | |

Source: USEPA 2014c.

**Table 3.7-15 Carbon Monoxide Monitoring Data for Study Area 2**

| Monitoring Station | Year | Second Highest 8-hour Concentration (ppm) | | Location | County |
|---|---|---|---|---|---|
| | | Monitored Value | NAAQS | | |
| AQS 48-113-0069 | 2011 | 1.3 | 9 | Dallas Hinton | Dallas County |
| | 2012 | 1.7 | | | |
| | 2013 | 1.7 | | | |

Source: USEPA 2014c.

**Table 3.7-16 Sulfur Dioxide Monitoring Data for Study Area 2**

| Monitoring Station | Year | $99^{th}$ Percentile 1-hour Concentration (ppm) | | Location | County |
|---|---|---|---|---|---|
| | | Monitored Value | NAAQS | | |
| AQS 48-113-0069 | 2011 | 0.0077 | 0.075 | Dallas Hinton | Dallas County |
| | 2012 | 0.0059 | | | |
| | 2013 | 0.0050 | | | |

Source: USEPA 2014c.

**Table 3.7-17 $PM_{10}$ Monitoring Data for Study Area 2**

| Monitoring Station | Year | Second-Highest 24-hour Concentration (μg/m$^3$) | | Location | County |
|---|---|---|---|---|---|
| | | Monitored Value | NAAQS | | |
| AQS 48-203-0002 | 2011 | 32 | 150 | Karnack | Harrison County |
| | 2012 | 36 | | | |
| | 2013 | 53 | | | |

Source: USEPA 2014c.

**Table 3.7-18 $PM_{2.5}$ Monitoring Data for Study Area 2**

| Monitoring Station | Year | $98^{th}$-percentile 24-hour or Annual Concentration (μg/m$^3$) | | Location | County |
|---|---|---|---|---|---|
| | | Monitored Value | NAAQS | | |
| AQS 48-203-0002[1] | 2005 | 19.2 | 35 | Karnack | Harrison County |
| | 2006 | 23.6 | | | |
| | 2007 | 23.3 | | | |
| AQS 48-113-0069[1] | 2005 | 23.0 | 35 | Dallas Hinton | Dallas County |
| | 2006 | 19.9 | | | |
| | 2007 | 23.2 | | | |
| AQS 48-203-0002[2] | 2005 | 11.9 | 12 | Karnack | Harrison County |
| | 2006 | 10.4 | | | |

**Table 3.7-18 $PM_{2.5}$ Monitoring Data for Study Area 2**

| Monitoring Station | Year | $98^{th}$-percentile 24-hour or Annual Concentration (µg/m³) | | Location | County |
|---|---|---|---|---|---|
| | | Monitored Value | NAAQS | | |
| | 2007 | 9.3 | | | |
| AQS 48-113-0069[2] | 2005 | 10.4 | 12 | Dallas Hinton | Dallas County |
| | 2006 | 9.7 | | | |
| | 2007 | 9.6 | | | |

1 Reflects $98^{th}$ percentile 24-hour data.

2 Reflects annual data.

Source: USEPA 2014c.

*Visibility and Deposition*

**Table 3.7-19** presents wet and dry deposition data from selected air quality monitoring stations within or nearest to Study Area 2 and the associated CESA for the period of 2011 through 2013. Visibility data for the same time period are presented in **Table 3.7-20**. The monitoring station locations are presented in **Figure 3.7-1**.

*Climate*

The climate in Study Area 2 is similar to that described above for Study Area 1.

*Greenhouse Gases, Climate Change, and Change in Air Quality*

Study Area 2 is expected to have similar trends in climate change as those described above for Study Area 1.

**Table 3.7-19 Annual Average Wet and Dry Deposition of Ammonium, Sulfate, and Nitrate – Study Area 2**

| Monitoring Station | Year | Ammonium (kg/ha) | Nitrate (kg/ha) | Sulfate (kg/ha) |
|---|---|---|---|---|
| **Wet Deposition** | | | | |
| TX21 | 2011 | 2.36 | 5.85 | 8.27 |
| | 2012 | 2.64 | 7.6 | 10.64 |
| | 2013 | 2.13 | 6.11 | 10.72 |
| ALC188 | 2011 | 0.29 | 0.77 | 1.06 |
| | 2012 | 0.25 | 0.68 | 0.86 |
| | 2013 | 0.21 | 0.59 | 0.86 |
| **Dry Deposition** | | | | |
| ALC188 | 2011 | 0.26 | 1.32 | 0.39 |
| | 2012 | 0.21 | 1.08 | 0.28 |
| | 2013 | 0.19 | 0.94 | 0.26 |

Sources: NADP 2014; USEPA 2014d.

**Table 3.7-20 Visibility – Study Area 2**

| Monitoring Station | Year | 20 Percent Best Days (deciviews) | 20 Percent Worst Days (deciviews) | Average All Days (deciviews) |
|---|---|---|---|---|
| CACR1 | 2011 | 11.70 | 22.67 | 17.49 |
| | 2012 | 9.54 | 21.49 | 16.09 |
| | 2013 | 8.61 | 21.35 | 15.36 |

Source: IMPROVE 2014.

Study Area 3

*Criteria Pollutants*

**Tables 3.7-21** through **3.7-26** present monitored criteria pollutant levels from selected air quality monitoring stations within or near Study Area 3 and the associated CESA for the period of 2011 through 2013. Monitoring stations used for this analysis are located in Ellis, Harrison, Dallas, McLennan, Smith, and Tarrant counties (see **Figure 3.7-1**). These stations are used in part to determine attainment status for the criteria pollutants. All counties in the study area are designated as attainment or unclassifiable for all criteria pollutants, with the following exceptions. For $PM_{2.5}$, the study area counties are designated as attainment, pending, or unclassifiable. For ozone, areas within Study Area 3 are designated as attainment or unclassifiable; however, the northwest portion of the associated CESA encompasses an area designated as moderate non-attainment for the 8-hour average ozone standard. The non-attainment area is near Dallas, Texas.

**Table 3.7-21 Ozone Monitoring Data for Study Area 3**

| Monitoring Station | Year | Fourth Highest 8-hour Concentration (ppm) | | | Location | County |
|---|---|---|---|---|---|---|
| | | Monitored Value | 3-year Average | NAAQS | | |
| AQS 48-139-0016 | 2011 | 0.080 | 0.078 | 0.075 | Midlothian OFW | Ellis County |
| | 2012 | 0.078 | | | | |
| | 2013 | 0.075 | | | | |
| AQS 48-423-0007 | 2011 | 0.078 | 0.075 | 0.075 | Tyler Airport (Relocated) | Smith County |
| | 2012 | 0.076 | | | | |
| | 2013 | 0.071 | | | | |
| AQS 48-309-1037 | 2011 | 0.078 | 0.074 | 0.075 | Waco Mazanec | McLennan County |
| | 2012 | 0.073 | | | | |
| | 2013 | 0.072 | | | | |
| AQS 48-113-0069 | 2011 | 0.084 | 0.084 | 0.075 | Dallas Hinton | Dallas County |
| | 2012 | 0.087 | | | | |
| | 2013 | 0.081 | | | | |
| AQS 48-439-1002 | 2011 | 0.082 | 0.081 | 0.075 | Fort Worth Northwest | Tarrant County |
| | 2012 | 0.077 | | | | |
| | 2013 | 0.084 | | | | |

Source: USEPA 2014c.

**Table 3.7-22 Nitrogen Dioxide Monitoring Data for Study Area 3**

| Monitoring Station | Year | Annual Concentration (ppm) | | Location | County |
|---|---|---|---|---|---|
| | | Monitored Value | NAAQS | | |
| AQS 48-139-0016 | 2011 | 0.0161 | 0.053 | Midlothian OFW | Ellis County |
| | 2012 | 0.0162 | | | |
| | 2013 | 0.0140 | | | |
| AQS 48-423-0007 | 2011 | 0.0079 | 0.053 | Tyler Airport (Relocated) | Smith County |
| | 2012 | 0.0064 | | | |
| | 2013 | 0.0063 | | | |
| AQS 48-309-1037 | 2011 | 0.0093 | 0.053 | Waco Mazanec | McLennan County |
| | 2012 | 0.0088 | | | |
| | 2013 | 0.0074 | | | |
| AQS 48-113-0069 | 2011 | 0.0262 | 0.053 | Dallas Hinton | Dallas County |
| | 2012 | 0.0245 | | | |
| | 2013 | 0.0248 | | | |
| AQS 48-439-1002 | 2011 | 0.0246 | 0.053 | Fort Worth Northwest | Tarrant County |
| | 2012 | 0.0243 | | | |
| | 2013 | 0.0236 | | | |

Source: USEPA 2014c.

**Table 3.7-23 Carbon Monoxide Monitoring Data for Study Area 3**

| Monitoring Station | Year | Second Highest 8-hour Concentration (ppm) | | Location | County |
|---|---|---|---|---|---|
| | | Monitored Value | NAAQS | | |
| AQS 48-309-1037 | 2011 | 1.1 | 9 | Waco Mazanec | McLennan County |
| | 2012 | 0.4 | | | |
| | 2013 | 0.3 | | | |
| AQS 48-113-0069 | 2011 | 1.3 | 9 | Dallas Hinton | Dallas County |
| | 2012 | 1.7 | | | |
| | 2013 | 1.7 | | | |
| AQS 48-439-1002 | 2011 | 1.2 | 9 | Fort Worth Northwest | Tarrant County |
| | 2012 | 1.2 | | | |
| | 2013 | 1.0 | | | |

Source: USEPA 2014c.

**Table 3.7-24 Sulfur Dioxide Monitoring Data for Study Area 3**

| Monitoring Station | Year | 99th Percentile 1-hour Concentration (ppm) | | Location | County |
|---|---|---|---|---|---|
| | | Monitored Value | NAAQS | | |
| AQS 48-139-0016 | 2011 | 0.0107 | 0.075 | Midlothian OFW | Ellis County |
| | 2012 | 0.0146 | | | |
| | 2013 | 0.0160 | | | |
| AQS 48-309-1037 | 2011 | 0.0042 | 0.075 | Waco Mazanec | McLennan County |
| | 2012 | 0.0067 | | | |
| | 2013 | 0.0073 | | | |
| AQS 48-113-0069 | 2011 | 0.0077 | 0.075 | Dallas Hinton | Dallas County |
| | 2012 | 0.0059 | | | |
| | 2013 | 0.0050 | | | |

Source: USEPA 2014c.

**Table 3.7-25 $PM_{10}$ Monitoring Data for Study Area 3**

| Monitoring Station | Year | Second-Highest 24-hour Concentration (μg/m$^3$) | | Location | County |
|---|---|---|---|---|---|
| | | Monitored Value | NAAQS | | |
| AQS 48-113-0061 | 2011 | 57 | 150 | East of Bickers and Furey Streets | Harrison County |
| | 2012 | 62 | | | |
| | 2013 | 77 | | | |

Source: USEPA 2014c.

**Table 3.7-26 $PM_{2.5}$ Monitoring Data for Study Area 3**

| Monitoring Station | Year | 98th-percentile 24-hour or Annual Concentration (μg/m$^3$) | | Location | County |
|---|---|---|---|---|---|
| | | Monitored Value | NAAQS | | |
| AQS 48-139-0016[1] | 2005 | 20.2 | 35 | Midlothian OFW | Ellis County |
| | 2006 | 22.6 | | | |
| | 2007 | 24.9 | | | |
| AQS 48-113-0069[1] | 2005 | 23.0 | 35 | Dallas Hinton | Dallas County |
| | 2006 | 19.9 | | | |
| | 2007 | 23.2 | | | |
| AQS 48-439-1002[1] | 2005 | 22.1 | 35 | Fort Worth Northwest | Tarrant County |
| | 2006 | 22.1 | | | |
| | 2007 | 26.4 | | | |
| AQS 48-139-0016[2] | 2005 | 10.2 | 12 | Midlothian OFW | Ellis County |
| | 2006 | 10.1 | | | |
| | 2007 | 8.8 | | | |

**Table 3.7-26 $PM_{2.5}$ Monitoring Data for Study Area 3**

| Monitoring Station | Year | 98th-percentile 24-hour or Annual Concentration (µg/m³) | | Location | County |
|---|---|---|---|---|---|
| | | Monitored Value | NAAQS | | |
| AQS 48-113-0069[2] | 2005 | 10.4 | 12 | Dallas Hinton | Dallas County |
| | 2006 | 9.7 | | | |
| | 2007 | 9.6 | | | |
| AQS 48-439-1002[2] | 2005 | 10.7 | 12 | Fort Worth Northwest | Tarrant County |
| | 2006 | 10.5 | | | |
| | 2007 | 10.4 | | | |

1 Reflects 98th percentile 24-hour data.

2 Reflects annual data.

Source: USEPA 2014c.

*Visibility and Deposition*

**Table 3.7-27** presents wet and dry deposition data from selected air quality monitoring stations within or nearest to Study Area 3 and the associated CESA for the period of 2011 through 2013. The monitoring station locations are presented in **Figure 3.7-1**. No visibility information was available within 200 km of the study area.

**Table 3.7-27 Annual Average Wet and Dry Deposition of Ammonium, Sulfate, and Nitrate – Study Area 3**

| Monitoring Station | Year | Ammonium (kg/ha) | Nitrate (kg/ha) | Sulfate (kg/ha) |
|---|---|---|---|---|
| **Wet Deposition** | | | | |
| TX56 | 2011 | 3.73 | 6.72 | 7.87 |
| | 2012 | 2.29 | 6.04 | 4.86 |
| | 2013 | 2.94 | 6.6 | 6.73 |
| TX21 | 2011 | 2.36 | 5.85 | 8.27 |
| | 2012 | 2.64 | 7.6 | 10.64 |
| | 2013 | 2.13 | 6.11 | 10.72 |
| TX10 | 2011 | 1.43 | 4.03 | 5.54 |
| | 2012 | 2.31 | 6.8 | 7.75 |
| | 2013 | 1.46 | 5.02 | 8.71 |
| ALC188 | 2011 | 0.29 | 0.77 | 1.06 |
| | 2012 | 0.25 | 0.68 | 0.86 |
| | 2013 | 0.21 | 0.59 | 0.86 |
| **Dry Deposition** | | | | |
| ALC188 | 2011 | 0.26 | 1.32 | 0.39 |
| | 2012 | 0.21 | 1.08 | 0.28 |
| | 2013 | 0.19 | 0.94 | 0.26 |

Source: NADP 2014; USEPA 2014d.

*Climate*

Central Texas is characterized by warm and humid summers, mild winters, and transitionary springs and falls. **Table 3.7-28** presents representative temperature and precipitation data for the College Station Airport. A wind rose showing typical wind conditions from the College Station ASOS station is presented in **Figure 3.7-3**.

**Table 3.7-28 Average Monthly Temperature and Precipitation Data for College Station Airport for the Period of 1981-2010**

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sept | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average Maximum Temperature (°F) | 61.0 | 64.8 | 71.7 | 78.9 | 85.8 | 91.7 | 94.8 | 96.2 | 90.5 | 81.4 | 71.0 | 62.3 |
| Average Temperature (°F) | 51.1 | 54.6 | 61.4 | 68.5 | 76.2 | 82.2 | 84.7 | 85.3 | 80.0 | 70.8 | 60.8 | 52.2 |
| Average Minimum Temperature (°F) | 41.2 | 44.4 | 51.0 | 58.1 | 66.6 | 72.7 | 74.6 | 74.5 | 69.4 | 60.3 | 50.5 | 42.2 |
| Average Precipitation (inches) | 3.2 | 2.9 | 3.2 | 2.7 | 4.3 | 4.5 | 2.1 | 2.7 | 3.2 | 4.9 | 3.2 | 3.2 |

Source: Texas Office of the State Climatologist 2014.

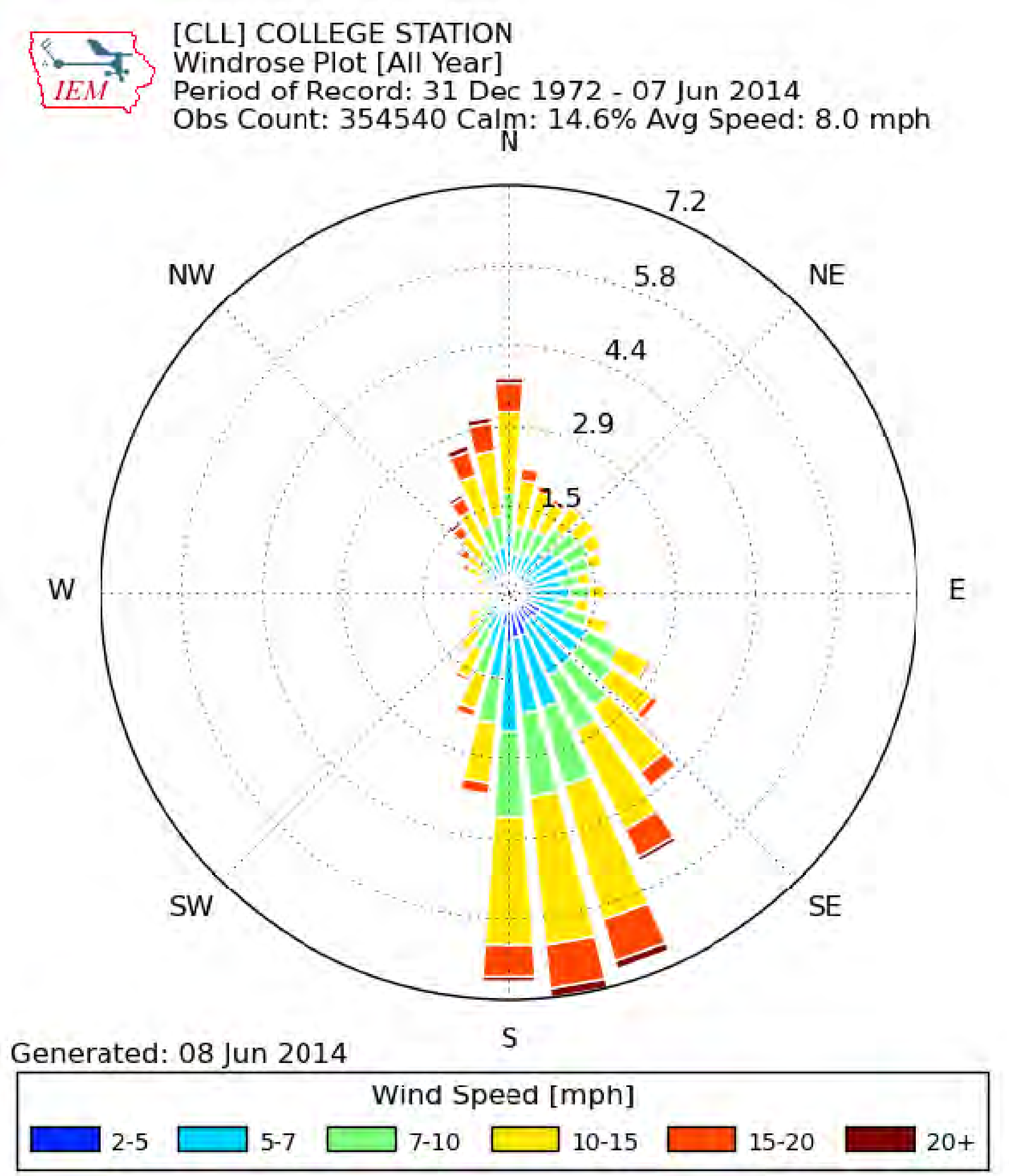
*Greenhouse Gases, Climate Change, and Change in Air Quality*

Study Area 3 is expected to have similar trends in climate change as those described above for Study Area 1.

<u>Study Area 4</u>

*Criteria Pollutants*

**Tables 3.7-29** through **3.7-34** present monitored criteria pollutant levels from selected air quality monitoring stations within or near Study Area 4 and the associated CESA for the period of 2011 through 2013. Monitoring stations used for this analysis are located in Travis, Conroe, McLennan, and Harris counties (see **Figure 3.7-1**). These stations are used in part to determine attainment status for the criteria pollutants. All counties in the study area are designated as attainment or unclassifiable for all criteria pollutants, with the exception of $PM_{2.5}$ which is designated as attainment, pending, or unclassifiable.




**Source: Iowa Environmental Mesonet 2014.**

**Figure 3.7-3 Wind Rose for College Station Airport**

**Table 3.7-29 Ozone Monitoring Data for Study Area 4**

| Monitoring Station | Year | Fourth Highest 8-hour Concentration (ppm) | | | Location | County |
|---|---|---|---|---|---|---|
| | | Monitored Value | 3-year Average | NAAQS | | |
| AQS 48-453-0020 | 2011 | 0.073 | 0.073 | 0.075 | Austin Audubon Society | Travis County |
| | 2012 | 0.076 | | | | |
| | 2013 | 0.070 | | | | |
| AQS 48-339-0078 | 2011 | 0.080 | 0.079 | 0.075 | Conroe (Relocated) | Montgomery County |
| | 2012 | 0.082 | | | | |
| | 2013 | 0.075 | | | | |
| AQS 48-453-0014 | 2011 | 0.075 | 0.073 | 0.075 | Austin Northwest | Travis County |
| | 2012 | 0.074 | | | | |
| | 2013 | 0.069 | | | | |
| AQS 48-309-1037 | 2011 | 0.078 | 0.074 | 0.075 | Waco Mazanec | McLennan County |
| | 2012 | 0.073 | | | | |
| | 2013 | 0.072 | | | | |
| AQS 48-201-0024 | 2011 | 0.083 | 0.077 | 0.075 | Houston Aldine | Harris County |
| | 2012 | 0.075 | | | | |
| | 2013 | 0.074 | | | | |

Source: USEPA 2014c.

**Table 3.7-30 Nitrogen Dioxide Monitoring Data for Study Area 4**

| Monitoring Station | Year | Annual Concentration (ppm) | | Location | County |
|---|---|---|---|---|---|
| | | Monitored Value | NAAQS | | |
| AQS 48-453-0020 | 2010 | 0.0068 | 0.053 | Austin Audubon Society | Travis County |
| | 2011 | 0.0060 | | | |
| | 2012 | 0.0067 | | | |
| AQS 48-339-0078 | 2011 | 0.0115 | 0.053 | Conroe (Relocated) | Conroe County |
| | 2012 | 0.0103 | | | |
| | 2013 | 0.0082 | | | |
| AQS 48-309-1037 | 2011 | 0.0093 | 0.053 | Waco Mazanec | McLennan County |
| | 2012 | 0.0088 | | | |
| | 2013 | 0.0074 | | | |
| AQS 48-201-0024 | 2011 | 0.0195 | 0.053 | Houston Aldine | Harris County |
| | 2012 | 0.0213 | | | |
| | 2013 | 0.0198 | | | |

Source: USEPA 2014c.

**Table 3.7-31 Carbon Monoxide Monitoring Data for Study Area 4**

| Monitoring Station | Year | Second Highest 8-hour Concentration (ppm) | | Location | County |
|---|---|---|---|---|---|
| | | Monitored Value | NAAQS | | |
| AQS 48-453-0014 | 2011 | 0.5 | 9 | Austin Northwest | Travis County |
| | 2012 | 0.4 | | | |
| | 2013 | 0.4 | | | |
| AQS 48-309-1037 | 2011 | 1.1 | 9 | Waco Mazanec | McLennan County |
| | 2012 | 0.4 | | | |
| | 2013 | 0.3 | | | |
| AQS 48-201-0024 | 2011 | 1.5 | 9 | Houston Aldine | Harris County |
| | 2012 | 1.7 | | | |
| | 2013 | 1.6 | | | |

Source: USEPA 2014c.

**Table 3.7-32 Sulfur Dioxide Monitoring Data for Study Area 4**

| Monitoring Station | Year | $99^{th}$ Percentile 1-hour Concentration (ppm) | | Location | County |
|---|---|---|---|---|---|
| | | Monitored Value | NAAQS | | |
| AQS 48-309-1037 | 2011 | 0.0042 | 0.075 | Waco Mazanec | McLennan County |
| | 2012 | 0.0067 | | | |
| | 2013 | 0.0073 | | | |

Source: USEPA 2014c.

**Table 3.7-33 $PM_{10}$ Monitoring Data for Study Area 4**

| Monitoring Station | Year | Second-Highest 24-hour Concentration (µg/m$^3$) | | Location | County |
|---|---|---|---|---|---|
| | | Monitored Value | NAAQS | | |
| AQS 48-453-0020 | 2011 | 33 | 150 | Austin Audubon Society | Travis County |
| | 2012 | 32 | | | |
| | 2013 | 51 | | | |
| AQS 48-453-0021 | 2011 | 33 | 150 | Austin Webberville Road | Travis County |
| | 2012 | 28 | | | |
| | 2013 | 57 | | | |
| AQS 48-201-0024 | 2011 | 55 | 150 | Houston Aldine | Harris County |
| | 2012 | 77 | | | |
| | 2013 | 58 | | | |

Source: USEPA 2014c.

**Table 3.7-34 $PM_{2.5}$ Monitoring Data for Study Area 4**

| Monitoring Station | Year | 98th-percentile 24-hour or Annual Concentration (μg/m³) | | Location | County |
|---|---|---|---|---|---|
| | | Monitored Value | NAAQS | | |
| AQS 48-453-0020[1] | 2005 | 21.3 | 35 | Austin Audubon Society | Travis County |
| | 2006 | 17.2 | | | |
| | 2007 | 24.4 | | | |
| AQS 48-453-0021[1] | 2005 | 21.6 | 35 | Austin Webberville Road | Travis County |
| | 2006 | 23.4 | | | |
| | 2007 | 27.0 | | | |
| AQS 48-201-0024[1] | 2005 | 20.9 | 35 | Houston Aldine | Harris County |
| | 2006 | 26.2 | | | |
| | 2007 | 22.1 | | | |
| AQS 48-453-0020[2] | 2005 | 8.5 | 12 | Austin Audubon Society | Travis County |
| | 2006 | 7.7 | | | |
| | 2007 | 7.3 | | | |
| AQS 48-453-0021[2] | 2005 | 10.8 | 12 | Austin Webberville Road | Travis County |
| | 2006 | 10.1 | | | |
| | 2007 | 8.3 | | | |
| AQS 48-201-0024[2] | 2005 | 11.5 | 12 | Houston Aldine | Harris County |
| | 2006 | 11.2 | | | |
| | 2007 | 10.7 | | | |

[1] Reflects 98th percentile 24-hour data.

[2] Reflects annual data.

Source: USEPA 2014c.

*Visibility and Deposition*

**Table 3.7-35** presents wet and dry deposition data from selected air quality monitoring stations within or nearest to Study Area 4 and the associated CESA for the period of 2011 through 2013. The monitoring station locations are presented in **Figure 3.7-1**. No visibility information was available within 200 km of the area.

*Climate*

The climate for Study Area 4 is similar to that described above for Study Area 3.

*Greenhouse Gases, Climate Change, and Change in Air Quality*

Area 4 is expected to have similar trends in climate change as those described above for Study Area 1.

**Table 3.7-35 Annual Average Wet and Dry Deposition of Ammonium, Sulfate, and Nitrate – Study Area 4**

| Monitoring Station | Year | Ammonium (kg/ha) | Nitrate (kg/ha) | Sulfate (kg/ha) |
|---|---|---|---|---|
| **Wet Deposition** | | | | |
| TX10 | 2011 | 1.43 | 4.03 | 5.54 |
| | 2012 | 2.31 | 6.8 | 7.75 |
| | 2013 | 1.46 | 5.02 | 8.71 |
| ALC188 | 2011 | 0.29 | 0.77 | 1.06 |
| | 2012 | 0.25 | 0.68 | 0.86 |
| | 2013 | 0.21 | 0.59 | 0.86 |
| **Dry Deposition** | | | | |
| ALC188 | 2011 | 0.26 | 1.32 | 0.39 |
| | 2012 | 0.21 | 1.08 | 0.28 |
| | 2013 | 0.19 | 0.94 | 0.26 |

Source: NADP 2014; USEPA 2014d.

Study Area 5

*Criteria Pollutants*

**Tables 3.7-36** through **3.7-41** present monitored criteria pollutant levels from selected air quality monitoring stations within or near Study Area 5 and the associated CESA for the period of 2011 through 2013 (unless otherwise noted). The monitoring station used for this analysis is located in Bexar County (see **Figure 3.7-1**). This station is used in part to determine attainment status for the criteria pollutants. All counties in the study area are designated as attainment or unclassifiable for all criteria pollutants, with the exception of $PM_{2.5}$ which is designated as attainment, pending, or unclassifiable.

**Table 3.7-36 Ozone Monitoring Data for Study Area 5**

| Monitoring Station | Year | Fourth Highest 8-hour Concentration (ppm) | | | Location | County |
|---|---|---|---|---|---|---|
| | | Monitored Value | 3-year Average | NAAQS | | |
| AQS 48-029-0059 | 2011 | 0.071 | 0.070 | 0.075 | Calaveras Lake | Bexar County |
| | 2012 | 0.069 | | | | |
| | 2013 | 0.067 | | | | |
| AQS 48-029-0032 | 2011 | 0.075 | 0.082 | 0.075 | Camp Bullis | Bexar County |
| | 2012 | 0.087 | | | | |
| | 2013 | 0.083 | | | | |

Source: USEPA 2014c.

**Table 3.7-37 Nitrogen Dioxide Monitoring Data for Study Area 5**

| Monitoring Station | Year | Annual Concentration (pp) | | Location | County |
|---|---|---|---|---|---|
| | | Monitored Value | NAAQS | | |
| AQS 48-029-0059 | 2010 | 0.0119 | 0.053 | Calavaras Lake | Bexar County |
| | 2011 | 0.0112 | | | |
| | 2012 | 0.0101 | | | |

Source: USEPA 2014c.

**Table 3.7-38 Carbon Monoxide Monitoring Data for Study Area 5**

| Monitoring Station | Year[1] | Second Highest 8-hour Concentration (ppm) | | Location | County |
|---|---|---|---|---|---|
| | | Monitored Value | NAAQS | | |
| AQS 48-029-0622 | 2008 | 0.6 | 9 | 7145 Gardner Road | Bexar County |
| | 2009 | 0.9 | | | |
| | 2010 | 0.7 | | | |

[1] Reflects the most current CO data available from this site.

Source: USEPA 2014c.

**Table 3.7-39 Sulfur Dioxide Monitoring Data for Study Area 5**

| Monitoring Station | Year | $99^{th}$ Percentile 1-hour Concentration (ppm) | | Location | County |
|---|---|---|---|---|---|
| | | Monitored Value | NAAQS | | |
| AQS 48-029-0622 | 2011 | 0.0370 | 0.075 | 7145 Gardner Road | Bexar County |
| | 2012 | 0.0310 | | | |
| | 2013 | 0.0280 | | | |

Source: USEPA 2014c.

**Table 3.7-40 $PM_{10}$ Monitoring Data for Study Area 5**

| Monitoring Station | Year | Second-Highest 24-hour Concentration (μg/$m^3$) | | Location | County |
|---|---|---|---|---|---|
| | | Monitored Value | NAAQS | | |
| AQS 48-029-0053 | 2011 | 45 | 150 | Selma | Bexar County |
| | 2012 | 50 | | | |
| | 2013 | 58 | | | |

Source: USEPA 2014c.

**Table 3.7-41 $PM_{2.5}$ Monitoring Data for Study Area 5**

| Monitoring Station | Year | 98th-percentile 24-hour or Annual Concentration (µg/m³) Monitored Value | NAAQS | Location | County |
|---|---|---|---|---|---|
| AQS 48-029-0059[1] | 2005 | 27.3 | 35 | Calavaras Lake | Bexar County |
| | 2006 | 23.4 | | | |
| | 2007 | 18.9 | | | |
| AQS 48-029-0032[1] | 2005 | 25.7 | 35 | Camp Bullis | Bexar County |
| | 2006 | 18.2 | | | |
| | 2007 | 26.1 | | | |
| AQS 48-029-0059[2] | 2005 | 9.5 | 12 | Calavaras Lake | Bexar County |
| | 2006 | 8.6 | | | |
| | 2007 | 7.7 | | | |
| AQS 48-029-0032[2] | 2005 | 9.4 | 12 | Camp Bullis | Bexar County |
| | 2006 | 0.04 | | | |
| | 2007 | 8.8 | | | |

[1] Reflects 98th percentile 24-hour data.

[2] Reflects annual data.

Source: USEPA 2014c.

*Visibility and Deposition*

**Table 3.7-42** presents wet deposition data from selected air quality monitoring stations within or nearest to Study Area 5 and the associated CESA for the period of 2011 through 2013. The monitoring station locations are presented in **Figure 3.7-1**. No stations with dry deposition or visibility data were found within 200 km of the area.

**Table 3.7-42 Annual Average Wet Deposition of Ammonium, Sulfate, and Nitrate – Study Area 5**

| Monitoring Station | Year | Ammonium (kg/ha) | Nitrate (kg/ha) | Sulfate (kg/ha) |
|---|---|---|---|---|
| TX03 | 2011 | 0.97 | 2.54 | 3.37 |
| | 2012 | 3.01 | 4.56 | 6.18 |
| | 2013 | 3.99 | 6.15 | 7.39 |
| TX10 | 2011 | 1.43 | 4.03 | 5.54 |
| | 2012 | 2.31 | 6.8 | 7.75 |
| | 2013 | 1.46 | 5.02 | 8.71 |

Source: NADP 2014.

*Climate*

Southern Texas is characterized by warm and humid summers, mild winters, and transitionary springs and falls. **Table 3.7-43** presents representative temperature and precipitation data for Study Area 5, based on data from the San Antonio International Airport. **Figure 3.7-4** presents a wind rose showing wind conditions at the San Antonio ASOS station located at the airport.

**Table 3.7-43 Average Monthly Temperature and Precipitation Data from the San Antonio International Airport for the Period of 1981-2010**

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sept | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average Maximum Temperature (°F) | 62.9 | 66.9 | 73.5 | 80.5 | 87.0 | 92.3 | 94.6 | 96.0 | 90.3 | 82.2 | 72.2 | 64.0 |
| Average Temperature (°F) | 51.8 | 55.6 | 62.2 | 69.3 | 76.9 | 82.4 | 84.6 | 85.3 | 79.7 | 71.2 | 61.1 | 52.9 |
| Average Minimum Temperature (°F) | 40.7 | 44.2 | 50.8 | 58.1 | 66.8 | 72.6 | 74.6 | 74.7 | 69.1 | 60.1 | 50.1 | 41.7 |
| Average Precipitation (inches) | 1.8 | 1.8 | 2.3 | 2.1 | 4.0 | 4.1 | 2.7 | 2.1 | 3.0 | 4.1 | 2.3 | 1.9 |

Source: Texas Office of the State Climatologist 2014.

*Greenhouse Gases, Climate Change, and Change in Air Quality*

Area 5 is expected to have similar trends in climate change as those described above for Study Area 1.

Study Area 6

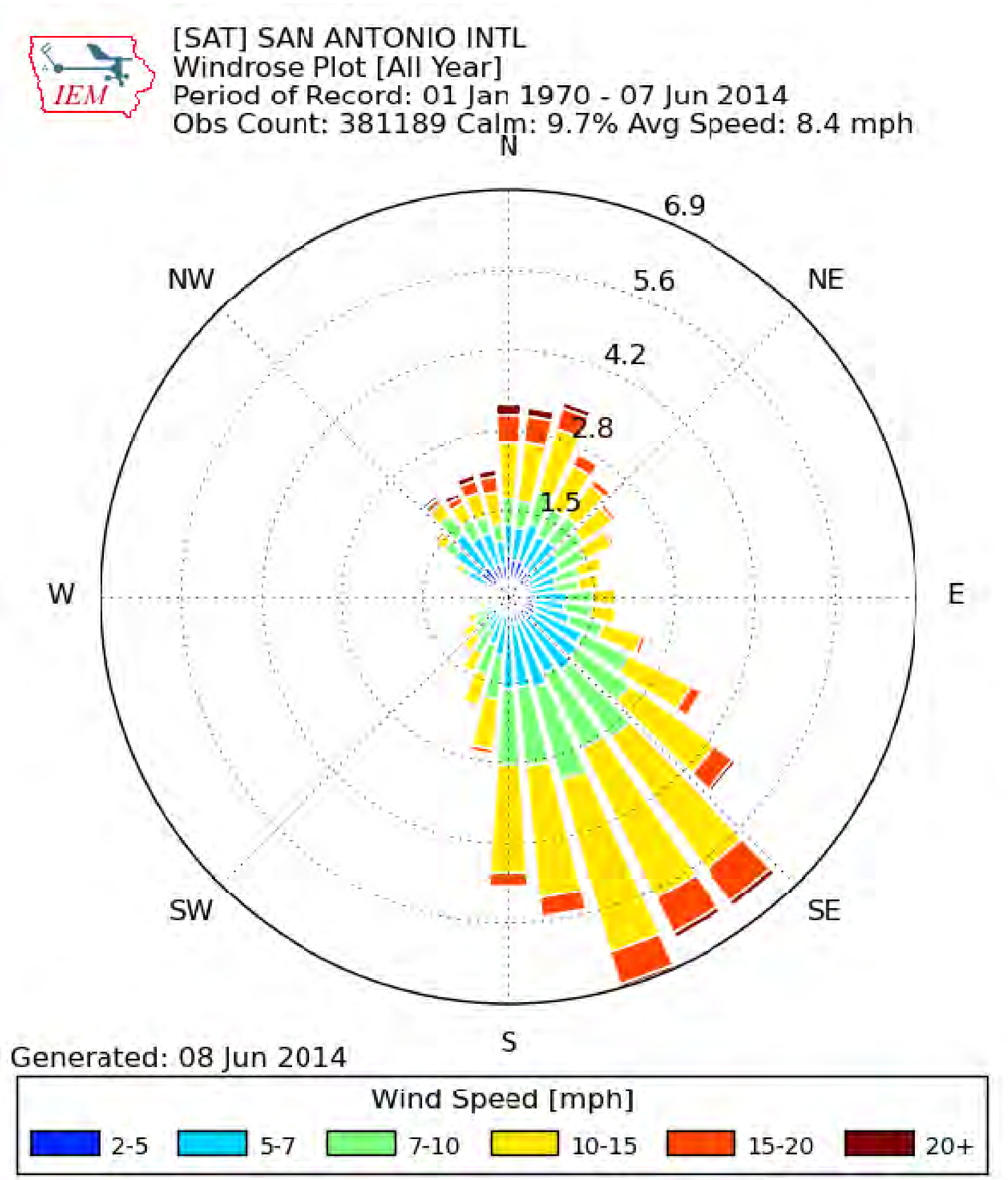
*Criteria Pollutants*

**Tables 3.7-44** through **3.7-49** present monitored criteria pollutant levels from selected air quality monitoring stations within or near Study Area 6 and the associated CESA for the period of 2011 through 2013. The monitoring station used for this analysis is located in Bexas County. These stations are used in part to determine attainment status for the criteria pollutants. All counties in the study area are designated as attainment or unclassifiable for all criteria pollutants, with the exception of $PM_{2.5}$ which is designated as attainment, pending, or unclassifiable.

**Table 3.7-44 Ozone Monitoring Data for Study Area 6**

| Monitoring Station | Year | Fourth Highest 8-hour Concentration (ppm) | | | Location | County |
|---|---|---|---|---|---|---|
| | | Monitored Value | 3-year Average | NAAQS | | |
| AQS 48-029-0059 | 2011 | 0.071 | 0.070 | 0.075 | Calaveras Lake | Bexar County |
| | 2012 | 0.070 | | | | |
| | 2013 | 0.069 | | | | |

Source: USEPA 2014c.




**Source: Iowa Environmental Mesonet 2014.**

**Figure 3.7-4 Wind Rose for San Antonio International Airport**

**Table 3.7-45 Nitrogen Dioxide Monitoring Data for Study Area 6**

| Monitoring Station | Year | Annual Concentration (ppm) | | Location | County |
|---|---|---|---|---|---|
| | | Monitored Value | NAAQS | | |
| AQS 48-029-0059 | 2010 | 0.0119 | 0.053 | Calaveras Lake | Bexar County |
| | 2011 | 0.0112 | | | |
| | 2012 | 0.0101 | | | |

Source: USEPA 2014c.

**Table 3.7-46 Carbon Monoxide Monitoring Data for Study Area 6**

| Monitoring Station | Year | Second Highest 8-hour Concentration (ppm) | | Location | County |
|---|---|---|---|---|---|
| | | Monitored Value | NAAQS | | |
| AQS 48-029-0622 | 2008 | 0.6 | 9 | 7145 Gardner Road | Bexar County |
| | 2009 | 0.9 | | | |
| | 2010 | 0.7 | | | |

[1] Reflects the most current CO data available from this site.

Source: USEPA 2014c.

**Table 3.7-47 Sulfur Dioxide Monitoring Data for Study Area 6**

| Monitoring Station | Year | $99^{th}$ Percentile 1-hour Concentration (ppm) | | Location | County |
|---|---|---|---|---|---|
| | | Monitored | NAAQS | | |
| AQS 48-029-0622 | 2011 | 0.0370 | 0.075 | 7145 Gardner Road | Bexar County |
| | 2012 | 0.0310 | | | |
| | 2013 | 0.0280 | | | |

Source: USEPA 2014c.

**Table 3.7-48 $PM_{10}$ Monitoring Data for Study Area 6**

| Monitoring Station | Year | Second-Highest 24-hour Concentration (μg/$m^3$) | | Location | County |
|---|---|---|---|---|---|
| | | Monitored | NAAQS | | |
| AQS 48-029-0053 | 2011 | 45 | 150 | Selma | Bexar County |
| | 2012 | 50 | | | |
| | 2013 | 58 | | | |

Source: USEPA 2014c.

**Table 3.7-49 $PM_{2.5}$ Monitoring Data for Study Area 6**

| Monitoring Station | Year | 98th-percentile 24-hour or Annual Concentration (µg/m³) | | Location | County |
|---|---|---|---|---|---|
| | | Monitored Value | NAAQS | | |
| AQS 48-029-0059[1] | 2005 | 27.3 | 35 | Calavaras Lake | Bexar County |
| | 2006 | 23.4 | | | |
| | 2007 | 18.9 | | | |
| AQS 48-029-0032[1] | 2005 | 25.7 | 35 | Camp Bullis | Bexar County |
| | 2006 | 18.2 | | | |
| | 2007 | 26.1 | | | |
| AQS 48-029-0059[2] | 2005 | 9.5 | 12 | Calavaras Lake | Bexar County |
| | 2006 | 8.6 | | | |
| | 2007 | 7.7 | | | |
| AQS 48-029-0032[2] | 2005 | 9.4 | 12 | Camp Bullis | Bexar County |
| | 2006 | 0.04 | | | |
| | 2007 | 8.8 | | | |

[1] Reflects 98th percentile 24-hour data.

[2] Reflects annual data.

Source: USEPA 2014c.

*Visibility and Deposition*

**Table 3.7-50** presents wet deposition data from the monitoring station nearest to Study Area 5 and the associated CESA for the period of 2011 through 2013. The monitoring station location is presented in **Figure 3.7-1**. No stations with dry deposition or visibility data were found within 200 km of the study area.

**Table 3.7-50 Annual Average Wet Deposition of Ammonium, Sulfate, and Nitrate – Study Area 6**

| Monitoring Station | Year | Ammonium (kg/ha) | Nitrate (kg/ha) | Sulfate (kg/ha) |
|---|---|---|---|---|
| TX03 | 2011 | 0.97 | 2.54 | 3.37 |
| | 2012 | 3.01 | 4.56 | 6.18 |
| | 2013 | 3.99 | 6.15 | 7.39 |
| TX16 | 2011 | 1.53 | 3.53 | 3.81 |
| | 2012 | 1.23 | 3.1 | 3.95 |
| | 2013 | 1.82 | 3.86 | 4.83 |

Source: NADP 2014.

*Climate*

The climate in Study Area 6 is similar to that described above for Study Area 5.

*Greenhouse Gases, Climate Change, and Change in Air Quality*

Area 6 is expected to have similar trends in climate change as those described above for Study Area 1.

### 3.7.2 Environmental Consequences (Study Areas 1-6)

Air quality has the potential to be affected by emissions from mining equipment and mine-related construction, operation, and reclamation activities. Regional air quality also is affected by natural events such as windstorms and wildfires, as well as larger emissions generating facilities such as power plants and transportation activities in adjacent urban corridors. Natural events generally are short lived, lasting from several hours to several days. The effects during these events may impact human health and the environment, and generally are considered part of the natural and physical environment.

Air quality and AQRV impacts from potential future mine expansion areas and satellite mines would be assessed as required by applicable regulatory requirements at the time they are proposed. Environmental consequences for site-specific mine locations also would be evaluated at that time. The potential air quality impacts for a typical surface coal or lignite mine (as described in Section 2.2.4) are discussed below; the analysis is applicable to all six study areas.

#### 3.7.2.1 Proposed Action

Construction and operations activities at a typical mine would be sources of total suspended particulates, $PM_{10}$, and $PM_{2.5}$. Fuel-burning mobile sources would emit low levels of gaseous pollutants (e.g., $SO_2$, oxides of nitrogen [$NO_X$], CO, and reactive organic gases [ROGs]). Typical mine reclamation activities also would result in an increase in fugitive and gaseous emissions in the local area. During construction, operations, and reclamation, vehicle exhaust emissions would be generated; however, these emissions would be small compared to potential fugitive emissions from earth moving, hauling, and other construction or operations activities. Particulate matter concentrations due to construction, operation, and reclamation activities would vary, and impacts would depend on the activity location and the daily wind and weather conditions. However, any such impacts are expected to be localized near mining activities.

Typical mine-related construction and operations would result in temporary air quality impacts due to increases in local fugitive dust levels. Dust generated from construction and operation (i.e., mining and material hauling) activities is termed “fugitive” because it is not discharged to the atmosphere in a confined flow stream (e.g., stack, chimney, or vent). The principal sources of fugitive dust would include land clearing, material handling and hauling during active mining, and wind erosion from temporary stockpiles and disturbance areas.

Fugitive dust emissions from disturbance areas would be controlled by minimizing the acreage of coal or lignite mining disturbance at any given time, prompt revegetation of re-graded lands, and restricting fugitive dust causing activities during periods of air stagnation. Concentrations of fugitive dust from disturbance areas would be unlikely to cause a violation of NAAQS with implementation of the proposed control measures to reduce emissions.

Fugitive dust emissions from haul roads would be controlled by the application of water sprays, chemical dust suppressants, or slow-curing liquid asphalt as allowed by TCEQ. Other controls would include proper loading of haul trucks (i.e., not over-loading) to prevent spillage; prompt removal of coal or lignite, rock, or soil from roads; compaction of unpaved roads, as needed; and restriction of travel of unauthorized vehicles on other than established roads. Concentrations of fugitive dust from paved and unpaved roads due to haul trucks would be unlikely to cause a violation of NAAQS with implementation of these control measures to reduce emissions.

Particulate emissions related to potential spontaneous coal combustion would be minimized by promptly extinguishing areas of burning or smoldering coal and conducting periodic inspections for burning areas whenever the potential for spontaneous combustion is high. With these measures in place, exceedance of applicable air quality standards is not anticipated. Mobile sources and potential areas of burning or smoldering coal or lignite would emit low levels of HAPs that would be unlikely to present a health hazard to the public.

Air quality impacts due to emissions from mining operations would occur throughout the operational phase of a typical mine. Typical mine equipment emissions were calculated using the typical mine equipment list (see **Table 2-4**). Since the equipment list provides ranges of values, combustion emissions for typical mine equipment were calculated based on the maximum number of each piece of equipment and standard assumptions regarding horsepower rating and annual operating hours. In addition to equipment combustion emissions, particulate matter emissions resulting from fugitive and windblown dust were calculated. Particulate matter windblown dust emissions are based on 650 acres of mine pit-related disturbance at any given time, which is the maximum projected acreage of pit-related disturbance for a typical mine (see Section 2.2.4.2, Typical Operations Phase). **Table 3.7-51** summarizes the calculated typical mine emissions for criteria pollutants and greenhouse gases.

The primary sources contributing to $PM_{10}$ and $PM_{2.5}$ emissions would be truck haulage, windblown dust, and fugitive dust. Implementation of typical environmental protection measures (e.g., prompt revegetation of re-graded areas; application of water sprays, chemical dust suppressants, or slow-curing liquid asphalt on haul roads; etc.) as discussed above, would minimize $PM_{10}$ and $PM_{2.5}$ emissions. Truck haulage also would emit other criteria pollutants, such as $NO_X$. The primary sources of $NO_X$ emissions would be heavy equipment and haul trucks.

Although emissions would occur during construction, operations, and reclamation, the impacts would be transitory and limited in duration. Following closure and final reclamation, emissions from a mine would cease, and nearby pollutant concentrations would return to background levels.

*General Conformity Review*

Areas currently designated as moderate nonattainment for ozone in proximity to Dallas are not anticipated to be impacted by a future mine expansion area or satellite mine. The total annual emissions shown in **Table 3.7-51** would be emitted in areas currently designated as attainment or unclassifiable and, therefore, would not subject to General Conformity.

*Greenhouse Gas Emissions*

The potential contribution to climate change associated with a typical mine expansion area or satellite mine would be through release of GHGs during mine construction, operation, and reclamation activities. GHG emissions, specifically $CO_2$ and methane ($CH_4$), would be released from the operation of the same construction and mining equipment described above. To estimate the total global warming potential of GHG emissions, GHG emissions are reported in units of $CO_2e$. $CO_2e$ is a quantity that describes, for a given GHG, the amount of $CO_2$ that would have the same amount of radiative forcing, when measured over 100 years. To calculate $CO_2e$, first the total $CO_2$ emissions and the $CH_4$ emissions are calculated. To convert $CH_4$ emissions into $CO_2e$ units, the $CH_4$ emissions are multiplied by a global warming potential of 28. The resulting $CO_2e$ from $CH_4$ is added to $CO_2$ emissions to calculate the total $CO_2e$.

The total $CO_2e$ estimated to be released by a typical mine is shown in **Table 3.7-51**. $CH_4$ emissions would be less than 0.01 percent of the total GHG emissions. Nearly all of the $CO_2e$ emissions (more than 97 percent) would be attributed to mobile sources. The mobile sources would include, but would not limited to, backhoes, dozers, loaders, tractors, continuous miners, cranes, off highway trucks, scrapers, and graders.

**Table 3.7-51 Estimated Total Annual Emissions for a Typical Mine**

| Source Type | ROG | CO | $NO_X$ | $SO_X$ | $PM_{10}$ | $PM_{2.5}$ | $CO_2e$ (metric tpy)[1] |
|---|---|---|---|---|---|---|---|
| | (typ) | | | | | | |
| **Mobile Sources** | | | | | | | |
| Excavators/Backhoe/Continuous Miners | 12 | 38 | 128 | 0.13 | 4.0 | 4.0 | 11,305 |
| Crane | 0 | 0 | 1 | 0.00 | 0.0 | 0.0 | 55 |
| Tractors/Loaders/Utility Backhoes | 10 | 35 | 102 | 0.12 | 3.8 | 3.8 | 10,638 |
| Off-highway Trucks | 131 | 408 | 1371 | 1.40 | 44.3 | 44.3 | 127,452 |
| Scrapers | 1 | 6 | 13 | 0.01 | 0.5 | 0.5 | 1,161 |
| Graders | 3 | 10 | 28 | 0.03 | 1.0 | 1.0 | 2,920 |
| Crawler Tractors/Dozers | 41 | 160 | 379 | 0.38 | 15.0 | 15.0 | 34,185 |
| Hydromulcher | 0 | 1 | 1 | 0.00 | 0.1 | 0.1 | 87 |
| **Total Mobile Sources** | 198 | 658 | 2,022 | 2.00 | 69 | 69 | 187,803 |
| **Stationary Sources** | | | | | | | |
| Pumps | 7 | 30 | 57 | 0.06 | 2.9 | 2.9 | 5,331 |
| Poly Pipe Fusion | 0 | 0 | 0 | 0.00 | 0.0 | 0.0 | 0 |
| Welder/Generator | 0 | 1 | 2 | 0.00 | 0.1 | 0.1 | 177 |
| **Total Stationary Sources** | 7 | 31 | 59 | 0.07 | 3.0 | 3.0 | 5,331 |
| Wind Blown Dust[2] | -- | -- | -- | -- | 3.3 | 0.3 | -- |
| Fugitive Dust[2] | -- | -- | -- | -- | 9.8 | 1.0 | -- |
| **Total Emissions (All Sources)** | 205 | 689 | 2,081 | 2.10 | 84.7 | 73.0 | 193,134 |

[1] Assumes the global warming potential of $CH_4$ emissions is 25 (USEPA 2015a).

[2] Assumes a control factor of 50 percent.

The Mandatory Reporting of Greenhouse Gases Rule (GHG Reporting Rule) (as of June 15, 2010) requires certain suppliers of fossil fuels or industrial GHGs, manufacturers of vehicles and engines, and stationary sources that emit 25,000 metric tons or more per year of GHG emissions (as $CO_2e$) to submit annual reports to the USEPA. It is not expected that a typical surface coal or lignite mine expansion area or satellite mine would meet the definition of a supplier in 40 CFR 98.2(a)(4) that is subject to the GHG Reporting Rule. A typical mine is anticipated to emit greater than 25,000 metric tpy of $CO_2e$ emissions, the majority of these emissions would be due to mobile sources (as opposed to stationary sources). The estimated annual emission from stationary sources would be less than 9,000 metric tpy of $CO_2e$. The stationary sources would include pumps, welders, generators, and poly pipe fusion. Therefore, future surface coal or lignite mine expansion areas or satellite mines would comply with the GHG Reporting Rule.

The GHG Tailoring Rule requires review and permitting of new major stationary sources (greater than 100,000 tpy of $CO_2e$) and major modifications (greater than 75,000 tpy increase of $CO_2e$) of stationary sources under the PSD permitting program. If required, future mine expansion areas and satellite mines would comply with the GHG Tailoring Rule.

As a point of reference, the average GHG emissions per person in the U.S. is 20,750 pounds per year (USEPA 2015a); the emissions from a typical mine would be equivalent to the GHG emissions of approximately 35,000 individuals. The total global $CO_2e$ emissions is approximately 30,000 million metric tons per year. Over the period of 1 year, $CO_2e$ is essentially evenly distributed throughout the atmosphere around the earth. Since the projected total emissions of $CO_2e$ for a typical mine as shown in **Table 3.7-51** would be a tiny fraction of total global $CO_2e$ annual emissions, the potential contribution to anthropogenic global climate effects would be small.

#### 3.7.2.2 No Action Alternative

Under the No Action Alternative, the associated effects to air quality in all study areas would be similar to those described for the Proposed Action.

### 3.7.3 Cumulative Impacts

The cumulative air quality effects discussed below would apply to either the Proposed Action or the No Action Alternative. Past and present actions and RFFAs are discussed in Section 2.4.

The CESAs for air quality include the area encompassed by outer boundary of study areas plus a 5-km buffer from the boundaries (see **Appendix A**, **Figure A-9**). The CESAs also include designated 8-hour ozone non-attainment areas in the vicinity of the study areas.

Cumulative impacts to air quality would include impacts from typical mine emission sources, such as gaseous and particulate matter, and fugitive dust combined with impacts from nearby past and present mines, reservoirs, landfills, oil and gas development, urban areas, as well as impacts from background emission sources (e.g., windblown dust, public traffic on roads in the region, seasonal wildfires, and biogenic sources).

Due to the rural nature of the region in the study areas and the low density of emissions sources (e.g., vehicles and other fuel-fired equipment), levels of gaseous and particulate matter associated with potential future mines, past and present actions, and other RFFAs are anticipated to remain well below the NAAQS (levels determined to be protective of public health and welfare). Areas currently designated as moderate nonattainment for ozone in proximity to Dallas in CESA 3 are not anticipated to be impacted by future mine expansion areas and satellite mines.

### 3.7.4 Monitoring and Mitigation Measure

No additional mitigation measures are being considered for air quality.

### 3.7.5 Residual Adverse Effects

Some air quality impacts would be unavoidable due to the nature of a typical surface coal or lignite mine. As described in Section 3.7.2, the primary impacts would be from fugitive dust emissions, which would cease once mine operations end and disturbed areas are reclaimed. As vegetation becomes established, particulate levels would return to levels typical of undisturbed lands in the region. Once the disturbance ceases and wind erodible surfaces are reclaimed, there would be no residual adverse impacts as air resources would return to the pre-mining condition.

# 3.8 Land Use and Recreation

## 3.8.1 Affected Environment

### 3.8.1.1 Regional Overview

Study Areas 1 through 6 overlap partially or entirely with the rural and unpopulated portions of 32 counties, and their associated CESAs overlap with an additional 13 counties (see **Table 3.8-1**).

**Table 3.8-1 Counties that Overlap with the Study Areas and CESAs**

| Analysis Areas | Counties that Overlap with the Study Area | Additional Counties that Overlap with the CESA |
|---|---|---|
| Analysis Area 1 | Camp<br>Franklin<br>Hopkins<br>Rains<br>Titus<br>Wood | Morris<br>Smith<br>Upshur |
| Analysis Area 2 | Cherokee<br>Gregg<br>Harrison<br>Panola<br>Rusk<br>Shelby<br>Smith | Caddo (Louisiana)<br>De Soto (Louisiana)<br>Nacogdoches<br>San Augustine |
| Analysis Area 3 | Anderson<br>Falls<br>Freestone<br>Henderson<br>Leon<br>Limestone<br>Robertson<br>Van Zandt | Navarro |
| Analysis Area 4 | Bastrop<br>Burleson<br>Lee<br>Milam<br>Williamson | Robertson<br>Travis |
| Analysis Area 5 | Atascosa<br>McMullen | Live Oak |
| Analysis Area 6 | Dimmit<br>Kinney<br>Maverick<br>Zavala | -- |

The rural and unincorporated areas in these counties are not subject to county-wide land use plans. The majority of these areas contain privately owned lands and do not fall under the jurisdiction of any planning or zoning departments. However, in accord with Federal Regulations 64 *Federal Register* 70832 the following areas are not available for mining:

- National forest lands
- National park systems
- National recreation areas
- National trail systems
- National wilderness preservation systems
- Areas within 100 feet of the edge of any public road ROW (until the road has been relocated or closed by the appropriate regulatory authority [§761.14])
- Wild and scenic river systems
- Areas within 300 feet of an occupied dwelling (waivers can grant exceptions)
- Areas within 300 feet of any public/community building, school, church, or public park
- Areas within 100 feet of a cemetery (unless the cemetery is relocated under all applicable laws)

Some of the most prevalent recreation activities in the analysis areas include hunting, fishing, boating, hiking, bicycling, and wildlife viewing.

### 3.8.1.2 Study Areas

Study Area 1

Study Area 1 is located in northeastern Texas and encompasses approximately 1,426 square miles that overlap with rural and unpopulated portions of 6 counties. The portion of each county encompassed by the study area is summarized in **Table 3.8-2**.

**Table 3.8-2 Portion of Each County Encompassed by Study Area 1**

| County | County Area (square miles) | Study Area Overlap with County (square miles) | Percent of County within Study Area |
|---|---|---|---|
| Camp | 203 | 181 | 89 |
| Franklin | 284 | 157 | 55 |
| Hopkins | 789 | 278 | 35 |
| Rains | 259 | 17 | 7 |
| Titus | 412 | 273 | 66 |
| Wood | 689 | 520 | 75 |

*Land Use*

Approximately 65 percent of the lands in the counties associated with Study Area 1 are used for agricultural purposes (farming, ranching, and timber-based commodities). Agricultural land use by county is summarized in **Table 3.8-3**. Approximately 30 to 40 percent of the land in Camp County and 20 to 30 percent in Morris County are considered prime farmland (TSHA 2014b). (See Section 3.3, Soils and

Reclamation, for additional discussion on prime farmland.) Timber production also is a common land use in Camp, Franklin, and Wood counties.

**Table 3.8-3 Agricultural Land Use by County – Study Area 1**

| County | County Area (square miles) | Farmland within County (square miles) | Percent of County occupied by Farmland | Number of Farms in County | Average Farm Size (acres) |
|---|---|---|---|---|---|
| Camp | 203 | 122 | 60 | 487 | 161 |
| Franklin | 284 | 177 | 62 | 520 | 217 |
| Hopkins | 789 | 660 | 84 | 2,113 | 200 |
| Rains | 259 | 183 | 71 | 682 | 171 |
| Titus | 412 | 229 | 56 | 801 | 183 |
| Wood | 689 | 355 | 52 | 1,465 | 155 |

Source: USDA 2012.

Oil and gas development is another common use of rural and unpopulated land within Study Area 1. As of February 2014, a total of 2,322 wells (producing, shut-in, and injection) were recorded by the RCT in the 6 counties associate with the study area (see **Table 3.8-4**).

**Table 3.8-4 Number of Oil and Gas Wells per County – Study Area 1**

| County | Number of Wells in County[1] | | | Total |
|---|---|---|---|---|
| | Producing Wells | Shut-in Wells | Injection Wells | |
| Camp | 105 | 46 | 26 | 177 |
| Franklin | 107 | 168 | 18 | 293 |
| Hopkins | 65 | 57 | 18 | 140 |
| Rains | 0 | 0 | 0 | 0 |
| Titus | 217 | 219 | 27 | 463 |
| Wood | 672 | 478 | 99 | 1,249 |

[1] Well numbers as of February 2014.

Source: RCT 2014a.

Other land uses within Study Area 1 include transportation and utility corridors and incorporated communities. Major roadway corridors and rail lines in the study area are discussed in Section 3.10, Transportation. Utility corridors include transmission lines and pipelines. Surface lignite mining also occurs on rural lands within the study area.

*Recreation*

Dispersed recreation (e.g., hunting, fishing) is available on private lands within Study Area 1. Public recreation opportunities are available at Lake Bob Sandlin, Lake Cypress Springs, Lake Fork Reservoir, Lake Monticello, Lake Quitman, Tankersley Lake, Wisenbaker Lake, and Welsh Reservoir. Some of the activities available in these locations include fishing, boating, swimming, camping (primitive and developed sites), picnicking, waterfowl hunting, and wildlife viewing. Sport fish species include largemouth and spotted bass, catfish, and various sunfish (TPWD 2014k). Some of these reservoirs offer marinas with bait and gear shops, cabins and motels, and waterfront golf courses. Many of the larger lakes and reservoirs also support lake front residential communities and private boathouse ownership. Within Study Area 1 this includes the waterfront communities at Lake Bob Sandlin, Lake Cypress Springs, Lake Fork Reservoir, and Lake Quitman.

The Texas Forest Trail passes through the center of the study area from east to west. This trail system was adopted by the THC in the 1990s and is a part of their Heritage Trail Program.

No designated national recreation areas, national parks, wilderness area, wildlife refuges, forests, or segments of wild and scenic rivers occur within Study Area 1.

Study Area 2

Study Area 2 is located in northeastern Texas to the south of Study Area 1 and encompasses approximately 2,265 square miles that overlap with rural and unpopulated portions of 7 counties. The portion of each county encompassed by the study area is summarized in **Table 3.8-5.**

**Table 3.8-5 Portion of Each County Encompassed by Study Area 2**

| County | County Area (square miles) | Study Area Overlap with County (square miles) | Percent of County within Study Area |
|---|---|---|---|
| Cherokee | 1,049 | 141 | 13 |
| Gregg | 273 | 48 | 18 |
| Harrison | 894 | 213 | 24 |
| Panola | 842 | 738 | 88 |
| Rusk | 1,049 | 813 | 78 |
| Shelby | 791 | 271 | 34 |
| Smith | 932 | 41 | 4 |

*Land Use*

Approximately 40 percent of the lands in the counties associated with Study Area 2 are used for agricultural purposes (farming, ranching, and timber-based commodities). Agricultural land use by county is summarized in **Table 3.8-6.** Approximately 10 to 20 percent of the land in Rusk County, 20 to 30 percent in Shelby County, and 10 percent in Smith County are considered prime farmland (TSHA 2014b). (See Section 3.3, Soils and Reclamation, for additional discussion on prime farmland.)

Oil and gas development is another common use of rural and unpopulated land within Study Area 2. A portion of Harrison, Panola, and Shelby counties are located above the Haynesville Shale which is estimated to contain 10.4 percent of all oil and gas operations in the U.S. (Jones 2014). As of February 2014, a total of 8,727 wells (producing, shut-in, and injection) were recorded by the RCT in the seven counties associated with Study Area 2 (see **Table 3.8-7**).

**Table 3.8-6 Agricultural Land Use by County – Study Area 2**

| County | County Area (square miles) | Farmland within County (square miles) | Percent of County Occupied by Farmland | Number of Farms in County | Average Farm Size (acres) |
|---|---|---|---|---|---|
| Cherokee | 1,049 | 471 | 45 | 1,574 | 191 |
| Gregg | 273 | 75 | 27 | 527 | 91 |
| Harrison | 894 | 312 | 35 | 1,298 | 154 |
| Panola | 842 | 355 | 42 | 1,079 | 211 |
| Rusk | 1,049 | 429 | 41 | 1,390 | 197 |
| Shelby | 791 | 308 | 39 | 1,048 | 188 |
| Smith | 932 | 472 | 51 | 2,961 | 102 |

Source: USDA 2012.

**Table 3.8-7 Number of Oil and Gas Wells per County – Study Area 2**

| County | Number of Wells in County[1] | | | Total |
|---|---|---|---|---|
| | Producing Wells | Shut-in Wells | Injection Wells | |
| Cherokee | 91 | 25 | 14 | 130 |
| Gregg | 3,321 | 592 | 51 | 3,964 |
| Harrison | 296 | 367 | 33 | 696 |
| Panola | 236 | 200 | 16 | 452 |
| Rusk | 1,936 | 818 | 94 | 2,848 |
| Shelby | 42 | 24 | 8 | 74 |
| Smith | 347 | 158 | 58 | 563 |

[1] Well numbers as of February 2014.

Source: RCT 2014a.

Other land uses within Study Area 2 include transportation and utility corridors and incorporated communities. Major roadway corridors and rail lines in the study area are discussed in Section 3.10, Transportation. Utility corridors include transmission lines and pipelines. Surface lignite mining also occurs on rural lands within the study area.

*Recreation*

Dispersed recreation (e.g., hunting, fishing) is available on private lands within Study Area 2. Public recreation opportunities are available at Lake Cherokee, Lake Murvaul, Lake Striker, Martin Lake, and Martin Creek State Park. The recreational opportunities offered at these locations are similar to those available at the lakes and reservoirs in Study Area 1 as described above. In addition, the Sabine River is a popular destination for boaters, canoers, rafters, and anglers.

Within Study Area 2, lakefront communities have been developed at Lake Cherokee, Lake Murvaul, and Lake Striker.

The Texas Forest Trail passes through the western portion of the study area from north to south. This trail system was adopted by the THC in the 1990s and is a part of their Heritage Trail Program.

No designated national recreation areas, national parks, wilderness areas, wildlife refuges, forests, or segments of wild and scenic rivers occur within Study Area 2.

Study Area 3

Study Area 3 is located in eastern Texas to the southwest of Study Areas 1 and 2 and contains approximately 1,905 square miles that overlap with rural and unpopulated portions of 8 counties. The portion of each county encompassed by the study area is summarized in **Table 3.8-8**.

**Table 3.8-8 Portion of Each County Encompassed by Study Area 3**

| County | County Area (square miles) | Study Area Overlap with County (square miles) | Percent of County within Study Area |
|---|---|---|---|
| Anderson | 1,077 | 32 | 3 |
| Falls | 765 | 44 | 6 |
| Freestone | 888 | 650 | 73 |
| Henderson | 950 | 315 | 33 |
| Leon | 1,078 | 81 | 8 |
| Limestone | 931 | 318 | 34 |
| Robertson | 855 | 387 | 45 |
| Van Zandt | 1,077 | 78 | 7 |

*Land Use*

Approximately 69 percent of the lands in the counties associated with Study Area 3 are used for agricultural purposes (farming, ranching, and to a lesser extent, timber-based commodities). **Table 3.8-9** presents a summary of agricultural land use by county.

**Table 3.8-9 Agricultural Land Use by County – Study Area 3**

| County | County Area (square miles) | Farmland within County (square miles) | Percent of County Occupied by Farmland | Number of Farms in County | Average Farm Size (acres) |
|---|---|---|---|---|---|
| Anderson | 1,077 | 586 | 54 | 2,001 | 187 |
| Falls | 765 | 598 | 78 | 1,263 | 303 |
| Freestone | 888 | 658 | 74 | 1,517 | 278 |
| Henderson | 950 | 540 | 57 | 1,961 | 176 |
| Leon | 1,078 | 929 | 86 | 1,962 | 303 |
| Limestone | 931 | 761 | 82 | 1,526 | 319 |
| Robertson | 855 | 579 | 68 | 2,915 | 127 |
| Van Zandt | 1,077 | 586 | 54 | 2,001 | 187 |

Source: USDA 2012.

Oil and gas development is another common use of rural and unpopulated land within Study Area 3. As of February 2014, a total of 2,506 wells (producing, shut-in, and injection) were recorded by the RCT in the eight counties associated with the study area (see **Table 3.8-10**).

**Table 3.8-10 Numbers of Oil and Gas Wells by County – Study Area 3**

| County | Number of Wells in County[1] | | | Total |
|---|---|---|---|---|
| | Producing Wells | Shut-in Wells | Injection Wells | |
| Anderson | 533 | 378 | 91 | 1,002 |
| Falls | 19 | 26 | 0 | 45 |
| Freestone | 57 | 48 | 10 | 115 |
| Henderson | 146 | 45 | 16 | 207 |
| Leon | 226 | 115 | 23 | 364 |
| Limestone | 75 | 23 | 18 | 116 |
| Robertson | 218 | 15 | 2 | 235 |
| Van Zandt | 331 | 301 | 25 | 657 |

[1] Well numbers as of February 2014.

Source: RCT 2014a.

Other land uses within the study area include transportation and utility corridors and incorporated communities. Major roadway corridors and rail lines in the study area are discussed in Section 3.10, Transportation. Utility corridors include transmission lines and pipelines. Surface lignite mining also occurs on rural lands within the study area.

*Recreation*

Dispersed recreation (e.g., hunting, fishing) is available on private lands within Study Area 3. Public recreation opportunities are available at Cedar Creek Reservoir, Fairfield Lake (and State Park), Forest Grove Reservoir, Lake Limestone, and Twin Oaks Reservoir. The recreational opportunities offered at these locations are similar to those available at the lakes and reservoirs in Study Area 1 as described above. In addition, the Brazos, Navasota, and Trinity rivers are popular destinations for boaters, canoers, rafters, and anglers.

Within Study Area 3, lakefront communities have been developed at Cedar Creek Reservoir and Lake Limestone.

The Texas Brazos Trail passes through the southern portion of the study area where it is co-located with roads and state routes. This trail system was adopted by the THC in the 1990s and is a part of their Heritage Trail Program.

No designated national recreation areas, national parks, wilderness areas, wildlife refuges, forests, or segments of wild and scenic rivers occur within Study Area 3.

<u>Study Area 4</u>

Study Area 4 is located in eastern Texas to the southwest of Study Area 3 and contains approximately 571 square miles that overlaps with rural and unpopulated portions of 5 counties. The portion of each county encompassed by the study area is summarized in **Table 3.8-11**.

**Table 3.8-11 Portion of Each County Encompassed by Study Area 4**

| County | County Area (square miles) | Study Area Overlap with County (square miles) | Percent of County within Study Area |
|---|---|---|---|
| Bastrop | 895 | 42 | 5 |
| Burleson | 688 | <1 | <1 |
| Lee | 631 | 75 | 12 |
| Milam | 1,019 | 413 | 41 |
| Williamson | 1,137 | 40 | 4 |

*Land Use*

Approximately 76 percent of the lands in the counties associated with Study Area 4 are used for agricultural purposes (farming, ranching, and to a lesser extent, timber-based commodities). **Table 3.8-12** presents a summary of agricultural land use by county.

**Table 3.8-12 Agricultural Land Use by County – Study Area 4**

| County | County Area (square miles) | Farmland within County (square miles) | Percent of County Occupied by Farmland | Number of Farms in County | Average Farm Size (acres) |
|---|---|---|---|---|---|
| Bastrop | 895 | 606 | 68 | 2,083 | 186 |
| Burleson | 688 | 524 | 76 | 1,429 | 235 |
| Lee | 631 | 497 | 79 | 1,807 | 176 |
| Milam | 1,019 | 825 | 81 | 1,909 | 277 |
| Williamson | 1,137 | 873 | 77 | 2,542 | 220 |

Source: USDA 2012.

Oil and gas development is another common use of rural and unpopulated land within Study Area 4. As of February 2014, a total of 4,747 wells (producing, shut-in, and injection) were recorded by the RCT in the 5 counties associated within the study area (see **Table 3.8-13**).

**Table 3.8-13 Number of Oil and Gas Wells by County – Study Area 4**

| County | Number of Wells per County[1] | | | Total |
|---|---|---|---|---|
| | Producing Wells | Shut-in Wells | Injection Wells | |
| Bastrop | 224 | 137 | 6 | 367 |
| Burleson | 995 | 205 | 10 | 1,210 |
| Lee | 795 | 145 | 2 | 942 |
| Milam | 1,730 | 319 | 73 | 2,122 |
| Williamson | 70 | 36 | 0 | 106 |

[1] Well numbers as of February 2014.

Source: RCT 2014a.

Other land uses within the study area include transportation and utility corridors and incorporated communities. Major roadway corridors and rail lines in the study area are discussed in Section 3.10, Transportation. Utility corridors include transmission lines and pipelines. Surface lignite mining also occurs on rural lands within the study area.

*Recreation*

Dispersed recreation (e.g., hunting, fishing) is available on private lands within Study Area 4. Public recreation opportunities are available at the Brazos and Little rivers. They provide recreational opportunities for boaters, canoers, rafters, and anglers. Alcoa Lake is the only major waterbody within Study Area 4; however, it is privately owned by the Aluminum Company of America (TSHA 2014b) and not recognized by the TPWD (2014) as a public recreation area.

The Texas Brazos Trail is located along the southwestern border of the study area. This trail system was adopted by the THC in the 1990s and is a part of their Heritage Trail Program.

No designated national recreation areas, national or state parks, wilderness areas, wildlife refuges, forests, or segments of wild and scenic rivers occur within Study Area 4.

Study Area 5

Study Area 5 is located in southern Texas and contains approximately 283 square miles that overlaps with rural and unpopulated portions of 2 counties. The portion of each county encompassed by the study area is summarized in **Table 3.8-14**.

**Table 3.8-14 Portion of Each County Encompassed by Study Area 5**

| County | County Area (square miles) | Study Area Overlap with County (square miles) | Percent of County within Study Area |
|---|---|---|---|
| Atascosa | 1,218 | 137 | 11 |
| McMullen | 1,159 | 146 | 13 |

*Land Use*

Approximately 78 percent of the lands in the counties associated with Study Area 5 are used for agricultural purposes (farming, ranching, and to a lesser extent, timber-based commodities). **Table 3.8-15** presents a summary of agricultural land use by county. Approximately 40 to 50 percent of Atascosa County is considered prime farmland (TSHA 2014b). (See Section 3.3, Soils and Reclamation, for additional discussion on prime farmland.)

**Table 3.8-15 Agricultural Land Use by County – Study Area 5**

| County | County Area (square miles) | Farmland within County (square miles) | Percent of County Occupied by Farmland | Number of Farms in County | Average Farm Size (acres) |
|---|---|---|---|---|---|
| Atascosa | 1,218 | 1,040 | 85 | 1,987 | 335 |
| McMullen | 1,159 | 808 | 70 | 238 | 2,174 |

Source: USDA 2012.

Oil and gas development is another common use of rural and unpopulated land within Study Area 5. All of the study area is located above a portion of the Eagle Ford Shale Play that supports a substantial amount of oil and gas production. Between 2008 and August of 2014, 16,134 permits to drill were issued for the Eagle Ford Shale Play (RCT 2014e). As of February 2014, a total of 3,203 wells (producing, shut-in, and injection) were recorded by the RCT in the two counties associated with the study area (see **Table 3.8-16**).

Other land uses within the study area include transportation and utility corridors and incorporated communities. Major roadway corridors and rail lines in the study area are discussed in Section 3.10, Transportation. Utility corridors include transmission lines and pipelines. Surface lignite mining also occurs on rural lands within the study area.

**Table 3.8-16 Number of Oil and Gas Wells by County – Study Area 5**

| County | Number of Wells per County[1] | | | Total |
|---|---|---|---|---|
| | Producing Wells | Shut-in Wells | Injection Wells | |
| Atascosa | 1,423 | 277 | 54 | 1,754 |
| McMullen | 1,182 | 233 | 34 | 1,449 |

[1] Well numbers as of February 2014.

Source: RCT 2014a.

*Recreation*

Dispersed recreation (e.g., hunting, fishing) is available on private lands within Study Area 5. Public recreation opportunities are available at Choke Canyon Reservoir (west of road 99) and potentially the Atascosa River. The recreational opportunities at Choke Canyon Reservoir are similar to those described above for the lakes and reservoirs in Study Area 1. In addition, the reservoir contains alligator gar and provides anglers and bow fishers the opportunity to catch specimens in excess of 200 pounds (TPWD 2014k). The Atascosa River currently is being studied by the Nueces River Authority to evaluate concentrations of dissolved oxygen and bacteria. Low levels of dissolved oxygen can compromise aquatic life in the river, and high levels of bacteria could pose a health risk to people that engage in contact recreation with the water (TCEQ 2014c). As a result, it is hard to estimate if the Atascosa River is currently providing recreational opportunities.

No designated heritage trail segments, national recreation areas, national or state parks, wilderness, wildlife refuges, forests, or segments of wild and scenic rivers occur within Study Area 5.

Study Area 6

Study Area 6 is located in southern Texas, to the west of Study Area 5, and contains approximately 394 square miles that overlaps with rural and unpopulated portions of 4 counties. The portion of each county encompassed by the study area is summarized in **Table 3.8-17**.

**Table 3.8-17 Portion of Each County Encompassed by Study Area 6**

| County | County Area (square miles) | Study Area Overlap with County (square miles) | Percent of County within Study Area |
|---|---|---|---|
| Dimmit | 1,307 | 4 | <1 |
| Kinney | 1,139 | <1 | <1 |
| Maverick | 1,287 | 267 | 21 |
| Zavala | 1,298 | 123 | 9 |

*Land Use*

Approximately 77 percent of the lands in the counties associated with Study Area 6 are used for agricultural purposes (farming, ranching, and small amounts of timber-based commodities occurring in Dimmit and Zavala counties). **Table 3.8-18** presents a summary of agricultural land use by county. Dimmit and Zavala counties are within an area of Texas known as the Winter Garden Region. This irrigated area produces vegetables, melons, and pecans year-round.

**Table 3.8-18 Agricultural Land Use by County – Study Area 6**

| County | County Area (square miles) | Farmland within County (square miles) | Percent of County Occupied by Farmland | Number of Farms in County | Average Farm Size (acres) |
|---|---|---|---|---|---|
| Dimmit | 1,307 | 1,058 | 81 | 367 | 1,845 |
| Kinney | 1,139 | 901 | 79 | 196 | 2,943 |
| Maverick | 1,287 | 845 | 66 | 294 | 1,840 |
| Zavala | 1,298 | 1,083 | 83 | 287 | 2,414 |

Source: USDA 2012

Oil and gas development is another common use of rural and unpopulated land within Study Area 6. A large portion of the study area is located above a portion of the Eagle Ford Shale Play. Between 2008 and August of 2014, 16,134 permits to drill were issued for the Eagle Ford Shale Play (RCT 2014e). As of February 2014, a total of 3,236 wells (producing, shut-in, and injection) were recorded by the RCT in the counties associated with Study Area 6 (see **Table 3.8-19**).

**Table 3.8-19 Number of Oil and Gas Wells by County – Study Area 6**

| County | Number of Wells per County[1] | | | Total |
|---|---|---|---|---|
| | Producing Wells | Shut-in Wells | Injection Wells | |
| Dimmit | 1,073 | 299 | 133 | 1,505 |
| Kinney | 0 | 1 | 0 | 1 |
| Maverick | 688 | 231 | 355 | 1,274 |
| Zavala | 275 | 167 | 14 | 456 |

[1] Well numbers as of February 2014.

Source: RCT 2014a.

Other land uses within Study Area 6 include transportation and utility corridors and incorporated communities. Major roadway corridors in the study area are discussed in Section 3.10, Transportation, and identified in **Table 3.10-1**. Utility corridors include transmission lines and pipelines. Surface mining of bituminous coal also occurs on rural lands within the study area.

*Recreation*

Outdoor recreational opportunities within Study Area 6 are limited to dispersed recreation (e.g., fishing and hunting) on private lands.

No designated heritage trail segments, national recreation areas, national or state parks, wilderness areas, wildlife refuges, forests, or segments of wild and scenic rivers occur within Study Area 6.

## 3.8.2 Environmental Consequences

Development of potential future surface coal or lignite mine expansion areas or satellite mines could result in conflicts with existing or planned land uses in the analysis area, including farming and ranching operations, the development of other energy or utility projects, expansion of urban areas, visitor experience at existing recreational areas, and development of new recreational areas.

Locations within the six study areas that would be not be available for future mine expansion areas or satellite mines would include existing development areas (e.g., other mines, towns, highways, reservoirs, etc.) and state and local parks. The six study areas contain a maximum of 4,379,400 acres; it is estimated that the maximum disturbance for all six areas would be 158,600 acres or 3.6 percent.

### 3.8.2.1 Proposed Action

<u>Impacts Common to all Study Areas</u>

*Surface Disturbance*

Surface disturbance as a result of a typical mine would occur incrementally over the mine life. Construction activities in a given area would result in the greatest amount of disturbance during the first year. Mining at a future mine expansion area or satellite mine would last for 1 to 30 years and approximately 5 to 30 years at a future satellite mine, with up to 5 years required for closure and final reclamation.

*Urban Growth and Infrastructure*

It is conceivable that mine development could occur anywhere in the study areas that are not precluded from development. This could result in the following conflicts with other existing or planned land uses:

- Conflict with the overall direction that a town may be able to grow;
- Conflict with, or displacement of, existing of planned utility or transportation ROWs;
- Conflict with, or displacement of, existing agricultural land uses; and
- Conflict with existing or planned industrial development.

The development of a typical mine near an urban area could delay urban growth until areas are mined and successfully reclaimed. This would tend to be more likely where other types of development (e.g., oil and gas) are responsible for temporary or permanent localized population growth. Should there be structures located within future mine expansion or satellite mine areas, the mining company would work with the landowners through purchase or lease agreements to acquire the properties.

Mining operations typically move through large areas and relocate infrastructure such as roads, pipelines, and transmission lines, as necessary. Relocation of these facilities would be done in coordination with the companies. Temporary service interruptions may be experienced during brief periods of construction. See the Section 3.10, Transportation, for more information relative to effects to roadways.

*Agricultural Uses*

A considerable portion of the rural and unpopulated portion of the six study areas supports agricultural uses of the land, including produce farming and ranching. In areas where a typical mine would overlap with agricultural areas, there could be a number of direct and indirect impacts. Mine-related surface disturbance could affect the viability of cropland, rangeland, or pasture by altering the soils and vegetation. This impact would be minimized through the salvage and replacement of prime farmland soils and the salvage of suitable growth media for reclamation of the remainder of the disturbance area. Indirect effects could include fugitive dust emissions related to mine construction and operation that could affect the health and vigor of vegetation (crops as well as forage) where in proximity to a mine. Fugitive dust emissions (i.e., $PM_{10}$ and $PM_{2.5}$) from disturbance areas at a typical mine would be controlled by minimizing the acreage of coal or lignite mining disturbance at any given time; the application of water sprays, chemical dust suppressants, and routine maintenance and/or slow-curing liquid asphalt as allowed by TCEQ; prompt revegetation of regraded lands; and restricting fugitive dust causing activities during periods of air stagnation. Assuming successful implementation of these measures, it is anticipated that fugitive dust emissions from a typical mine would remain well below the NAAQS (levels determined to be protective of public health and welfare) as discussed in Section 3.7, Air Quality.

Industrial Uses

The majority of industrial uses of land in rural and relatively unpopulated portions of the six study areas involve oil and gas development. Access to new oil and gas resources would be restricted in future mine locations during active mining; access to these resources would be re-established following the completion of mining and reclamation. Gathering lines, access roads, and other facilities and associated infrastructure may need to be relocated to allow for mine operations, and would be conducted in coordination with the oil and gas operator.

*Recreational Uses*

There are no federal lands within any of the study areas; however, there are some local parks near urban centers and dispersed recreation occurs in the rural and unpopulated areas on private lands. Dispersed recreation in future mine areas temporarily would be inaccessible while mine operations and reclamation progress through an area.

Mine construction and operation could disturb recreationists in a numbers of ways, potentially including mine-related noise, fugitive dust emissions, increased human presence, sedimentation in streams, and the visual intrusion of mine equipment and components where solitude and remote experiences are desired. Where in proximity to a mine, the recreational experiences from bicycle riding, boating, fishing, hiking, horseback riding, hunting, and wildlife viewing could be affected if the presence of mine-related activities were noticeable while recreationists are engaging in these activities. BMPs would be implemented by a typical mine to minimize fugitive dust emissions and to minimize erosion and subsequent sedimentation effects during mining, with the remainder of the potential effects to the recreational experience ceasing in a given area following the completion of mining and reclamation. As discussed in Section 3.7, Air Quality, it is anticipated that fugitive dust emissions from a typical mine would remain well below the NAAQS (levels determined to be protective of public health and welfare).

Potential future mine-related impacts that can be quantified or would vary from the impacts common to all study areas are described below for each study area.

Study Area 1

It is estimated that future mine-related surface disturbance would affect up to13,500 acres (1.5 percent) of the 912,500 acres in Study Area 1.

The counties in Study Area 1 range from 56 to 84 percent agricultural land (USDA 2012); both Camp and Morris counties contain a substantial amount of prime farmland. It is reasonable to expect that mine expansion areas or satellite mines temporarily would displace some portion of this land use until reclamation has been completed.

Lands managed for timber-based commodities and harvesting are common in Study Area 1 and could be impacted by future mine expansion areas or satellite mines where merchantable timber and associated commodities would be removed in advance of mine development. During reclamation, trees would be replanted in disturbance areas in accordance with the designated post-mining land use; however, commercial value would not be realized for a number of years.

Industrial land uses in the rural and unpopulated portions of Study Area 1 consist primarily of oil and gas development, with the exception of Rains County. Potential impacts to these resources would be as described in Section 3.8.2.1.

The White Oak Creek Wildlife Management Area (WMA) has been known to hold night-time events, such as stargazing. If mining operations were to be located near the WMA, it is possible that lighting for the mine would compromise this recreational experience or eliminate the practicality of such an event altogether until mining has been completed.

Study Area 2

It is estimated that future mine-related surface disturbance would affect up to 50,200 acres (3.5 percent) of the 1,449,300 acres in Study Area 2.

The counties in Study Area 2 range from 27 to 51 percent agricultural land (USDA 2012), including Rusk, Shelby, and Smith counties. It is reasonable to expect that mine expansion areas or satellite mines temporarily would displace some portion of this land use until reclamation has been completed. Potential impacts to lands managed for timber-based commodities and harvesting would be the same as described for Study Area 1.

Portions of Harrison, Panola, and Shelby counties and Caddo and De Soto parishes are located above the Haynesville Shale Play. As a result, oil and gas development is prevalent throughout the study area, thereby increasing the potential for the associated impacts as discussed in Section 3.8.2.1 in the eastern portion of Study Area 2.

Study Area 3

It is estimated that future mine-related surface disturbance would affect 50,600 acres (4.2 percent) of the 1,219,200 acres in Study Area 3.

The counties in Study Area 3 range from 54 to 86 percent agricultural land (USDA 2012), including approximately 30 to 40 percent of the land in Navarro County. It is reasonable to expect that mine expansion areas or satellite mines temporarily would displace some portion of this land use until reclamation has been completed. Potential impacts to lands managed for timber-based commodities and harvesting would be the same as described for Study Area 1.

Industrial land uses in the rural and unpopulated portions of Study Area 3 consist primarily of oil and gas development. Impacts to oil and gas development resulting from mining operations would be the same as discussed in Section 3.8.2.1.

Study Area 4

It is estimated that future mine-related surface disturbance would affect 9,800 acres (2.7 percent) of the 365,300 acres in Study Area 4.

The counties in Study Area 4 range from 40 to 81 percent agricultural land (USDA 2012), including approximately 30 percent of Robertson and 10 percent of Travis counties. It is reasonable to expect that mine expansion areas or satellite mines temporarily would displace some portion of this land use until reclamation has been completed. Potential impacts to lands managed for timber-based commodities and harvesting would be the same as described for Study Area 1.

Industrial land uses in the rural and unpopulated portions of Study Area 4 consist primarily of oil and gas development. Impacts to oil and gas development resulting from mining operations would be the same as discussed in Section 3.8.2.1.

Study Area 5

It is estimated that future mine-related surface disturbance would affect 9,500 acres (5.3 percent) of the 180,800 acres in Study Area 5.

The counties in Study Area 5 range from 70 to 85 percent agricultural land (USDA 2012), including approximately 40 to 50 percent of both Atascosa and Live Oak counties. It is reasonable to expect that mine expansion areas or satellite mines temporarily would displace some portion of this land use until reclamation has been completed. Potential impacts to lands managed for timber-based commodities and harvesting would be the same as described for Study Area 1.

Industrial land uses in the rural and unpopulated portions of Study Area 5 consist primarily of oil and gas development. All of Study Area 5 is located above the Eagle Ford Shale Play, which has been experiencing a dramatic increase in oil and gas development over the last 5 years. It is assumed that the rural and unpopulated areas of Atascosa and McMullen counties within Study Area 5 would experience increased oil and gas development. Future mine expansion areas and satellite mines could compete with oil and gas development for land in this study area, resulting in land use conflicts.

Study Area 6

It is estimated that future mine-related surface disturbance would affect 25,000 acres (9.9 percent) of the 252,300 acres in Study Area 6.

While urban growth for any of the cities and towns within Study Area 6 could be affected by the location a future mine expansion area or satellite mine for a period of up to 30 years, depending on proximity, this could be problematic for urban areas that are experiencing substantial growth and have boundary issues, such as the town of Eagle Pass. Eagle Pass, which is on the western edge of Study Are 6 and overlapped by the CESA, is bounded on the west by the Rio Grande River and U.S./Mexico border. Largely due to increasing development in the Eagle Ford Shale Play, the population of Eagle Pass has increased by almost 22 percent since the 2000 (City-Data.com 2014). Provided that oil and gas production continues in this play, Eagle Pass would likely experience continued growth, and a future mining could constrain urban growth, depending on the proximity of a future mine to the town.

The counties in Study Area 6 range from 66 to 83 percent agricultural land (USDA 2012). Agricultural operations in the Winter Garden Region in Dimmit, Maverick, and Zavala counties could experience conflicts with future mining operations, resulting in reductions to cropland and possible alterations to irrigation systems until mine reclamation has been completed.

Industrial land uses in the rural and unpopulated portions of Study Area 6 are similar to Study Area 5, with most of the area being located above the Eagle Ford Shale Play. Impacts to oil and gas development resulting from future mine operations would be the same as discussed in Sections 3.8.2.1 and 3.8.2.6, with the exception of Kinney County which has limited production.

### 3.8.2.2 No Action

Under the No Action Alternative, development of a future surface coal or lignite mine expansion area or satellite mine would be the same as described for the Proposed Action alternative. Therefore, the general impacts to land use and recreation would be the same, but may be spread over a longer period of time due to the possibly lengthier permitting process.

### 3.8.3 Cumulative Impacts

The CESAs for land use and recreation include the study area boundaries plus a 5-mile buffer, with the exception of Study Area 6 where the boundary ends at the border with Mexico (see **Appendix A**, **Figures A-10** through **A-15**). Cumulative impacts to land use and recreation would result from the combination of the effects of surface disturbance and changes to land uses caused by actions such as mining, infrastructure development, agricultural use, and oil and gas production.

Past and present projects include reservoirs, mines, landfills, state and federal road ROWs, and urban areas. RFFAs that would affect land use and recreation include relatively small areas of planned future highway work, new water supply developments, and most likely urban expansion in some areas. Development of future surface coal or lignite mine expansion areas or satellite mines under either the Proposed Action or the No Action alternatives would incrementally increase impacts to land uses and recreational resources. The impacts would be temporary and would cease following the completion of mining and successful reclamation. A summary of the past and present surface disturbance acreage by study area and CESA is presented in **Table 3.8-20**. RFFAs are discussed in Section 2.4.2.

**Table 3.8-20 Past and Present Surface Disturbance in Land Use and Recreation CESAs**

| CESA | Disturbed Inside Study Area (acres) | Disturbed Outside Study Area/Inside CESA (acres) | Total CESA Disturbed (acres) |
|---|---|---|---|
| 1 | 52,238 | 66,008 | 118,246 |
| 2 | 40,132 | 162,030 | 202,163 |
| 3 | 38,569 | 114,346 | 152,915 |
| 4 | 5,846 | 33,954 | 39,801 |
| 5 | 3,603 | 28,556 | 32,159 |
| 6 | 2,363 | 10,584 | 12,948 |

<u>Study Area 1 CESA</u>

The CESA for Study Area 1 includes four additional counties listed in **Table 3.8-1**. Past and present surface disturbance within Study Area 1 and the CESA are shown in **Table 3.8-20**. When combined with the projected 13,500 acres for potential future surface coal or lignite mine expansion or satellite mine disturbance, the cumulative surface disturbance would represent approximately 10 percent of the CESA for Study Area 1. This acreage of surface disturbance would increase in the future when reasonably foreseeable road improvements, water supply developments, and other surface-disturbing activities are constructed.

Agricultural land uses in the CESA outside the study area are similar to that described for Study Area 1. Oil and gas development varies in the CESA just as it does in the study area, with Morris County containing one well and Smith and Upshur counties contain 563 and 177 wells, respectively.

The CESA boundary within Morrison and Upshur counties overlaps with Ellison Creek Reservoir (also known as Lake Lone Star), Lake Sulphur Springs, and the northern-most portion of Lake O' the Pines. These waterbodies offer recreational opportunities and lake front communities. Within Morrison County, the CESA overlaps with the White Oak Creek WMA that is managed under a license agreement with the USACE and provides recreational opportunities for fishing, hiking, horseback riding, hunting, and wildlife viewing. While these recreation areas would not be directly affected by mining operations, there may be a contribution to cumulative effects such as noise and traffic if future mine expansion areas or satellite mines are close enough to be visible or accessed by the same roads.

Study Area 2 CESA

The CESA for Study Area 2 includes four additional counties as listed in **Table 3.8-1**, plus Caddo and De Soto parishes, located in the State of Louisiana. Past and present surface disturbance within Study Area 2 totals 40,132 acres. Surface disturbance outside Study Area 2 but within the CESA totals 162,030 acres for a combined total of 202,162 acres (see **Table 3.8-20**). When combined with the projected 50,200 acres for potential future surface coal or lignite mine expansion or satellite mine disturbance, the cumulative disturbance would represent approximately 12 percent of the Study Area 2 CESA. This acreage of surface disturbance would increase in the future when reasonably foreseeable road improvements, water supply developments, and other surface-disturbing activities are constructed.

Agricultural land uses in Nacogdoches and San Augustine are comparable to those within Study Area 2. Both Nacogodoches and San Augustine counties contain 20 to 30 percent prime farmland (TSHA 2014b). Oil and gas production varies throughout Study Area 2 with San Augustine having the lowest total number of wells at 23 and Nacogdoches at 187. Caddo and DeSoto Parishes are located above the Haynesville Shale Play and report 28,263 and 8,070 wells on file, respectively (Drilling Edge 2014).

The Study Area 2 CESA includes Lake Tyler East, which offers recreational opportunities and supports lakefront communities. While these recreation areas would not be directly affected by mining operations, there may be a contribution to cumulative effects such as noise and traffic if future mine expansion areas or satellite mines are close enough to be visible or accessed by the same roads.

Study Area 3 CESA

The CESA for Study Area 3 includes two additional counties as listed in **Table 3.8-1**. Past and present surface disturbance within Study Area 3 total 38,569 acres. Surface disturbance outside Study Area 3 but within the CESA total 114,346 acres for a combined total of 152,915 acres. When combined with the projected 50,600 acres for potential future surface coal or lignite mine expansion or satellite mine disturbance, the cumulative disturbance represents approximately 10 percent of the Study Area 3 CESA (see **Table 3.8-20**). This acreage of surface disturbance would increase in the future when reasonably foreseeable road improvements, water supply developments, and other surface-disturbing activities are constructed.

Agricultural land uses in both counties in the CESA are comparable to the counties overlapped by Study Area 3. Approximately 30 to 40 percent of the land in Navarro County is prime farmland (TSHA 2014b). Oil and gas production in Navarro County exceeds any of the counties within Study Area 3, with 1,515 wells. Kaufman County is similar to Falls County with 47 total wells.

The Study Area 3 CESA includes Richland Chambers Reservoir, which offers boating and quality fishing and supports lakefront property. While this recreation area would not be directly affected by mining operations, there may be a contribution to cumulative effects such as noise and traffic if future mine expansion areas or satellite mines are close enough to be visible or accessed by the same roads.

Study Area 4 CESA

The CESA for Study Area 4 includes two additional counties as listed in **Table 3.8-1**. Past and present surface disturbance within Study Area 4 totals 5,846 acres, and surface disturbance outside Study Area 4 but within the CESA total 33,954 acres, for a combined total of 39,800 acres (see **Table 3.8-20**). When combined with the projected 9,800 acres for potential future surface coal or lignite mine expansion or satellite mine disturbance, the cumulative disturbance represents approximately 7 percent of the Study Area 4 CESA. This acreage of surface disturbance would increase in the future when reasonably foreseeable road improvements, water supply developments, and other surface-disturbing activities are constructed.

Agricultural land uses in Robertson County are comparable to Milam County, with up to 30 percent of Robertson County designated as prime farmland (TSHA 2014b). Travis County consists of only 40 percent agricultural land use, less than any of the counties in Study Area 4, and approximately 10 percent is prime farmland (TSHA 2014b). Oil and gas production in Travis County is lower than any of the counties in the Study Area 4 at 31 wells. Robertson County is similar to Bastrop County with 235 wells. The portion of the CESA in Burleson County is located above the Eagle Ford Shale Play that produces oil (Eagle Ford Shale 2014) so may have a high potential for future development that cumulatively would affect land uses and recreation.

The Study Area 4 CESA includes Brushy Creek and the San Gabriel River. Except for during dry periods in the summer months, the San Gabriel River provides opportunities for boating and fishing.

Study Area 5 CESA

The CESA for Study Area 5 includes Live Oak County. Past and present surface disturbance within Study Area 5 totals 3,603 acres and surface disturbance outside Study Area 5 but within the CESA totals 28,556 acres for a combined total of 32,159 acres (see **Table 3.8-20**). When combined with the projected 9,500 acres for potential future surface coal or lignite mine expansion or satellite mine disturbance, the cumulative disturbance represents approximately 10 percent of the Study Area 5 CESA. This acreage of surface disturbance would increase in the future when reasonably foreseeable road improvements, water supply developments, and other surface-disturbing activities are constructed.

Agricultural land use in Live Oak County is most similar to Atascosa County with approximately 80 percent of the county used for agriculture and up to 50 percent designated as prime farmland. Oil and gas production in Live Oak County is approximately one-third of that in Atascosa or McMullen counties with 519 total wells.

Study Area 6 CESA

The Study Area 6 CESA does not overlap with any additional counties. Past and present surface disturbance within Study Area 6 totals 2,363 acres and surface disturbance outside Study Area 6 but within the CESA totals 10,584 acres, for a combined total of 12,948 acres (see **Table 3.8-20**). When combined with the projected 25,000 acres for potential future surface coal or lignite mine expansion or satellite mine disturbance, the cumulative disturbance represents approximately 8 percent of the Study Area 6 CESA. This acreage of surface disturbance would increase in the future when reasonably foreseeable road improvements, water supply developments, and other surface-disturbing activities are constructed.

The Study Area 6 CESA includes the Rio Grande, which offers opportunities for boating, fishing, hiking, and primitive camping. While the recreational uses along the Rio Grande would not be directly affected by mining operations, there may be a contribution to cumulative effects such as noise and traffic if future mine expansion areas or satellite mines are close enough to be visible or accessed by the same roads.

### 3.8.4 Monitoring and Mitigation Measures

No monitoring is being considered beyond the regulatory requirements for reclamation and post-mining land use.

The following mitigation may apply to manage impacts to land use, depending on the location of the mine:

- Accidental damage to property or infrastructure, as a result of mining activities, would be reported to landowners or the appropriate authorities immediately, and the mine operator would be responsible for repair or replacement.

### 3.8.5 Residual Adverse Impacts

Many of the effects to land uses and recreational experiences as a result of future mine expansion areas or satellite mines would cease once reclamation is completed. Effects to forest lands may continue for a period of years following closure and reclamation; however, such effects would diminish over time.

## 3.9 Social and Economic Values

### 3.9.1 Affected Environment

Social and economic data are reported on a county-wide basis, and some of the counties outside of but adjacent to the study areas may experience direct and/or indirect effects from future mine expansions or satellite mines (e.g., adjacent counties where mine workers may reside). As a result, the study areas and the cumulative effects study areas for social and economic values are the same and collectively are referred to here as analysis areas.

#### 3.9.1.1 Population

The estimated combined population of the 43 counties in the analysis area in 2010 was 3,370,529 a net increase of 20.3 percent from the 2000 Census (see **Table 3.9-1**). Analysis Area 4 experienced the highest net population growth from 2000 to 2010 (30.0 percent), primarily lead by growth in Williamson, Bastrop, Brazos, and Travis counties (see **Table 3.9-2**). The remaining analysis areas and all but six of the counties (Morris, San Augustine, Dimmit, Falls, Live Oak, and McMullen) had growth over this same time period. Texas statewide population grew from 20,851,820 in the 2000 Census to 25,145,561 in 2010, a 20.6 percent increase, while the Louisiana and U.S. population grew 1.4 and 9.7 percent, respectively.

**Table 3.9-1 Population and Population Change by Analysis Area**

| Location[1] | Population Levels | | | Population Change (percent) | |
|---|---|---|---|---|---|
| | 2000 | 2010 | 2020 (Projected) | 2000 to 2010 | 2010 to 2020 (Projected) |
| Analysis Area 1 | 350,021 | 405,336 | 467,936 | 15.8 | 15.4 |
| Analysis Area 2 | 836,010 | 870,500 | 906,197 | 4.1 | 4.1 |
| Analysis Area 3 | 463,894 | 526,644 | 607 ,252 | 13.5 | 15.3 |
| Analysis Area 4 | 1,344,760 | 1,748,087 | 2,249,673 | 30.0 | 28.7 |
| Analysis Area 5 | 51,788 | 57,149 | 68,672 | 10.4 | 20.2 |
| Analysis Area 6 | 98,450 | 105,934 | 118,962 | 7.6 | 12.3 |
| Total for Six Analysis Areas[2] | 2,801,802 | 3,370,529 | 4,075,571 | 20.3 | 20.9 |
| Texas | 20,851,820 | 25,145,561 | 30,622,577 | 20.6 | 21.8 |
| Louisiana | 4,468,976 | 4,533,372 | 4,758,690 | 1.4 | 5.0 |
| U.S. | 281,421,906 | 308,745,538 | 333,896,000 | 9.7 | 8.1 |

[1] Analysis area data apply to the study areas and CESAs.

[2] Smith County falls within Analysis Areas 1 and 2, and Robertson and Brazos counties fall within Analysis Areas 3 and 4. As a result, the sum total for the six analysis areas is greater than the actual total for the overall analysis area.

Source: City Data 2000a-c; Louisiana.gov 2014; Texas Department of State Health Services 2000, 2014; U.S. Census 2014, 2010a, 2000.

**Table 3.9-2 Population and Population Change by County**

| County[1] | Population Levels | | | Population Change (percent) | | Analysis Area |
|---|---|---|---|---|---|---|
| | 2000 | 2010 | 2020 (Projected) | 2000 to 2010 | 2010 to 2020 | |
| Camp County | 11,549 | 12,401 | 14,401 | 7.4 | 16.1 | 1 |
| Franklin County | 9,458 | 10,605 | 11,713 | 12.1 | 10.4 | 1 |
| Hopkins County | 31,960 | 35,161 | 39,048 | 10.0 | 11.1 | 1 |
| Morris County | 13,048 | 12,934 | 13,721 | -0.9 | 6.1 | 1 |
| Rains County | 9,139 | 10,914 | 13,129 | 19.4 | 20.3 | 1 |
| Titus County | 28,118 | 32,334 | 37,473 | 15.0 | 15.9 | 1 |
| Upshur County | 35,291 | 39,309 | 45,395 | 11.4 | 15.5 | 1 |
| Wood County | 36,752 | 41,964 | 48,775 | 14.2 | 16.2 | 1 |
| Smith County | 174,706 | 209,714 | 244,281 | 20.0 | 16.5 | 1 & 2 |
| Caddo Parish, Louisiana | 252,161 | 254,969 | 231,550 | 1.1 | -9.2 | 2 |
| DeSoto Parish, Louisiana | 25,494 | 26,656 | 32,170 | 4.6 | 20.7 | 2 |
| Cherokee County | 46,659 | 50,845 | 57,725 | 9.0 | 13.5 | 2 |
| Gregg County | 111,379 | 121,730 | 137,122 | 9.3 | 12.6 | 2 |
| Harrison County | 62,110 | 65,631 | 71,779 | 5.7 | 9.4 | 2 |
| Nacogdoches County | 59,203 | 64,524 | 74,321 | 9.0 | 15.2 | 2 |
| Panola County | 22,756 | 23,796 | 25,861 | 4.6 | 8.7 | 2 |
| Rusk County | 47,372 | 53,330 | 63,711 | 12.6 | 19.5 | 2 |
| San Augustine County | 8,946 | 8,865 | 9,230 | -0.9 | 4.1 | 2 |
| Shelby County | 25,224 | 25,448 | 28,022 | 0.9 | 10.1 | 2 |
| Anderson County | 55,109 | 58,458 | 61,877 | 6.1 | 5.8 | 3 |
| Falls County | 18,576 | 17,866 | 19,413 | -3.8 | 8.7 | 3 |
| Freestone County | 17,867 | 19,816 | 21,709 | 10.9 | 9.6 | 3 |
| Henderson County | 73,277 | 78,532 | 85,477 | 7.2 | 8.8 | 3 |
| Leon County | 15,335 | 16,801 | 19,404 | 9.6 | 15.5 | 3 |
| Limestone County | 22,051 | 23,384 | 25,930 | 6.0 | 10.9 | 3 |
| Navarro County | 45,124 | 47,735 | 54,997 | 5.8 | 15.2 | 3 |
| Van Zandt County | 48,140 | 52,579 | 58,455 | 9.2 | 11.2 | 3 |
| Robertson County | 16,000 | 16,622 | 19,604 | 3.9 | 17.9 | 3& 4 |
| Brazos County | 152,415 | 194,851 | 240,386 | 27.8 | 23.4 | 3 & 4 |
| Bastrop County | 57,733 | 74,171 | 101,908 | 28.5 | 37.4 | 4 |
| Burleson County | 16,470 | 17,187 | 19,672 | 4.4 | 14.5 | 4 |
| Lee County | 15,657 | 16,612 | 19,131 | 6.1 | 15.2 | 4 |
| Milam County | 24,238 | 24,757 | 26,588 | 2.1 | 7.4 | 4 |
| Travis County | 812,280 | 1,024,266 | 1,273,260 | 26.1 | 24.3 | 4 |
| Williamson County | 249,967 | 422,679 | 640,699 | 69.1 | 51.6 | 4 |

**Table 3.9-2 Population and Population Change by County**

| County[1] | Population Levels 2000 | 2010 | 2020 (Projected) | Population Change (percent) 2000 to 2010 | 2010 to 2020 | Analysis Area |
|---|---|---|---|---|---|---|
| Atascosa County | 38,628 | 44,911 | 56,193 | 16.3 | 25.1 | 5 |
| Live Oak County | 12,309 | 11,531 | 11,745 | -6.3 | 1.9 | 5 |
| McMullen County | 851 | 707 | 734 | -16.9 | 3.8 | 5 |
| Dimmit County | 10,248 | 9,996 | 10,588 | -2.5 | 5.9 | 6 |
| Kinney County | 3,379 | 3,598 | 3,779 | 6.5 | 5.0 | 6 |
| Maverick County | 47,297 | 54,258 | 63,108 | 14.7 | 16.3 | 6 |
| Uvalde County | 25,926 | 26,405 | 28,824 | 1.8 | 9.2 | 6 |
| Zavala County | 11,600 | 11,677 | 12,663 | 0.7 | 8.4 | 6 |
| Louisiana | 4,468,976 | 4,533,372 | 4,758,690 | 1.4 | 5.0 | -- |
| Texas | 20,851,820 | 25,145,561 | 30,622,577 | 20.6 | 21.8 | -- |
| U.S. | 281,421,906 | 308,745,538 | 333,896,000 | 9.7 | 8.1 | -- |

[1] Counties in Texas, unless otherwise noted.

Source: City Data 2000a-c; Louisiana.gov 2014; Texas Department of State Health Services 2000, 2014; U.S. Census 2014, 2010a, 2000.

The statewide population in Texas is expected to increase by 21.8 percent from 2010 to 2020, as shown in **Table 3.9-1**. The combined population for the 43 counties is expected to increase by 20.9 percent (U.S. Census 2014; Louisiana.gov 2014; Texas Department of State Health Services 2014).

### 3.9.1.2 Employment

The size of a county's labor force is measured as the total number of people currently employed plus the number actively seeking employment. Analysis Area 4 has experienced the most rapid growth in the size of its labor force between 2010 and 2013, growing by 8 percent from an average of 934,752 in 2010 to 1,013,474 in 2013 (**Table 3.9-3**). This was mainly driven by Brazos, Travis, and Williamson counties (**Table 3.9-4**). This is above the Texas and Louisiana statewide growth rate of 5.2 and 3.3 percent over the same period, respectively (American Community Services 2010, 2013).

The highest unemployment rate was in Analysis Area 6 during both 2010 and 2013 at 11.0 and 11.9 percent, respectively. Unemployment in Analysis Areas 3 and 4 was below that of Texas in 2010, and Analysis Areas 2 and 4 had an unemployment rate below the state level in 2013. The unemployment rate in Analysis Area 2 was slightly above the Louisiana rate in 2010 and below it in 2013. The average unemployment rate for all analysis areas was almost the same as that of Texas for both years and below that of Louisiana and the United States.

**Table 3.9-4** shows unemployment rates for the analysis area counties. San Augustin County (Analysis Area 2) had the highest unemployment rate in 2013, followed by the counties of Dimmit, Kinney, Morris, Maverick and Zavala, four of which are within Analysis Area 6. The lowest unemployment rate for the same year was in McMullen County (2.4 percent) within Analysis Area 5 followed by the counties of Franklin (5 percent), Freestone (5.3 percent), Lee (5.9 percent) and Live Oak (5.9 percent) in Analysis Areas 1, 3, 4, and 5, respectively.

**Table 3.9-3　Average Annual Labor Force and Monthly Unemployment Rates by Analysis Area**

| Location | Employment | | | Unemployment (percent) | |
|---|---|---|---|---|---|
| | 2010 | 2013 | Percent Change | 2010 | 2013 |
| Analysis Area 1 | 187,966 | 190,273 | 1 | 7.3 | 8.4 |
| Analysis Area 2 | 423,848 | 427,380 | 1 | 7.8 | 8.0 |
| Analysis Area 3 | 234,487 | 242,659 | 3 | 6.9 | 8.3 |
| Analysis Area 4 | 934,752 | 1,013,474 | 8 | 6.4 | 7.6 |
| Analysis Area 5 | 25,209 | 24,910 | -1 | 8.4 | 8.3 |
| Analysis Area 6 | 42,709 | 43,947 | 3 | 11.0 | 11.9 |
| Total for Six Analysis Areas[1] | 1,646,001 | 1,730,192 | 5 | 7.0 | 7.9 |
| Texas | 12,065,652 | 12,691,031 | 5.2 | 7.0 | 8.1 |
| Louisiana | 2,133,382 | 2,203,325 | 3.3 | 7.7 | 8.8 |
| U.S. | 155,163,977 | 158,197,577 | 2.0 | 7.9 | 9.7 |

[1] Smith County falls within Analysis Areas 1 and 2, and Robertson and Brazos counties fall within Analysis Areas 3 and 4. As a result, the sum total for the six analysis areas is greater than the actual total for the overall analysis area.

Source: American Community Services 2013, 2010.

**Table 3.9-4　Average Annual Labor Force and Monthly Unemployment Rates by County**

| County[1] | Employment | | | Unemployment (percent) | | Analysis Area |
|---|---|---|---|---|---|---|
| | 2010 | 2013 | Percent Change | 2010 | 2013 | |
| Camp County | 5,510 | 5,491 | -0.3 | 8.2 | 11.1 | 1 |
| Franklin County | 4,855 | 4,821 | -0.7 | 10.6 | 5.0 | 1 |
| Hopkins County | 16,450 | 16,383 | -0.4 | 7.0 | 8.4 | 1 |
| Morris County | 5,655 | 5,440 | -3.8 | 6.9 | 12.4 | 1 |
| Rains County | 5,310 | 4,951 | -6.8 | 6.7 | 8.9 | 1 |
| Titus County | 13,734 | 14,711 | 7.1 | 7.5 | 7.7 | 1 |
| Upshur County | 18,063 | 18,088 | 0.1 | 6.8 | 8.9 | 1 |
| Wood County | 17,241 | 17,090 | -0.9 | 7.9 | 9.1 | 1 |
| Smith County | 101,148 | 103,298 | 2.1 | 7.2 | 8.1 | 1 & 2 |
| Caddo Parish, Louisiana | 121,126 | 121,880 | 0.6 | 9.3 | 8.2 | 2 |
| DeSoto Parish, Louisiana | 12,512 | 11,944 | -4.5 | 9.9 | 9.9 | 2 |
| Cherokee County | 20,921 | 21,182 | 1.2 | 5.6 | 7.3 | 2 |
| Gregg County | 59,815 | 59,186 | -1.1 | 7.4 | 7.1 | 2 |
| Harrison County | 30,701 | 31,683 | 3.2 | 7.9 | 9.6 | 2 |
| Nacogdoches County | 30,227 | 29,781 | -1.5 | 7.3 | 8.1 | 2 |
| Panola County | 10,320 | 10,691 | 3.6 | 5.6 | 6.4 | 2 |
| Rusk County | 22,533 | 23,197 | 2.9 | 5.0 | 6.4 | 2 |
| San Augustine County | 3,284 | 2,992 | -8.9 | 10.5 | 14.2 | 2 |
| Shelby County | 11,261 | 11,546 | 2.5 | 7.3 | 7.6 | 2 |

**Table 3.9-4 Average Annual Labor Force and Monthly Unemployment Rates by County**

| County[1] | Employment | | | Unemployment (percent) | | Analysis Area |
|---|---|---|---|---|---|---|
| | 2010 | 2013 | Percent Change | 2010 | 2013 | |
| Anderson County | 20,985 | 21,512 | 2.5 | 7.0 | 7.3 | 3 |
| Falls County | 7,162 | 6,970 | -2.7 | 7.9 | 8.1 | 3 |
| Freestone County | 8,000 | 8,450 | 5.6 | 6.5 | 5.3 | 3 |
| Henderson County | 34,726 | 33,946 | -2.2 | 8.2 | 9.8 | 3 |
| Leon County | 6,877 | 7,162 | 4.1 | 5.4 | 7.3 | 3 |
| Limestone County | 8,830 | 10,059 | 13.9 | 4.0 | 6.8 | 3 |
| Navarro County | 22,637 | 22,523 | -0.5 | 8.0 | 10.2 | 3 |
| Van Zandt County | 23,448 | 22,884 | -2.4 | 6.7 | 7.0 | 3 |
| Robertson County | 7,468 | 7,436 | -0.4 | 7.9 | 11.0 | 3 & 4 |
| Brazos County | 94,354 | 101,717 | 7.8 | 6.4 | 8.1 | 3 & 4 |
| Bastrop County | 35,604 | 36,174 | 1.6 | 6.5 | 9.4 | 4 |
| Burleson County | 7,828 | 7,708 | -1.5 | 6.4 | 8.4 | 4 |
| Lee County | 7,940 | 7,924 | -0.2 | 5.1 | 5.9 | 4 |
| Milam County | 10,867 | 10,671 | -1.8 | 5.6 | 11.2 | 4 |
| Travis County | 559,045 | 606,970 | 8.6 | 6.4 | 7.4 | 4 |
| Williamson County | 211,646 | 234,874 | 11.0 | 6.5 | 7.5 | 4 |
| Atascosa County | 20,471 | 20,296 | -0.9 | 9.5 | 8.9 | 5 |
| Live Oak County | 4,204 | 4,232 | 0.7 | 3.3 | 5.9 | 5 |
| McMullen County | 534 | 382 | -28.5 | 7.1 | 2.4 | 5 |
| Dimmit County | 4,123 | 4,507 | 9.3 | 10.2 | 13.9 | 6 |
| Kinney County | 1,134 | 1,346 | 18.7 | 15.3 | 13.3 | 6 |
| Maverick County | 21,548 | 22,225 | 3.1 | 11.3 | 12.3 | 6 |
| Uvalde County | 11,623 | 11,325 | -2.6 | 10.9 | 9.9 | 6 |
| Zavala County | 4,281 | 4,544 | 6.1 | 9.8 | 12.2 | 6 |
| Louisiana | 2,133,382 | 2,203,325 | 3.3 | 7.7 | 8.8 | -- |
| Texas | 12,065,652 | 12,691,031 | 5.2 | 7.0 | 8.1 | -- |
| U.S. | 155,163,977 | 158,197,577 | 2.0 | 7.9 | 9.7 | -- |

[1] Counties in Texas, unless otherwise noted.

Source: American Community Services 2013, 2010.

**Table 3.9-5** shows the employment levels in the analysis areas by industry sector; **Table 3.9-6** presents the information by county. Sectors with the highest employments in the analysis areas include: Educational Services and Health Care and Social Assistance; Retail Trade; and Professional. At the state and national level, the highest employment sectors are Retail Trade, Education, and Professional sectors. The Agriculture, Forestry, Fishing and Hunting, and Mining sector is one of the smaller sectors. The Educational Services and Health Care and Social Assistance sector had the highest employment rate in all analysis areas as well as in Texas, Louisiana, and nationwide (American Community Services 2013).

**Table 3.9-5 Employment by Industrial Sector by Analysis Area**

| Location | Civilian Employed | Agriculture, Forestry, Fishing and Hunting, and Mining | Construction | Manufacturing | Wholesale Trade | Retail Trade | Transportation and Warehousing, and Utilities | Information | Finance and Insurance, and Real Estate and Rental and Leasing | Professional, Scientific, and Management, and Administrative and Waste Management Services | Educational Services, and Health Care and Social Assistance | Arts, Entertainment, and Recreation, and Accommodation and Food Services | Other Services, Except Public Administration | Public Administration |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Analysis Area 1 | 174,053 | 7,612 | 13,272 | 20,248 | 5,407 | 22,907 | 8,448 | 2,806 | 8,256 | 12,918 | 42,710 | 13,383 | 9,794 | 6,292 |
| Analysis Area 2 | 392,001 | 22,752 | 27,384 | 38,469 | 12,531 | 47,405 | 18,692 | 5,793 | 18,898 | 29,570 | 98,222 | 35,157 | 22,471 | 14,657 |
| Analysis Area 3 | 222,172 | 11,956 | 17,634 | 17,306 | 4,337 | 25,129 | 10,959 | 2,828 | 10,171 | 17,855 | 60,957 | 18,771 | 11,887 | 12,382 |
| Analysis Area 4 | 933,848 | 11,840 | 70,760 | 81,680 | 20,601 | 102,957 | 29,724 | 22,010 | 62,833 | 131,346 | 203,674 | 90,205 | 48,599 | 57,619 |
| Analysis Area 5 | 22,807 | 1,992 | 2,624 | 1,804 | 738 | 2,682 | 1,352 | 303 | 1,413 | 1,280 | 5,041 | 1,594 | 757 | 1,227 |
| Analysis Area 6 | 38,736 | 3,650 | 2,806 | 1,518 | 835 | 4,091 | 2,667 | 230 | 1,264 | 1,758 | 11,386 | 3,506 | 1,414 | 3,611 |
| Total ot the Six Analysis Areas[1] | 1,589,051 | 53,104 | 120,529 | 146,217 | 39,835 | 181,556 | 65,124 | 30,662 | 93,200 | 177,414 | 363,974 | 143,845 | 84,968 | 88,623 |
| Texas | 11,569,041 | 359,977 | 914,460 | 1,083,079 | 347,982 | 1,345,939 | 629,548 | 213,097 | 769,050 | 1,251,791 | 2,514,011 | 1,001,258 | 621,998 | 516,851 |
| Louisiana | 1,995,378 | 92,647 | 163,275 | 161,080 | 54,096 | 231,160 | 104,091 | 30,601 | 105,302 | 171,859 | 469,228 | 198,316 | 101,860 | 111,863 |
| U.S. | 141,864,697 | 2,731,302 | 8,864,481 | 14,867,423 | 3,937,876 | 16,415,217 | 7,010,637 | 3,056,318 | 9,469,756 | 15,300,528 | 32,871,216 | 13,262,892 | 7,043,003 | 7,034,048 |

[1] Smith County falls within Analysis Areas 1 and 2, and Robertson and Brazos counties fall within Analysis Areas 3 and 4. As a result, the sum total for the six analysis areas is greater than the actual total for the overall analysis area.

Source: American Community Services 2013, 2010.

**Table 3.9-6 Employment by Industrial Sector by County**

| County[1] | Civilian Employed Population | Agriculture, Forestry, Fishing and Hunting, and Mining | Construction | Manufacturing | Wholesale Trade | Retail Trade | Transportation and Warehousing, and Utilities | Information | Finance and Insurance, and Real Estate and Rental and Leasing | Professional, Scientific, and Management, and Administrative and Waste Management Services | Educational Services, and Health Care and Social Assistance | Arts, Entertainment, and Recreation, and Accommodation and Food Services | Other Services, Except Public Administration | Public Administration | Analysis Area |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Camp County | 4,884 | 238 | 417 | 888 | 150 | 675 | 281 | 46 | 130 | 241 | 1,118 | 301 | 238 | 161 | 1 |
| Franklin County | 4,577 | 274 | 388 | 302 | 64 | 813 | 345 | 4 | 123 | 336 | 1,178 | 409 | 173 | 168 | 1 |
| Hopkins County | 14,975 | 871 | 1,193 | 1,626 | 956 | 1,825 | 908 | 187 | 697 | 948 | 3,392 | 1,040 | 858 | 474 | 1 |
| Morris County | 4,768 | 251 | 265 | 912 | 248 | 432 | 268 | 22 | 224 | 100 | 1,397 | 191 | 280 | 178 | 1 |
| Rains County | 4,511 | 101 | 371 | 607 | 38 | 684 | 376 | 39 | 269 | 330 | 857 | 369 | 191 | 279 | 1 |
| Titus County | 13,571 | 525 | 876 | 3,580 | 316 | 1,639 | 869 | 50 | 522 | 664 | 2,634 | 1,006 | 644 | 246 | 1 |
| Upshur County | 16,463 | 1,317 | 1,839 | 1,905 | 400 | 2,130 | 951 | 340 | 534 | 1,159 | 3,670 | 794 | 761 | 663 | 1 |
| Wood County | 15,497 | 906 | 1,345 | 1,393 | 333 | 1,872 | 918 | 218 | 924 | 1,139 | 3,423 | 944 | 1,285 | 797 | 1 |
| Smith County | 94,807 | 3,129 | 6,578 | 9,035 | 2,902 | 12,837 | 3,532 | 1,900 | 4,833 | 8,001 | 25,041 | 8,329 | 5,364 | 3,326 | 1&2 |
| Caddo Parish, Louisiana | 110,887 | 4,062 | 6,455 | 7,046 | 3,427 | 13,488 | 5,959 | 2,040 | 5,228 | 8,664 | 29,856 | 13,782 | 6,469 | 4,411 | 2 |
| DeSoto Parish, Louisiana | 10,764 | 947 | 833 | 1,067 | 307 | 1,366 | 680 | 108 | 544 | 657 | 2,298 | 740 | 623 | 594 | 2 |
| Cherokee County | 19,617 | 1,477 | 1,320 | 2,192 | 512 | 2,171 | 1,058 | 360 | 760 | 1,524 | 4,889 | 998 | 1,133 | 1,223 | 2 |
| Gregg County | 55,001 | 3,576 | 3,617 | 7,248 | 2,164 | 6,834 | 2,279 | 587 | 2,906 | 4,381 | 12,027 | 4,596 | 3,338 | 1,448 | 2 |
| Harrison County | 28,644 | 2,163 | 2,082 | 3,620 | 1,058 | 3,068 | 1,587 | 221 | 1,634 | 2,111 | 6,579 | 2,014 | 1,629 | 878 | 2 |
| Nacogdoches County | 27,325 | 1,393 | 2,509 | 3,430 | 641 | 3,229 | 963 | 219 | 1,183 | 1,687 | 7,902 | 2,140 | 1,288 | 741 | 2 |
| Panola County | 10,004 | 2,110 | 972 | 813 | 325 | 897 | 638 | 32 | 492 | 476 | 2,113 | 302 | 479 | 355 | 2 |
| Rusk County | 21,720 | 2,302 | 1,887 | 2,308 | 822 | 2,059 | 1,240 | 260 | 754 | 1,398 | 4,692 | 1,499 | 1,300 | 1,199 | 2 |
| San Augustine County | 2,566 | 159 | 321 | 213 | 53 | 282 | 182 | 14 | 87 | 152 | 782 | 56 | 172 | 93 | 2 |
| Shelby County | 10,666 | 1,434 | 810 | 1,497 | 320 | 1,174 | 574 | 52 | 477 | 519 | 2,043 | 701 | 676 | 389 | 2 |
| Anderson County | 19,921 | 1,608 | 1,224 | 568 | 333 | 2,583 | 1,404 | 194 | 697 | 1,283 | 4,617 | 1,167 | 1,089 | 3,154 | 3 |
| Falls County | 6,405 | 508 | 607 | 717 | 96 | 593 | 374 | 28 | 303 | 250 | 1,823 | 327 | 277 | 502 | 3 |
| Freestone County | 7,999 | 1,179 | 742 | 611 | 90 | 622 | 561 | 41 | 259 | 405 | 2,043 | 570 | 470 | 406 | 3 |
| Henderson County | 30,609 | 1,482 | 3,006 | 3,085 | 682 | 3,635 | 1,527 | 427 | 1,830 | 2,637 | 6,517 | 2,440 | 1,811 | 1,530 | 3 |
| Leon County | 6,637 | 1,014 | 803 | 461 | 131 | 719 | 496 | 45 | 238 | 341 | 1,058 | 695 | 257 | 379 | 3 |
| Limestone County | 9,376 | 788 | 578 | 843 | 193 | 819 | 523 | 90 | 276 | 567 | 3,090 | 515 | 617 | 477 | 3 |
| Navarro County | 20,191 | 778 | 1,602 | 3,113 | 492 | 2,741 | 1,408 | 201 | 799 | 1,608 | 4,079 | 1,218 | 1,068 | 1,084 | 3 |

### Table 3.9-6 Employment by Industrial Sector by County

| County[1] | Civilian Employed Population | Agriculture, Forestry, Fishing and Hunting, and Mining | Construction | Manufacturing | Wholesale Trade | Retail Trade | Transportation and Warehousing, and Utilities | Information | Finance and Insurance, and Real Estate and Rental and Leasing | Professional, Scientific, and Management, and Administrative and Waste Management Services | Educational Services, and Health Care and Social Assistance | Arts, Entertainment, and Recreation, and Accommodation and Food Services | Other Services, Except Public Administration | Public Administration | Analysis Area |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Van Zandt County | 21,275 | 1,030 | 1,699 | 2,135 | 608 | 2,639 | 1,480 | 394 | 967 | 1,452 | 4,755 | 1,397 | 1,708 | 1,011 | 3 |
| Robertson County | 6,608 | 643 | 601 | 341 | 26 | 645 | 631 | 35 | 372 | 331 | 1,709 | 467 | 363 | 444 | 3&4 |
| Brazos County | 93,151 | 2,926 | 6,772 | 5,432 | 1,686 | 10,133 | 2,555 | 1,373 | 4,430 | 8,981 | 31,266 | 9,975 | 4,227 | 3,395 | 3&4 |
| Bastrop County | 32,720 | 828 | 3,883 | 3,369 | 523 | 4,037 | 2,217 | 482 | 1,421 | 3,284 | 5,707 | 2,577 | 1,515 | 2,877 | 4 |
| Burleson County | 7,057 | 636 | 648 | 767 | 128 | 824 | 317 | 121 | 252 | 360 | 1,733 | 470 | 553 | 248 | 4 |
| Lee County | 7,458 | 867 | 754 | 684 | 187 | 908 | 450 | 43 | 262 | 315 | 1,697 | 474 | 317 | 500 | 4 |
| Milam County | 9,459 | 805 | 1,052 | 884 | 110 | 1,178 | 695 | 138 | 396 | 445 | 2,253 | 510 | 486 | 507 | 4 |
| Travis County | 561,181 | 3,308 | 43,044 | 45,907 | 12,021 | 57,645 | 15,714 | 15,219 | 39,469 | 87,381 | 114,569 | 59,714 | 30,780 | 36,410 | 4 |
| Williamson County | 216,214 | 1,827 | 14,006 | 24,296 | 5,920 | 27,587 | 7,145 | 4,599 | 16,231 | 30,249 | 44,740 | 16,018 | 10,358 | 13,238 | 4 |
| Atascosa County | 18,453 | 1,407 | 2,359 | 1,389 | 638 | 2,234 | 1,006 | 252 | 1,175 | 1,145 | 4,216 | 1,250 | 574 | 808 | 5 |
| Live Oak County, | 3,981 | 508 | 254 | 386 | 91 | 421 | 290 | 51 | 214 | 127 | 788 | 312 | 173 | 366 | 5 |
| McMullen County | 373 | 77 | 11 | 29 | 9 | 27 | 56 | - | 24 | 8 | 37 | 32 | 10 | 53 | 5 |
| Dimmit County | 3,882 | 815 | 287 | 49 | 84 | 611 | 145 | - | 95 | 100 | 863 | 347 | 142 | 344 | 6 |
| Kinney County | 1,167 | 145 | 193 | 13 | - | 74 | 112 | 21 | 44 | 8 | 256 | 67 | 15 | 219 | 6 |
| Maverick County | 19,497 | 1,316 | 1,287 | 1,006 | 557 | 2,196 | 1,453 | 142 | 784 | 722 | 5,771 | 1,828 | 390 | 2,045 | 6 |
| Uvalde County | 10,199 | 859 | 760 | 315 | 175 | 1,038 | 742 | - | 181 | 772 | 3,282 | 819 | 636 | 620 | 6 |
| Zavala County | 3,991 | 515 | 279 | 135 | 19 | 172 | 215 | 67 | 160 | 156 | 1,214 | 445 | 231 | 383 | 6 |
| Louisiana | 1,995,378 | 92,647 | 163,275 | 161,080 | 54,096 | 231,160 | 104,091 | 30,601 | 105,302 | 171,859 | 469,228 | 198,316 | 101,860 | 111,863 | |
| Texas | 11,569,041 | 359,977 | 914,460 | 1,083,079 | 347,982 | 1,345,939 | 629,548 | 213,097 | 769,050 | 1,251,791 | 2,514,011 | 1,001,258 | 621,998 | 516,851 | |
| U.S. | 141,864,697 | 2,731,302 | 8,864,481 | 14,867,423 | 3,937,876 | 16,415,217 | 7,010,637 | 3,056,318 | 9,469,756 | 15,300,528 | 32,871,216 | 13,262,892 | 7,043,003 | 7,034,048 | |

[1] Counties in Texas, unless otherwise noted.

Source: American Community Services 2013, 2010.

### 3.9.1.3 Income

As shown in **Table 3.9-7**, Analysis Area 4 had the highest personal income per capita in 2010 and 2013. All analysis areas had a per capita income lower than that of Texas and the nationwide average in both 2010 and 2013. Similarly, the per capita income in Analysis Area 2 was lower than that of Louisiana in both years. Personal incomes for Morris, Navarro, Freestone, Rusk, and Live Oak counties were 1 to 3 percent lower from 2010 to 2013 (**Table 3.9-8**). Zavala County had the lowest per capita income in 2010 and 2013. McMullen, Dimmit, and Zavala counties experienced the greatest rate of increase in personal income from 2010 to 2013, with an increase of 28, 25, and 26 percent, respectively (American Community Services 2013, 2010).

**Table 3.9-7 Annual per Capital Personal Income for 2010 and 2013 by Analysis Area**

| Location | Per Capita Income | | |
|---|---|---|---|
| | 2010 | 2013 | Percent Change |
| Analysis Area 1 | $23,262 | $23,910 | 2.8 |
| Analysis Area 2 | $22,532 | $23,673 | 5.1 |
| Analysis Area 3 | $20,182 | $20,905 | 3.6 |
| Analysis Area 4 | $24,257 | $25,079 | 3.4 |
| Analysis Area 5 | $20,453 | $22,861 | 11.8 |
| Analysis Area 6 | $13,630 | $15,025 | 10.2 |
| Total of the Six Analysis Areas[1] | $26,139 | $27,332 | 4.6 |
| Texas | $24,870 | $26,019 | 4.6 |
| Louisiana | $23,094 | $24,442 | 5.8 |
| United States | $27,334 | $28,155 | 3.0 |

[1] Smith County falls within Analysis Areas 1 and 2, and Robertson and Brazos counties fall within Analysis Areas 3 and 4. As a result, the sum total for the six analysis areas is greater than the actual total for the overall analysis area.

Source: American Community Services 2013, 2010.

**Table 3.9-8 Annual Per Capital Personal Income for 2010 and 2013 by County**

| County[1] | Per Capita Income | | | Analysis Area |
|---|---|---|---|---|
| | 2010 | 2013 | Percent Change | |
| Camp County | $18,710 | $19,176 | 2.5 | 1 |
| Franklin County | $23,821 | $28,189 | 18.3 | 1 |
| Hopkins County | $21,163 | $21,606 | 2.1 | 1 |
| Morris County | $20,292 | $20,045 | -1.2 | 1 |
| Rains County | $20,855 | $21,946 | 5.2 | 1 |
| Titus County | $17,520 | $19,356 | 10.5 | 1 |
| Upshur County | $21,946 | $22,483 | 2.4 | 1 |
| Wood County | $21,682 | $23,129 | 6.7 | 1 |
| Smith County | $25,374 | $25,626 | 1.0 | 1&2 |
| Caddo Parish, Louisiana | $22,594 | $24,308 | 7.6 | 2 |

**Table 3.9-8 Annual Per Capital Personal Income for 2010 and 2013 by County**

| County[1] | Per Capita Income | | | Analysis Area |
|---|---|---|---|---|
| | 2010 | 2013 | Percent Change | |
| DeSoto Parish, Louisiana | $20,112 | $21,547 | 7.1 | 2 |
| Cherokee County | $17,230 | $18,801 | 9.1 | 2 |
| Gregg County | $23,024 | $24,064 | 4.5 | 2 |
| Harrison County | $22,019 | $23,236 | 5.5 | 2 |
| Nacogdoches County | $18,180 | $20,362 | 12.0 | 2 |
| Panola County | $22,846 | $26,525 | 16.1 | 2 |
| Rusk County | $22,392 | $21,640 | -3.4 | 2 |
| San Augustine County | $17,184 | $18,695 | 8.8 | 2 |
| Shelby County | $20,103 | $21,126 | 5.1 | 2 |
| Anderson County | $17,465 | $18,495 | 5.9 | 3 |
| Falls County | $14,979 | $16,486 | 10.1 | 3 |
| Freestone County | $23,235 | $22,876 | -1.5 | 3 |
| Henderson County | $21,580 | $21,995 | 1.9 | 3 |
| Leon County | $22,484 | $24,170 | 7.5 | 3 |
| Limestone County | $18,420 | $19,352 | 5.1 | 3 |
| Navarro County | $20,539 | $20,327 | -1.0 | 3 |
| Van Zandt County | $20,989 | $21,920 | 4.4 | 3 |
| Robertson County | $21,113 | $21,709 | 2.8 | 3&4 |
| Brazos County | $21,018 | $21,720 | 3.3 | 3&4 |
| Bastrop County | $22,918 | $23,342 | 1.9 | 4 |
| Burleson County | $21,379 | $21,529 | 0.7 | 4 |
| Lee County | $23,074 | $25,123 | 8.9 | 4 |
| Milam County | $21,509 | $21,248 | -1.2 | 4 |
| Travis County | $31,785 | $33,206 | 4.5 | 4 |
| Williamson County | $29,663 | $31,070 | 4.7 | 4 |
| Atascosa County | $18,461 | $20,193 | 9.4 | 5 |
| Live Oak County | $21,540 | $21,016 | -2.4 | 5 |
| McMullen County | $21,358 | $27,375 | 28.2 | 5 |
| Dimmit County | $14,045 | $17,516 | 24.7 | 6 |
| Kinney County | $14,207 | $16,700 | 17.5 | 6 |
| Maverick County | $12,444 | $13,668 | 9.8 | 6 |
| Uvalde County | $17,022 | $17,339 | 1.9 | 6 |
| Zavala County | $10,180 | $12,828 | 26.0 | 6 |
| Louisiana | $23,094 | $24,442 | 5.8 | -- |
| Texas | $24,870 | $26,019 | 4.6 | -- |
| U.S. | $27,334 | $28,155 | 3.0 | -- |

[1] Counties in Texas, unless otherwise noted.

Source: American Community Services 2013, 2010.

### 3.9.1.4 Public Finance

As shown in **Table 3.9-9**, the actual property tax rates within the six analysis areas in 2013 varied from 0.26 percent (Analysis Area 6) to 0.42 percent (Analysis Area 4) (Texas County Property Tax 2013; Louisiana Tax 2013). This rate is calculated from the appraised value and revenue produced. However, Analysis Area 4 also has more than half of the total apprised property value, and so receives the majority of the total county property taxes. This is primarily driven by Travis County, as it produces more than a third of the total county property taxes in the analysis area (**Table 3.9-10**).

**Table 3.9-9 Property Tax for 2013 by Analysis Area**

| Location | County Property Taxes | | |
|---|---|---|---|
| | Total Appraised Property Value | Revenue Produced | Actual Tax Rate (percent) |
| Analysis Area 1 | $33,180,493,464 | $104,448,888 | 0.31 |
| Analysis Area 2 | $80,685,430,491 | $308,505,473 | 0.38 |
| Analysis Area 3 | $49,339,704,074 | $179,931,180 | 0.36 |
| Analysis Area 4 | $202,646,638,183 | $845,038,148 | 0.42 |
| Analysis Area 5 | $12,329,327,486 | $42,040,610 | 0.34 |
| Analysis Area 6 | $15,726,305,318 | $40,517,400 | 0.26 |
| Total of the Six Analysis Areas[1] | $358,250,829,882 | $1,399,244,130 | 0.39 |

[1] Smith County falls within Analysis Areas 1 and 2, and Robertson and Brazos counties fall within Analysis Areas 3 and 4. As a result, the sum total for the six analysis areas is greater than the actual total for the overall analysis area.

Source: Louisiana Tax 2013; Texas County Property Tax 2013.

**Table 3.9-10 Property Tax for 2013 by County**

| County[1] | County Property Taxes | | | Analysis Area |
|---|---|---|---|---|
| | Total Appraised Property Value | Revenue Produced | Actual Tax Rate (percent) | |
| Camp County | $929,349,791 | $3,434,101 | 0.37 | 1 |
| Franklin County | $1,468,059,570 | $4,782,565 | 0.33 | 1 |
| Hopkins County | $2,499,268,516 | $9,244,734 | 0.37 | 1 |
| Morris County | $1,061,929,820 | $2,657,392 | 0.25 | 1 |
| Rains County | $886,340,268 | $3,632,478 | 0.41 | 1 |
| Titus County | $3,052,560,281 | $9,743,277 | 0.32 | 1 |
| Upshur County | $2,730,614,183 | $9,826,776 | 0.36 | 1 |
| Wood County | $4,132,894,466 | $15,453,375 | 0.37 | 1 |
| Smith County | $16,419,476,569 | $45,674,190 | 0.28 | 1&2 |
| Caddo Parish, Louisiana[2] | $19,331,000,000 | $103,816,883 | 0.54 | 2 |
| DeSoto Parish, Louisiana[2] | $5,141,200,000 | $37,217,282 | 0.72 | 2 |
| Cherokee County | $3,324,209,472 | $13,117,307 | 0.39 | 2 |
| Gregg County | $9,761,380,773 | $22,477,829 | 0.23 | 2 |
| Harrison County | $7,497,725,398 | $19,495,797 | 0.26 | 2 |
| Nacogdoches County | $5,082,902,610 | $15,180,244 | 0.30 | 2 |

**Table 3.9-10 Property Tax for 2013 by County**

| County[1] | County Property Taxes: Total Appraised Property Value | Revenue Produced | Actual Tax Rate (percent) | Analysis Area |
|---|---|---|---|---|
| Panola County | $4,902,880,340 | $19,730,117 | 0.40 | 2 |
| Rusk County | $5,920,819,590 | $20,525,090 | 0.35 | 2 |
| San Augustine County | $1,074,387,600 | $3,082,255 | 0.29 | 2 |
| Shelby County | $2,229,448,139 | $8,188,479 | 0.37 | 2 |
| Anderson County | $3,826,323,353 | $13,695,822 | 0.36 | 3 |
| Falls County | $1,169,506,390 | $5,270,665 | 0.45 | 3 |
| Freestone County | $4,072,949,910 | $8,416,893 | 0.21 | 3 |
| Henderson County | $6,903,065,244 | $26,218,240 | 0.38 | 3 |
| Leon County | $3,149,134,650 | $7,394,002 | 0.23 | 3 |
| Limestone County | $3,411,550,657 | $14,759,693 | 0.43 | 3 |
| Navarro County | $3,701,531,754 | $17,335,465 | 0.47 | 3 |
| Van Zandt County | $3,868,049,551 | $11,277,021 | 0.29 | 3 |
| Robertson County | $4,935,060,784 | $14,239,735 | 0.29 | 3&4 |
| Brazos County | $14,302,531,781 | $61,323,644 | 0.43 | 3&4 |
| Bastrop County | $6,313,367,932 | $28,009,419 | 0.44 | 4 |
| Burleson County | $2,340,908,952 | $6,630,854 | 0.28 | 4 |
| Lee County | $2,598,369,382 | $9,132,463 | 0.35 | 4 |
| Milam County | $3,060,543,336 | $10,681,180 | 0.35 | 4 |
| Travis County | $127,144,392,234 | $533,212,650 | 0.42 | 4 |
| Williamson County | $41,951,463,782 | $181,808,203 | 0.43 | 4 |
| Atascosa County | $4,650,122,104 | $14,969,591 | 0.32 | 5 |
| Live Oak County | $4,003,352,805 | $11,559,538 | 0.29 | 5 |
| McMullen County | $3,675,852,577 | $15,511,481 | 0.42 | 5 |
| Dimmit County | $6,217,834,435 | $11,828,730 | 0.19 | 6 |
| Kinney County | $1,315,422,430 | $1,658,058 | 0.13 | 6 |
| Maverick County | $3,575,709,620 | $12,395,115 | 0.35 | 6 |
| Uvalde County | $2,855,706,770 | $10,125,549 | 0.35 | 6 |
| Zavala County | $1,761,632,063 | $4,509,948 | 0.26 | 6 |

[1] Counties in Texas, unless otherwise noted.

[2] Appraised property value in Louisiana presented here is actually the fair market value, as the assessed value is generally 10 or 15 percent of the fair market value.

Source: Louisiana Tax 2013; Texas County Property Tax 2013.

The current (2014) state retail sales tax rate in Texas is 6.25 percent. City and county sales tax rates vary by jurisdiction at the discretion of the local governing body. Texas counties in the six analysis areas impose either 0 percent or 0.50 percent sales and use tax (**Table 3.9-11**) (Texas County Sales Tax 2013; Texas State Sales Tax 2013). Cities may also impose sales and use tax; the total maximum combined rate (including Texas state retail sales tax) is 8.25 percent. Louisiana imposes 4 percent state retail sales tax, and the two parishes associated with Analysis Area 2 have sales tax of 3.35 and 3.5 percent, respectively (Louisiana Sales Tax 2013).

**Table 3.9-11 County Sales Taxes for 2013**

| County[1] | Sales Tax by County and State (percent) | Analysis Area |
|---|---|---|
| Camp County | 0.50 | 1 |
| Franklin County | 0.50 | 1 |
| Hopkins County | 0.50 | 1 |
| Morris County | 0.50 | 1 |
| Rains County | 0.50 | 1 |
| Titus County | 0.50 | 1 |
| Upshur County | 0.50 | 1 |
| Wood County | 0.00 | 1 |
| Smith County | 0.50 | 1&2 |
| Caddo Parish, Louisiana | 3.35 | 2 |
| DeSoto Parish, Louisiana | 3.50 | 2 |
| Cherokee County | 0.50 | 2 |
| Gregg County | 0.50 | 2 |
| Harrison County | 0.00 | 2 |
| Nacogdoches County | 0.00 | 2 |
| Panola County | 0.00 | 2 |
| Rusk County | 0.00 | 2 |
| San Augustine County | 0.50 | 2 |
| Shelby County | 0.00 | 2 |
| Anderson County | 0.50 | 3 |
| Falls County | 0.50 | 3 |
| Freestone County | 0.00 | 3 |
| Henderson County | 0.00 | 3 |
| Leon County | 0.50 | 3 |
| Limestone County | 0.00 | 3 |
| Navarro County | 0.50 | 3 |
| Van Zandt County | 0.00 | 3 |
| Robertson County | 0.00 | 3&4 |
| Brazos County | 0.50 | 3&4 |
| Bastrop County | 0.50 | 4 |
| Burleson County | 0.50 | 4 |
| Lee County | 0.50 | 4 |
| Milam County | 0.00 | 4 |
| Travis County | 0.00 | 4 |
| Williamson County | 0.00 | 4 |
| Atascosa County | 0.50 | 5 |

**Table 3.9-11 County Sales Taxes for 2013**

| County[1] | Sales Tax by County and State (percent) | Analysis Area |
|---|---|---|
| Live Oak County | 0.50 | 5 |
| McMullen County | 0.00 | 5 |
| Dimmit County | 0.50 | 6 |
| Kinney County | 0.00 | 6 |
| Maverick County | 0.00 | 6 |
| Uvalde County | 0.50 | 6 |
| Zavala County | 0.00 | 6 |
| Louisiana | 4.00 | |
| Texas | 6.25 | |

[1] Counties in Texas, unless otherwise noted.

Source: Louisiana Sales Tax 2013; Texas County Sales Tax 2013; Texas State Sales Tax 2013.

### 3.9.1.5 Public Education

Public schools in Texas and Louisiana are funded by a combination of local, state, and federal funds. The percentage of revenue from each source varies by district because of variations in student population and local property wealth. Because of the disparity in property taxing capacity among districts, Texas has a revenue balancing or equalization formula by which it redistributes property tax revenues from tax-rich districts to poorer districts. The bulk of school funding derives from local and state funds, with the federal funds being used for special programs or to provide services to a specific group of students.

The actual tax rate (calculated from the appraised value and revenue produced) for the six analysis areas is 1.02 percent; this is similar to the state actual tax rate (Texas School District Tax Rates 2013; Louisiana Tax 2013) (**Table 3.9-12**). Almost half of the revenue produced comes from Travis County (**Table 3.9-13**).

**Table 3.9-12 School District 2013 Funding Received from Property Taxes by Analysis Area**

| Location | School District Funding from Property Taxes | | |
|---|---|---|---|
| | Total Appraised Property Value | Revenue Produced | Actual Tax Rate (percent) |
| Analysis Area 1 | $33,162,001,321 | $317,301,094 | 0.96 |
| Analysis Area 2 | $81,064,905,273 | $727,675,960 | 0.90 |
| Analysis Area 3 | $49,371,624,660 | $448,243,897 | 0.91 |
| Analysis Area 4 | $202,658,888,412 | $2,322,092,214 | 1.15 |
| Analysis Area 5 | $12,310,321,163 | $98,704,208 | 0.80 |
| Analysis Area 6 | $15,736,813,833 | $106,289,759 | 0.68 |

**Table 3.9-12 School District 2013 Funding Received from Property Taxes by Analysis Area**

| Location | School District Funding from Property Taxes | | |
|---|---|---|---|
| | Total Appraised Property Value | Revenue Produced | Actual Tax Rate (percent) |
| Total of the Six Analysis Areas[1] | *$358,657,684,426* | *$3,643,295,200* | 1.02 |
| Louisiana | $456,331,000,000 | $1,543,383,304 | 0.34 |
| Texas | $2,326,066,320,168 | $24,854,671,461 | 1.07 |

1 Smith County falls within Analysis Areas 1 and 2, and Robertson and Brazos counties fall within Analysis Areas 3 and 4. As a result, the sum total for the six analysis areas is greater than the actual total for the overall analysis area.

Source: Louisiana Tax 2013; Texas School District Tax Rates 2013.

**Table 3.9-13 School District 2013 Funding Received from Property Taxes by County**

| County[1] | School District Funding from Property Taxes | | | Analysis Area |
|---|---|---|---|---|
| | Total Appraised Property Value | Revenue Produced | Actual Tax Rate (percent) | |
| Camp County | $926,527,200 | $7,554,272 | 0.82 | 1 |
| Franklin County | $1,473,715,520 | $12,354,158 | 0.84 | 1 |
| Hopkins County | $2,499,462,622 | $21,088,357 | 0.84 | 1 |
| Morris County | $1,059,540,250 | $8,941,642 | 0.84 | 1 |
| Rains County | $886,450,268 | $6,466,354 | 0.73 | 1 |
| Titus County | $3,050,657,677 | $27,628,401 | 0.91 | 1 |
| Upshur County | $2,717,110,473 | $21,485,401 | 0.79 | 1 |
| Wood County | $4,129,330,867 | $36,318,200 | 0.88 | 1 |
| Smith County | $16,419,206,444 | $175,464,309 | 1.07 | 1&2 |
| Caddo Parish, Louisiana[2] | $19,331,000,000 | $126,533,857 | 0.65 | 2 |
| DeSoto Parish, Louisiana[2] | $5,141,200,000 | $41,215,250 | 0.80 | 2 |
| Cherokee County | $3,322,986,296 | $25,369,293 | 0.76 | 2 |
| Gregg County | $9,760,420,998 | $119,968,145 | 1.23 | 2 |
| Harrison County | $7,496,942,608 | $72,098,968 | 0.96 | 2 |
| Nacogdoches County | $5,079,768,950 | $42,065,195 | 0.83 | 2 |
| Panola County | $5,287,275,310 | $48,948,327 | 0.93 | 2 |
| Rusk County | $5,921,271,910 | $51,787,877 | 0.87 | 2 |
| San Augustine County | $1,074,314,960 | $7,644,608 | 0.71 | 2 |
| Shelby County | $2,230,517,797 | $16,580,131 | 0.74 | 2 |
| Anderson County | $3,825,296,121 | $33,698,510 | 0.88 | 3 |
| Falls County | $1,198,932,240 | $5,713,952 | 0.48 | 3 |
| Freestone County | $4,072,316,450 | $40,201,873 | 0.99 | 3 |
| Henderson County | $6,904,005,618 | $61,064,035 | 0.88 | 3 |
| Leon County | $3,149,050,680 | $19,488,473 | 0.62 | 3 |

**Table 3.9-13 School District 2013 Funding Received from Property Taxes by County**

| County[1] | School District Funding from Property Taxes | | | Analysis Area |
|---|---|---|---|---|
| | Total Appraised Property Value | Revenue Produced | Actual Tax Rate (percent) | |
| Limestone County | $3,408,306,819 | $24,981,804 | 0.73 | 3 |
| Navarro County | $3,701,143,217 | $32,381,201 | 0.87 | 3 |
| Van Zandt County | $3,884,909,723 | $29,166,426 | 0.75 | 3 |
| Robertson County | $4,925,281,876 | $39,703,679 | 0.81 | 3&4 |
| Brazos County | $14,302,381,916 | $161,843,944 | 1.13 | 3&4 |
| Bastrop County | $6,307,705,872 | $62,345,569 | 0.99 | 4 |
| Burleson County | $2,340,478,577 | $14,284,180 | 0.61 | 4 |
| Lee County | $2,595,853,138 | $16,230,745 | 0.63 | 4 |
| Milam County | $3,052,550,367 | $19,544,560 | 0.64 | 4 |
| Travis County | $127,122,054,532 | $1,506,486,506 | 1.19 | 4 |
| Williamson County | $42,012,582,134 | $501,653,031 | 1.19 | 4 |
| Atascosa County | $4,634,653,077 | $39,510,402 | 0.85 | 5 |
| Live Oak County | $3,999,793,433 | $30,774,002 | 0.77 | 5 |
| McMullen County | $3,675,874,653 | $28,419,804 | 0.77 | 5 |
| Dimmit County | $6,198,723,681 | $57,535,844 | 0.93 | 6 |
| Kinney County | $1,389,804,793 | $3,520,598 | 0.25 | 6 |
| Maverick County | $3,543,178,769 | $23,184,422 | 0.65 | 6 |
| Uvalde County | $2,843,489,986 | $14,358,363 | 0.50 | 6 |
| Zavala County | $1,761,616,604 | $7,690,532 | 0.44 | 6 |
| Louisiana | $456,331,000,000 | $1,543,383,304 | 0.34 | |
| Texas | $2,326,066,320,168 | $24,854,671,461 | 1.07 | |

[1] Counties in Texas, unless otherwise noted.

[2] Appraised property value in Louisiana presented here is actually the fair market value, as the assessed value is generally 10 or 15 percent of the fair market value.

Source: Louisiana Tax 2013; Texas School District Tax Rates 2013.

### 3.9.1.6 Housing

At the time of the 2010 census, there were 153,288 vacant housing units within the six analysis areas (**Table 3.9-14**). More than 80 percent were rental units. Among the six analysis areas, Analysis Area 5 had the highest vacancy rate at 18 percent. Vacancy rates in the counties ranged from 6 percent in Williamson County to 36 percent in McMullen County. Most of the counties have higher vacancy rates than their particular state (**Table 3.10-15**) (U.S. Census 2010b).

**Table 3.9-14 2010 Housing Vacancy Rates by Analysis Area**

| Location | Housing Units | | | Vacancy Rate (percent) | Vacancy Rate by Type (percent) | |
|---|---|---|---|---|---|---|
| | Total | Occupied | Vacant | | Home Owner Units | Rental Units |
| Analysis Area 1 | 174,585 | 153,659 | 20,926 | 12.0 | 2.1 | 10.0 |
| Analysis Area 2 | 386,436 | 344,852 | 41,584 | 10.8 | 1.6 | 8.9 |
| Analysis Area 3 | 225,980 | 192,901 | 33,079 | 14.6 | 2.1 | 8.9 |
| Analysis Area 4 | 747,149 | 683,574 | 63,575 | 8.5 | 2.3 | 8.7 |
| Analysis Area 5 | 24,181 | 19,813 | 4,368 | 18.1 | 1.8 | 8.6 |
| Analysis Area 6 | 38,846 | 32,932 | 5,914 | 15.2 | 1.4 | 8.2 |
| Total of the Six Analysis Areas[1] | 1,423,684 | 1,270,396 | 153,288 | 10.8 | 2.0 | 8.9 |
| Texas | 9,977,436 | 8,922,933 | 1,054,503 | 10.6 | 2.1 | 10.8 |
| Louisiana | 1,964,981 | 1,728,360 | 236,621 | 12.0 | 1.8 | 10.5 |
| United States | 131,704,730 | 116,716,292 | 14,988,438 | 11.4 | 2.4 | 9.2 |

[1] Smith County falls within Analysis Areas 1 and 2, and Robertson and Brazos counties fall within Analysis Areas 3 and 4. As a result, the sum total for the six analysis areas is greater than the actual total for the overall analysis area.

Source: U.S. Census 2010b.

**Table 3.9-15 2010 Housing Vacancy Rates by County**

| County[1] | Housing Units | | | Vacancy Rate (percent) | Vacancy Rate by Type (percent) | | Analys is Area |
|---|---|---|---|---|---|---|---|
| | Total | Occupied | Vacant | | Homeowner Units | Rental Units | |
| Camp County | 5,656 | 4,678 | 978 | 17.3 | 2.8 | 10.3 | 1 |
| Franklin County | 5,770 | 4,159 | 1,611 | 27.9 | 2.4 | 10.2 | 1 |
| Hopkins County | 15,029 | 13,308 | 1,721 | 11.5 | 1.5 | 9.4 | 1 |
| Morris County | 6,024 | 5,226 | 798 | 13.2 | 2.1 | 9.4 | 1 |
| Rains County | 5,269 | 4,377 | 892 | 16.9 | 2.3 | 7.2 | 1 |
| Titus County | 12,054 | 10,813 | 1,241 | 10.3 | 1.8 | 10.7 | 1 |
| Upshur County | 16,613 | 14,925 | 1,688 | 10.2 | 1.7 | 7.8 | 1 |
| Wood County | 20,861 | 17,118 | 3,743 | 17.9 | 2.3 | 10.3 | 1 |
| Smith County | 87,309 | 79,055 | 8,254 | 9.5 | 2.1 | 10.5 | 1&2 |
| Caddo Parish, Louisiana | 112,028 | 102,139 | 9,889 | 8.8 | 1.4 | 7.7 | 2 |
| DeSoto Parish, Louisiana | 12,290 | 10,562 | 1,728 | 14.1 | 1.0 | 7.0 | 2 |
| Cherokee County | 20,859 | 17,894 | 2,965 | 14.2 | 1.9 | 10.7 | 2 |
| Gregg County | 49,514 | 45,798 | 3,716 | 7.5 | 1.6 | 6.9 | 2 |
| Harrison County | 27,704 | 24,523 | 3,181 | 11.5 | 1.6 | 8.6 | 2 |

**Table 3.9-15 2010 Housing Vacancy Rates by County**

| County[1] | Housing Units | | | Vacancy Rate (percent) | Vacancy Rate by Type (percent) | | Analys is Area |
|---|---|---|---|---|---|---|---|
| | Total | Occupied | Vacant | | Homeowner Units | Rental Units | |
| Nacogdoches County | 27,406 | 23,861 | 3,545 | 12.9 | 1.4 | 10.4 | 2 |
| Panola County | 10,920 | 9,271 | 1,649 | 15.1 | 1.6 | 9.3 | 2 |
| Rusk County | 21,191 | 18,476 | 2,715 | 12.8 | 1.4 | 9.6 | 2 |
| San Augustine County | 5,342 | 3,625 | 1,717 | 32.1 | 1.4 | 13.9 | 2 |
| Shelby County | 11,873 | 9,648 | 2,225 | 18.7 | 1.3 | 9.5 | 2 |
| Anderson County | 20,116 | 17,218 | 2,898 | 14.4 | 2.0 | 8.9 | 3 |
| Falls County | 7,724 | 6,302 | 1,422 | 18.4 | 2.0 | 9.1 | 3 |
| Freestone County | 9,265 | 7,259 | 2,006 | 21.7 | 1.8 | 11.7 | 3 |
| Henderson County | 39,595 | 31,020 | 8,575 | 21.7 | 3.1 | 10.3 | 3 |
| Leon County | 9,509 | 6,896 | 2,613 | 27.5 | 1.8 | 14.6 | 3 |
| Limestone County | 10,536 | 8,499 | 2,037 | 19.3 | 2.3 | 8.0 | 3 |
| Navarro County | 20,234 | 17,380 | 2,854 | 14.1 | 2.2 | 9.1 | 3 |
| Van Zandt County | 22,817 | 20,047 | 2,770 | 12.1 | 1.8 | 8.1 | 3 |
| Robertson County | 8,484 | 6,541 | 1,943 | 22.9 | 1.3 | 13.1 | 3&4 |
| Brazos County | 77,700 | 71,739 | 5,961 | 7.7 | 1.7 | 7.0 | 3&4 |
| Bastrop County | 29,316 | 25,840 | 3,476 | 11.9 | 2.1 | 9.9 | 4 |
| Burleson County | 8,832 | 6,822 | 2,010 | 22.8 | 1.5 | 7.4 | 4 |
| Lee County | 7,499 | 6,151 | 1,348 | 18.0 | 1.9 | 10.7 | 4 |
| Milam County | 11,305 | 9,408 | 1,897 | 16.8 | 2.0 | 13.9 | 4 |
| Travis County | 441,240 | 404,467 | 36,773 | 8.3 | 2.5 | 8.7 | 4 |
| Williamson County | 162,773 | 152,606 | 10,167 | 6.2 | 2.0 | 8.8 | 4 |
| Atascosa County | 17,631 | 15,246 | 2,385 | 13.5 | 1.7 | 8.5 | 5 |
| Live Oak County | 6,065 | 4,257 | 1,808 | 29.8 | 2.4 | 9.5 | 5 |
| McMullen County | 485 | 310 | 175 | 36.1 | 0.4 | 1.7 | 5 |
| Dimmit County | 4,350 | 3,421 | 929 | 21.4 | 1.4 | 9.3 | 6 |
| Kinney County | 1,940 | 1,350 | 590 | 30.4 | 3.5 | 15.3 | 6 |
| Maverick County | 17,462 | 15,563 | 1,899 | 10.9 | 1.0 | 6.9 | 6 |
| Uvalde County | 10,811 | 9,025 | 1,786 | 16.5 | 1.8 | 9.4 | 6 |
| Zavala County | 4,283 | 3,573 | 710 | 16.6 | 1.0 | 5.9 | 6 |
| Louisiana | 1,964,981 | 1,728,360 | 236,621 | 12.0 | 1.8 | 10.5 | |
| Texas | 9,977,436 | 8,922,933 | 1,054,503 | 10.6 | 2.1 | 10.8 | |
| U.S. | 131,704,730 | 116,716,292 | 14,988,438 | 11.4 | 2.4 | 9.2 | |

[1] Counties in Texas, unless otherwise noted.

Source: U.S. Census 2010b.

### 3.9.2 Environmental Consequences

Issues associated with social and economic values include potential impacts to local employment with related income and population effects, tax and other public revenue changes, as well as effects on public services supply and demand, property values, growth and development of local communities, and the local social fabric and quality of life. These issues include local concerns about the location and timing of displacement of homes and livelihoods.

The analysis area for direct and indirect effects to social and economic values includes 43 counties within or adjacent to the six study areas, two of which are in the State of Louisiana, and the remaining counties are in the State of Texas.

#### 3.9.2.1 Proposed Action

The life of a typical mine expansion would range from approximately 1 to 30 years. For a typical satellite mine, it would range from approximately 5 to 30 years. The time period associated with the three general mine phases generally would be:

- Construction or development activities (primarily in mine year 1);
- Operations or steady-state mining activities (starting in mine year 1 or 2 and continuing for up to 30 years); and
- Closure and final reclamation activities (up to 5 years following the completion of mining).

Mining is ongoing in all study areas. Therefore, it is not expected to lead to a substantial increase of employees (281 to 341 new hires) (see **Table 2-5**), because existing employees at mines which are near the end of the mine life would transition to the new locations.

<u>Population and Housing</u>

The population of the study areas would not be expected to change measurably as a result of the Proposed Action because it would result in approximately 281 to 341 new hires, mostly in Study Area 6, which has the lowest current and projected future population. There would be no impetus for population growth caused by the development of satellite mines or mine expansion areas.

Potential future surface coal and lignite mine expansion areas and satellite mines may result in resident displacement in the study area, depending on the location of mining operations. Although the size and location of the displacement is not known, it is not expected to be substantial and would not occur all at once but sequentially as mining progresses through each mine area. Displacement would continue for the life of the disturbance plus at least 7 years while reclamation activities would be completed and monitored. It is not known where the displaced families would relocate; however, it is assumed that most would remain in the study area for jobs, family ties, or other reasons for their current choice of location. As described in Section 3.9.1.6, there are currently 153,288 homes vacant in the all six study areas with a vacancy rate between 8 and 18 percent. Total population growth of around 700,000 is expected in all study areas by 2020. However, it is assumed that a comparable number of homes would be on the market going forward and there would be sufficient housing available to accommodate the comparably marginal number of displacees locally if they choose to remain in the area. Demographic characteristics of the potential displacees are discussed in Section 3.15, Environmental Justice.

<u>Employment</u>

It is anticipated that a future mine expansion area or satellite mine would not substantially change employment or income patterns in the study areas. The only notable change from the current employment levels would be an estimated maximum of 1,165 contract workers; more than 60 percent would be temporary during the construction phases. With nearly 140,000 potential workers unemployed in the 43-county study area, it is assumed that a majority of contract workers needed for future mine expansion areas or satellite mines would be hired from the local area unless certain specific skills would be needed that would not be locally available. As presented in **Table 2-5**, the highest number of new hires is expected to occur within Study Area 6, which has the highest percentage of unemployment (11.8 percent) among the six study areas.

Temporary contract workers would not be expected to relocate to the study area; those not living within daily commuting distance likely would reside in campgrounds or motel facilities during the work week and commute to permanent homes on weekends. Temporary contract workers would provide a modest increase in commercial activity and sales tax revenues in the study areas; however, they would not be expected to have a substantial effect on the area population or economy due to their temporary status. A small number of farm and ranch workers currently working in the study areas may be displaced during mine operations, and tenants and employees likely would lose their employment until the lands have been reclaimed and agriculture resumes.

Income

Wage and salary income provided to the mine workers at future mine expansion areas or satellite mines is assumed to be comparable to worker income at the existing mines. Consequently, a typical mine is expected to have similar effects on study area income as does the existing coal or lignite mine. Extending mining in the analysis area would serve to maintain mine workers' income over a longer time period.

Potential future development of mine expansion areas or satellite mines may shift the income within the counties. However, the shift in income would be marginal and would happen gradually; therefore, it would not result in substantial change in income within the counties of each study area.

Public Finance

Future mine expansion or satellite mines would result in additional value to the tax base of the 43 counties of the analysis area. However, the dynamic nature of mining operations makes it difficult to predict taxable assets for the counties. State and local taxing jurisdictions currently receive $640 million in annual revenues from coal and lignite mining-related activities (Clower et al. 2013). Coal and lignite mining also supports approximately $147 million annually in direct and indirect tax revenues.

Property taxes are collected by the jurisdiction in which the equipment and mine are located at the beginning of each year. As future mining progresses through each study area, property tax revenue may change as the area being mined and mining equipment move into and out of the various jurisdictions. As the coal and lignite resources are depleted at existing mines, property tax revenues in those counties would decline.

Public Education

Property tax payments to local school districts could change depending on the location of future mine expansion areas and satellite mines. If there are shifts between school districts, the actual effects on school district budgets may not be noticeable as the shift in property tax payments, because state financial support would be adjusted to compensate for gains or losses under Texas' school funding rules.

#### 3.9.2.2 No Action

Under the No Action Alternative, the permitting of future coal and lignite expansion areas and satellite mines may be spread over a longer period of time due to the possibly lengthier permitting process. Therefore, the No Action Alternative would affect population (including race and ethnicity), income, industry, employment, public finance, and housing in a similar way as the Proposed Action.

### 3.9.3 Cumulative Impacts

The CESAs for social and economic values use the same boundaries as the study areas for direct and indirect effects (see **Appendix A**, **Figure A-16**). The past and present actions and RFFAs are identified in Section 2.4. Social and economic effects of the past and present actions in the CESAs are reflected in Section 3.9.1, Affected Environment.

There may be temporary increases in employment due to future highway construction projects; however, the greatest impact from increased employment resulting in population growth, housing demands, and increases in the tax base in the six CESAs is most likely to come from oil and gas development. Projected future mining-related employment under both the Proposed Action and the No Action alternatives would be relatively minor compared to oil and gas development in all but CESA 1.

### 3.9.4 Monitoring and Mitigation Measures

No monitoring or mitigation measures are recommended for social and economic values.

### 3.9.5 Residual Adverse Effects

There would be no residual adverse effects associated with social and economic issues as a result of the Proposed Action or the No Action alternatives.

# 3.10 Transportation

## 3.10.1 Affected Environment

### 3.10.1.1 Highways

LOS is a standardized method of qualitatively measuring the operational conditions of traffic flows on roadways and the perception of those conditions by motorists and passengers (Transportation Research Boarc 2000). A road's LOS is determined based on the ratio of traffic flow volumes to estimated capacity. LOS is rated "A" through "F." An "A" rating generally represents free-flowing conditions with few restrictions, and an "F" rating represents a "forced or break-down" flow condition with queues forming and traffic volume exceeding the theoretical capacity of the roadway (Transportation Research Board 2000). Generally, LOS "E" represents a traffic volume condition at the theoretical capacity of the roadway. Detailed LOS analyses have not been conducted for road segments in the analysis area; however, approximations were developed based on existing traffic levels relative to general roadway characteristics.

The relevant LOS standard for evaluating traffic conditions in the six study areas is the commonly used criterion for rural highways of LOS C during peak hour periods. At LOS C, traffic flows are in the stable range; however, most drivers are becoming restricted in their freedom to select speed, change lanes, or pass other vehicles.

Traffic flow data from 2012, estimated LOS, and TxDOT highway classification information for the major highways in each the six analysis study areas are presented in **Table 3.10-1**.

**Table 3.10-1 Highways and Status by Study Area**

| Highway Number[1] | Average Annual Daily Traffic[2] | Estimated LOS | TxDOT Classification |
|---|---|---|---|
| **Study Area 1** | | | |
| I-30 | 25,000 | B | Rural Major Collector |
| U.S. Highway 67 | 2,500 | A | Rural Minor Arterial |
| U.S. Highway 271 | 11,600 | A | Rural Principal Arterial |
| U.S. Highway 80 | 3,000 | A | Rural Minor Arterial |
| SH 11 | 7,800 | B | Rural Minor Arterial |
| SH 19 | 3,300 | A | Rural Minor Arterial |
| SH 37 | 3,200 | A | Rural Minor Arterial |
| SH 49 | 5,500 | A | Rural Major Collector |
| SH 96 | NA | NA | Rural Principal Arterial |
| SH 154/182 | 4,200 | A | Rural Minor Arterial |
| **Study Area 2** | | | |
| I-20 | 13,500-30,000 | B | Rural Major Collector |
| U.S. Highway 59 | 7,200-10,700 | A | Rural Principal Arterial |
| U.S. Highway 79 | 4,800-6,300 | A | Rural Principal Arterial |
| U.S. Highway 84 | 10,900 | B | Rural Minor Arterial |
| U.S. Highway 259 | 6,700-12,000 | A | Rural Principal Arterial |
| SH 7 | NA | NA | Rural Minor Arterial |
| SH 42 | NA | NA | Rural Major Collector |
| SH 43 | 4,400 | A | Rural Minor Arterial |

**Table 3.10-1 Highways and Status by Study Area**

| Highway Number[1] | Average Annual Daily Traffic[2] | Estimated LOS | TxDOT Classification |
|---|---|---|---|
| SH 110 | NA | NA | Rural Major Collector |
| SH 135 | NA | NA | Rural Major Collector |
| SH 149 | 8,300 | B | Rural Minor Arterial |
| SH 204 | NA | NA | Rural Minor Arterial |
| SH 322 | NA | NA | Rural Minor Arterial |
| SH 323 | NA | NA | Rural Major Collector |
| **Study Area 3** | | | |
| I-45 | 24,000-26,000 | B | Rural Major Collector |
| U.S. Highway 79 | 6,500 | A | Rural Principal Arterial |
| U.S. Highway 84 | 3,100-6,400 | A | Rural Minor Arterial |
| U.S. Highway 175 | 4,600-6,800 | A | Rural Principal Arterial |
| U.S. Highway 287 | 2,500 | A | Rural Minor Arterial |
| SH 6 | 5,100 | A | Rural Principal Arterial |
| SH 7 | 2,800 | A | Rural Minor Arterial |
| SH 14 | 1,950-2,400 | A | Rural Minor Arterial |
| SH 19 | 4,500 | A | Rural Minor Arterial |
| SH 31 | 7,100 | B | Rural Principal Arterial |
| SH 75 | NA | NA | Rural Major Collector |
| SH 164 | NA | NA | Rural Major Collector |
| SH 179 | NA | NA | Rural Major Collector |
| SH 198 | NA | NA | Rural Major Collector |
| **Study Area 4** | | | |
| U.S. Highway 77 | 4,600 | A | Rural Minor Arterial |
| U.S. Highway 79 | 5,100-6,500 | A | Rural Principal Arterial |
| U.S. Highway 190 | 7,500 | A | Rural Principal Arterial |
| U.S. Highway 290 | 10,800 | A | Rural Principal Arterial |
| SH 36 | 4,600 | A | Rural Principal Arterial |
| **Study Area 5** | | | |
| I-37/U.S. Highway 281 | 12,700 | B | Rural Local |
| SH 16 | 4,900 | A | Rural Minor Arterial |
| SH 72 | NA | NA | Rural Major Collector |
| **Study Area 6** | | | |
| U.S. Highway 57 | 3,600 | A | Rural Minor Arterial |
| U.S. Highway 277 | 3,700 | A | Rural Principal Arterial |

[1] I = Interstate Highway; SH = State Highway.

[2] Based on 2012 data.

Study Area 1

Study Area 1 includes all or part of Camp, Franklin, Hopkins, Rains, Titus, and Wood counties. Major highways in the study area and the CESA are identified in **Table 3.10-1**. Traffic in Study Area 1 counties generally has grown slowly from 2000 to 2012, or declined modestly over the same period. Daily vehicle miles traveled (VMT) declined by over 4 percent in Camp and Rains counties over this period; the other counties experienced changes ranging from declines of 3 percent to increases of 11 percent.

Study Area 2

Study Area 2 includes all or part of Cherokee, Gregg, Harrison, Panola, Rusk, Shelby, and Smith counties. Major highways in the study area and the CESA are identified in **Table 3.10-1**. Changes in VMT in Study Area 2 from 2000 to 2012 followed a pattern similar to Study Area 1, with Cherokee County travel declining by 4 percent or more, while VMT in the other counties ranged from declines of 3 percent to increases of 11 percent.

Study Area 3

Study Area 3 includes all or part of Anderson, Falls, Freestone, Henderson, Leon, Limestone, Robertson, and Van Zandt counties. Major highways in the study area and the CESA are identified in **Table 3.10-1**. Changes in Study Area 3 VMT from 2000 to 2012 generally ranged from a decline of 3 percent to an increase of 11 percent in 6 of the 8 counties. VMT declined by 4 percent or more in Limestone County, and increased between 12 percent and 34 percent from 2000 to 2012 in Leon County.

Study Area 4

Study Area 4 includes all or part of Bastrop, Burleson, Lee, Milam, and Williamson counties. Major highways in the study area and the CESA are identified in **Table 3.10-1**. The VMT in three of the five Study Area 4 counties ranged from a decline of 3 percent to an increase of 11 percent. The other two counties (Williamson and Bastrop) experienced an increase in VMT, ranging from 12 to 34 percent from 2000 to 2012.

Study Area 5

Study Area 5 covers all or part of Atascosa and McMullen counties. Major highways in the study area and the CESA are identified in **Table 3.10-1**. Study Area 5 is located in one of the oil “boom” sections of south Texas. Increased petroleum development in the two study area counties is reflected in the increases in VMT. The VMT increase in Atascosa County ranged from 35 to 85 percent from 2000 to 2012, while the increase in McMullin County was greater than 85 percent, the highest level reported by TxDOT (2014b).

Study Area 6

Study Area 6 covers all or part of Dimmit, Kinney, Maverick, and Zavala counties. Major highways in the study area and the CESA are identified in **Table 3.10-1**. Dimmit County, which is in one of the south Texas oil and gas development areas, experienced an increase in VMT of more than 85 percent from 2000 to 2012. The VMT in Kinney County, which primarily lies between two oil and gas development areas, ranged from a decline of 3 percent to an increase of 11 percent. Maverick and Zavala counties, which were identified by TxDOT (2014b) as being adjacent to an oil and gas development area, experienced a modest growth in VMT, ranging of from 12 to 34 percent.

### 3.10.1.2 Railroads

Study Area 1

Four rail lines intersect with Study Area 1. They are operated by Union Pacific, Kansas City Southern Railway, Blacklands Railroad, and Texas Utilities. Data from TxDOT (2010) indicate that of the four rail lines, the Kansas City Southern Railway hauled the most freight at 10 to 19.9 million tons annually. Second was the Blacklands Railroad at up to 9.9 million tons of freight hauled annually.

Study Area 2

Seven rail lines intersect with Study Area 2. Two are operated by Union Pacific, and the others are operated by Burlington Northern/Santa Fe, Blacklands Railroad, Texas Utilities, Southwest Electric Power, and Timberrock Railroad. TxDOT (2010) data indicate that of the rail operators, the Union Pacific hauled the most freight at 20 to 29.9 million tons annually. Next were Burlington Northern/Santa Fe, Blacklands Railroad, and Texas Utilities, all hauling up to 9.9 million tons annually.

Study Area 3

Six rail lines intersect with Study Area 3. Three are operated by Union Pacific and the others are operated by Burlington Northern/Santa Fe, Texas Utilities, and Texas Utilities Electric Big Brown Steam Electric Station Rail Spur. TxDOT (2010) data indicate that of the operators, Union Pacific and Burlington Northern/Santa Fe hauled the most freight at 20 to 29.9 million tons annually.

Study Area 4

Four rail lines intersect with Study Area 4. They are operated by Union Pacific, Burlington Northern/Santa Fe, Rockdale Sandow, Southern Railroad Co., and Capitol Metropolitan Transportation Authority. TxDOT (2010) data indicate that the Burlington Northern/Santa Fe line was one of the most highly utilized rail lines in Study Area 4 and the state, hauling more than 60 million tons of freight annually. Second was the Union Pacific at 40 to 49.9 million tons hauled annually.

Study Area 5

One railway, operated by Union Pacific, borders the Study Area 5 on the north. TxDOT (2010) data indicate that the Union Pacific rail line hauled up to 9.9 million tons of freight annually.

Study Area 6

Primary rail service to Study Area 6 is provided by a Union Pacific line that generally runs northward from Eagle Pass to the east-west main line that connects easterly to a hub at San Antonio and northwesterly through Del Rio and Sierra Blanca to El Paso. As of 2007, the Eagle Pass line hauled between 10 and 19.9 million tons of freight annually.

### 3.10.2 Environmental Consequences

### 3.10.2.1 Proposed Action

The analysis area for direct and indirect effects for transportation includes the six study areas, with the focus on major roadway and rail transportation networks serving those areas.

Highways

Transportation impacts are commonly evaluated based on whether the acceptable LOS would be maintained on major roadway segments, and whether safe travel conditions for the public would be adversely affected. At a regional scale, the key consideration would be whether there any existing travel constraints on major roadways, including LOS, traffic safety, travel times, and private property access, that would be exacerbated by potential future surface coal or lignite mine expansion areas or satellite mines.

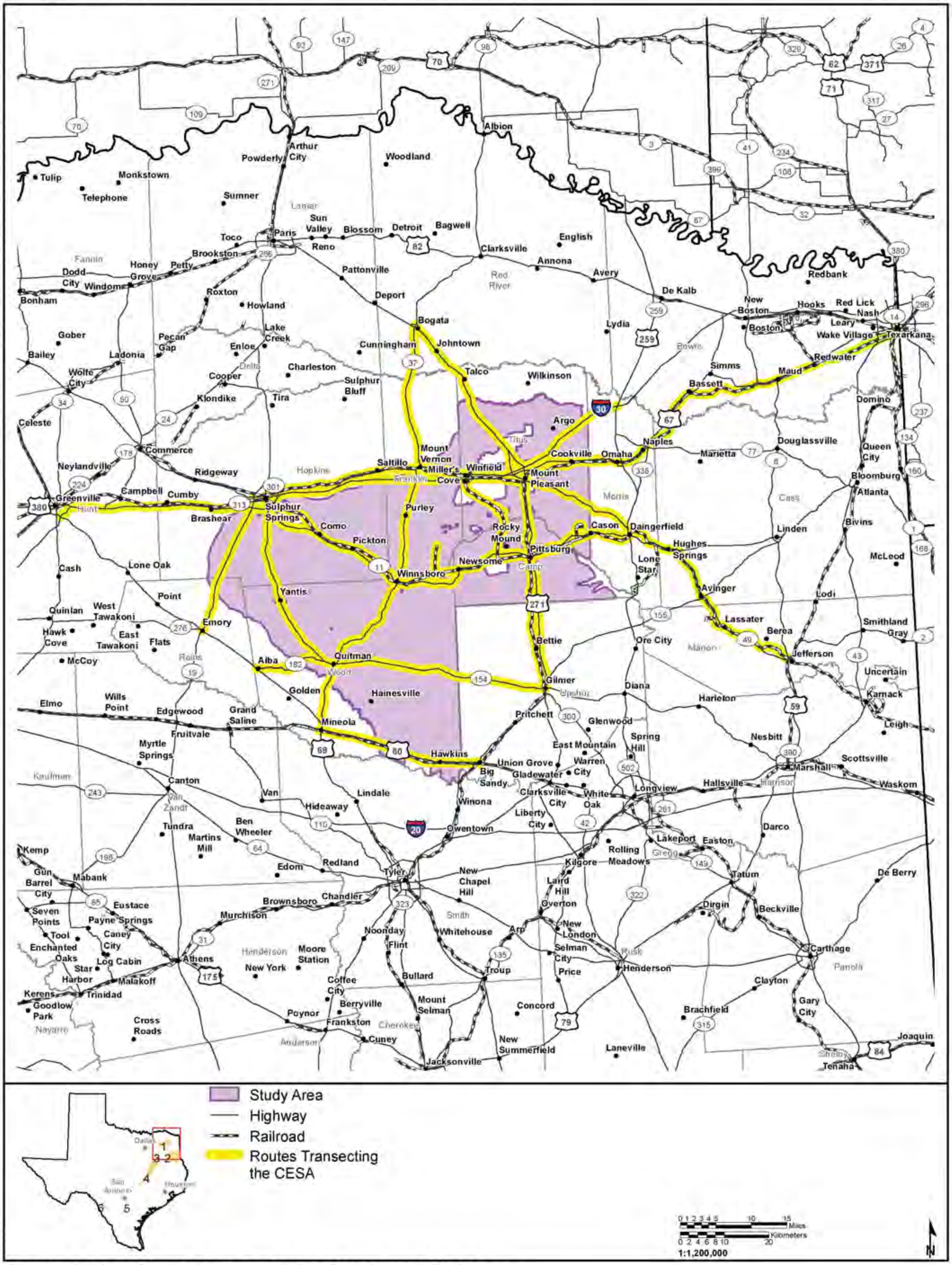



**Figure 3.10-1 Study Area 1 – Major Roads and Rail Lines**

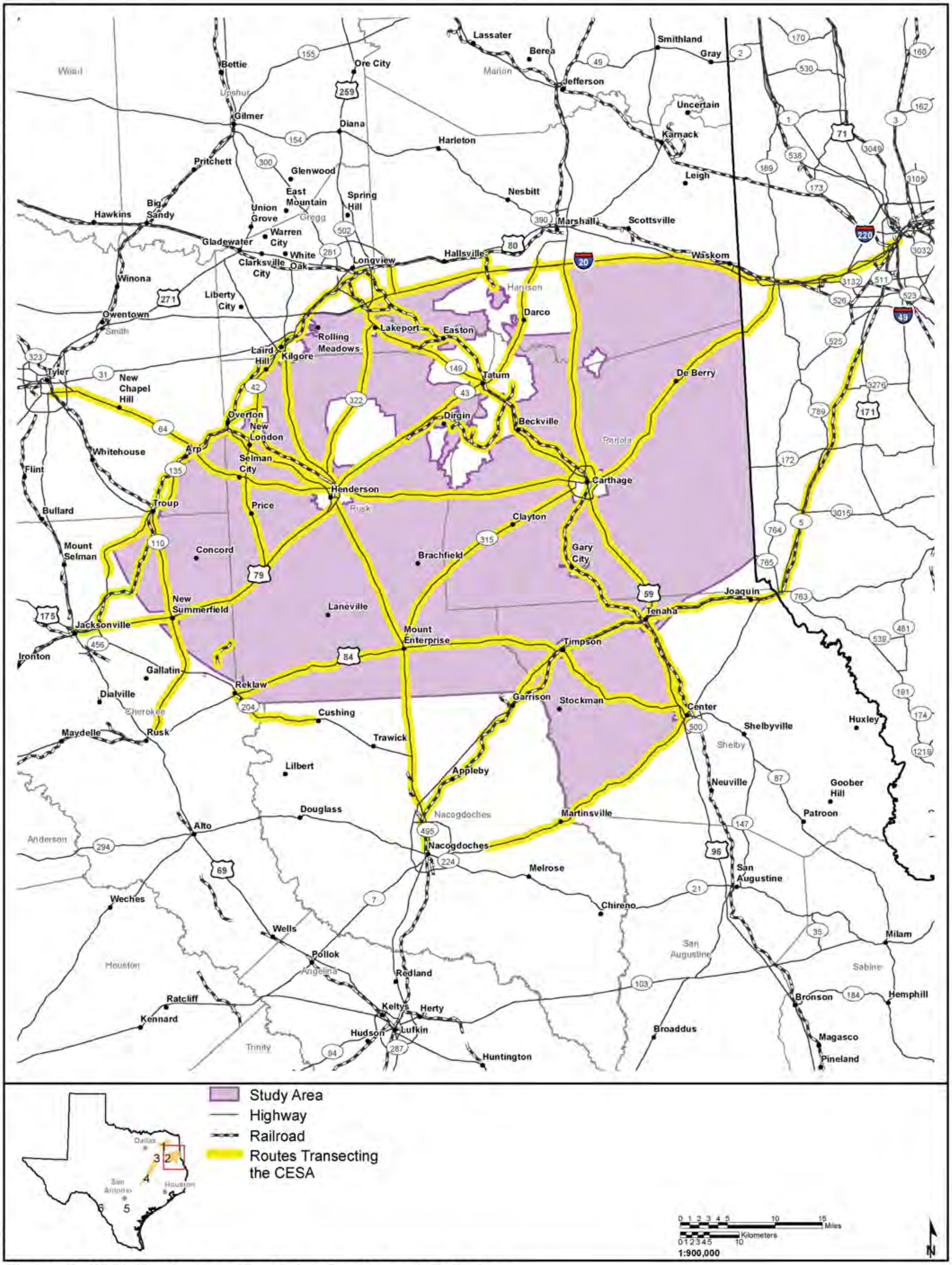



**Figure 3.10-2 Study Area 2 – Major Roads and Rail Lines**

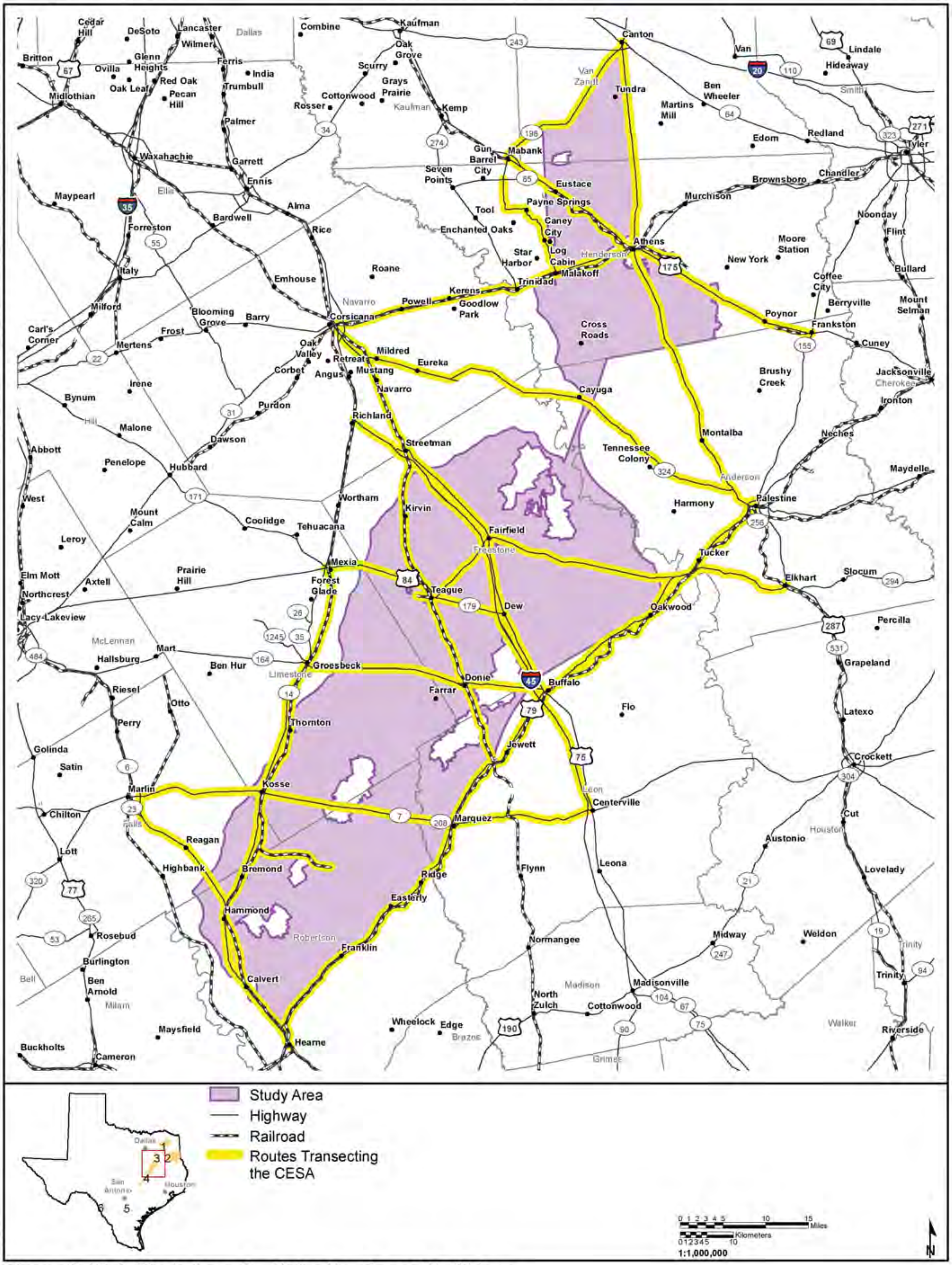



Figure 3.10-3 Study Area 3 – Major Roads and Rail Lines

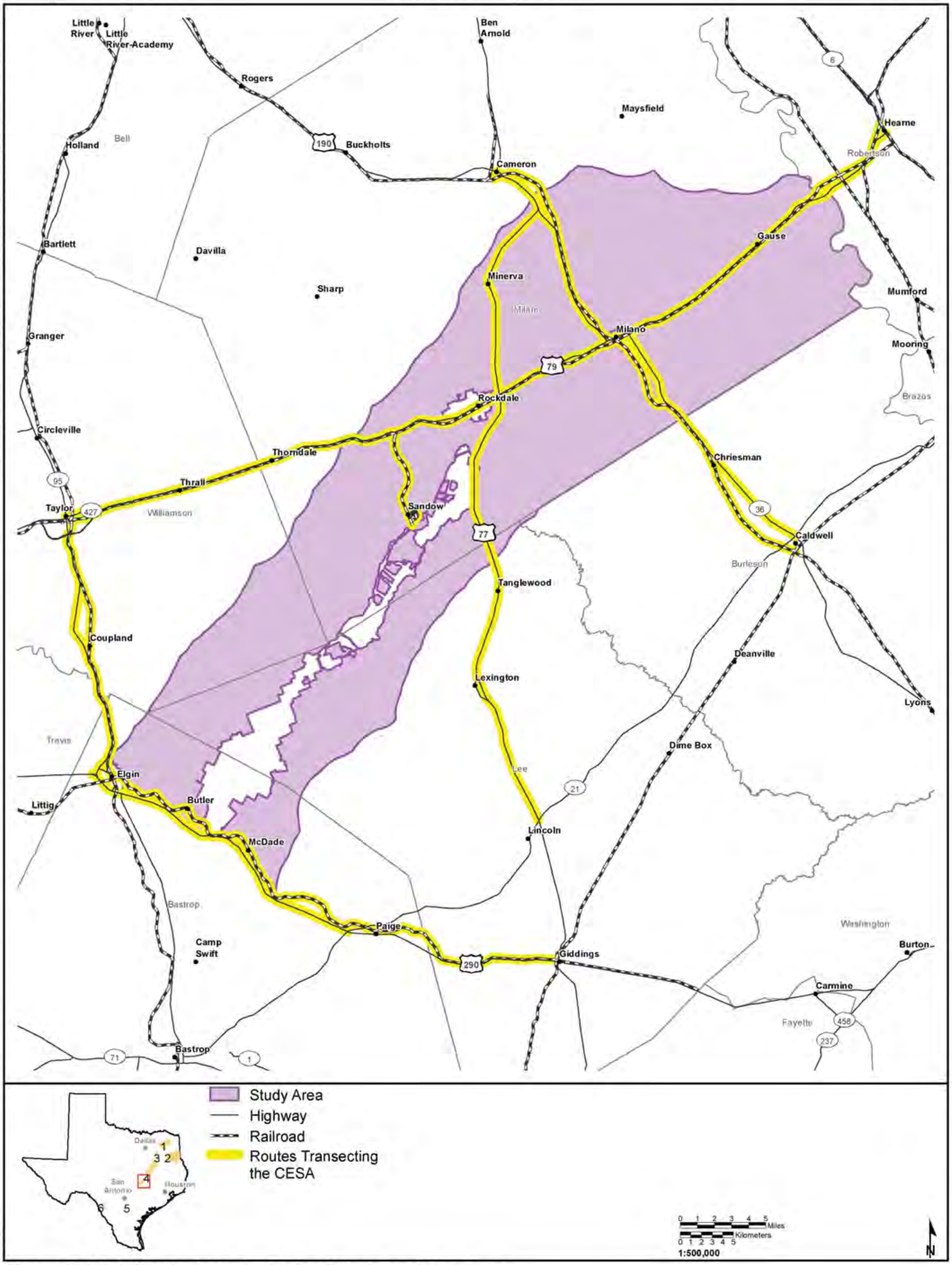



Figure 3.10-4 Study Area 4 – Major Roads and Rail Lines

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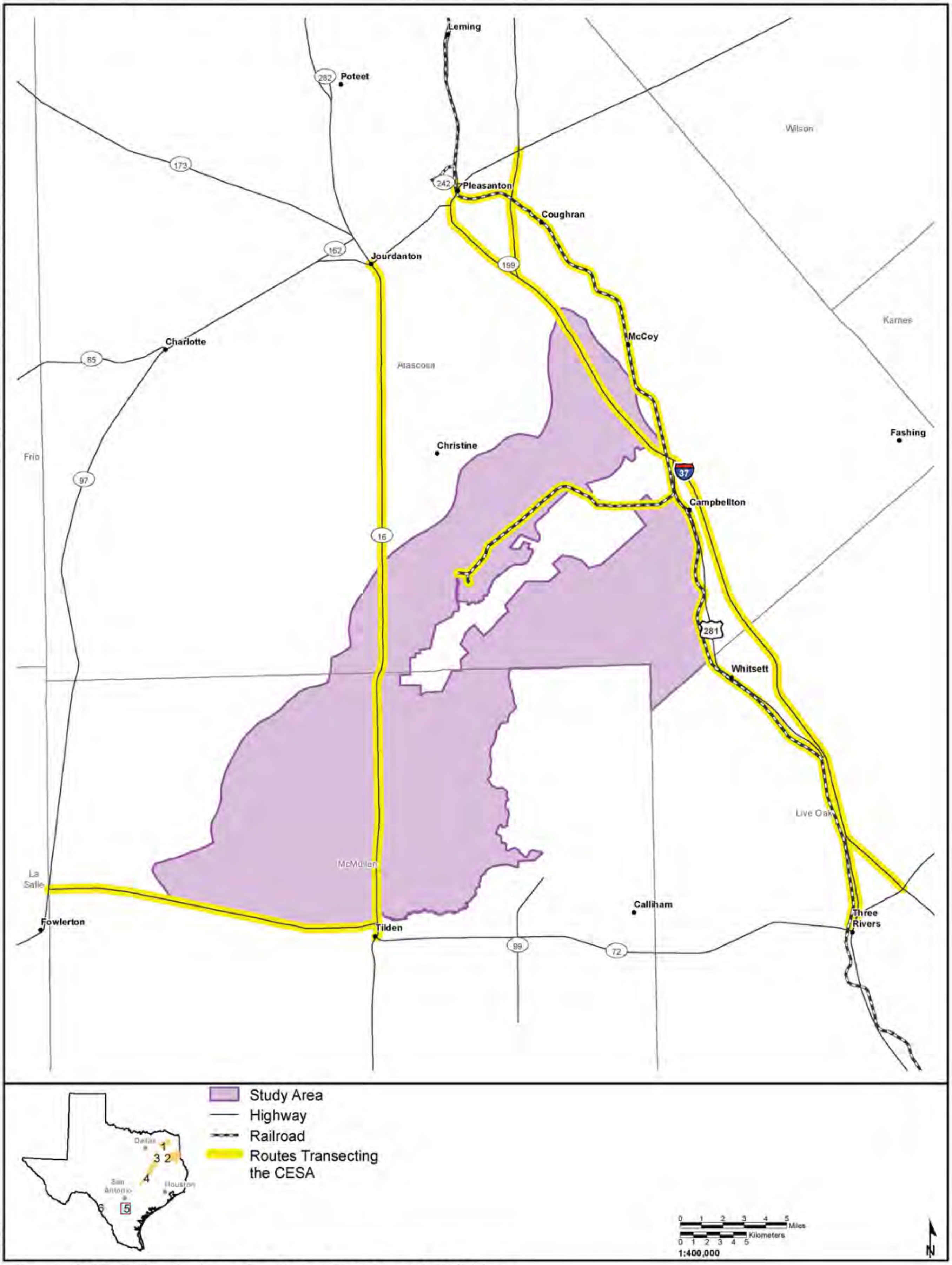


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Figure 3.10-5 Study Area 5 – Major Roads and Rail Lines

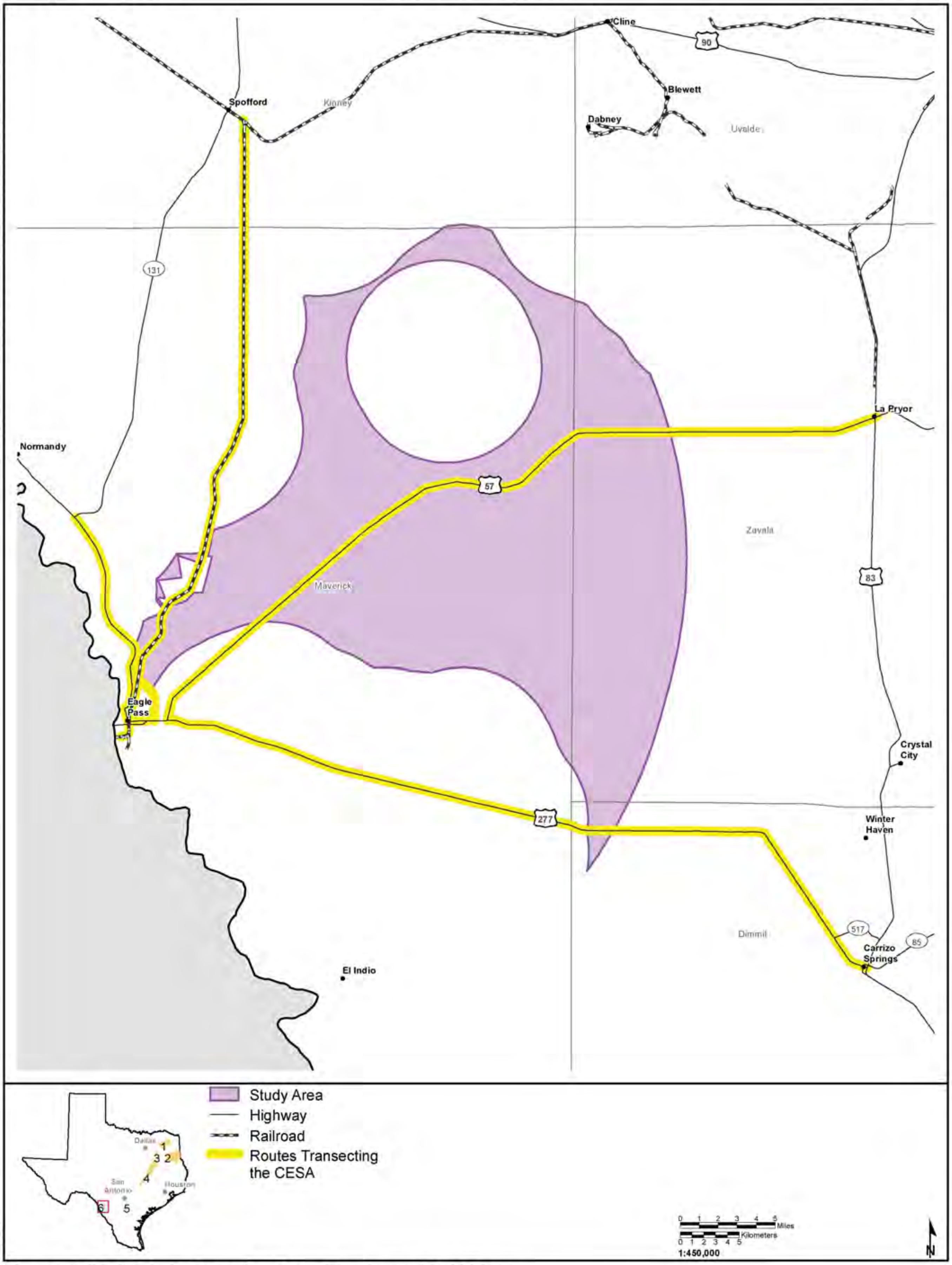


Figure 3.10-6 Study Area 6 – Major Roads and Rail Lines

The transportation corridors potentially affected by future mine expansion areas or satellite mines would depend on the location of an expansion area or satellite mine in relation to the existing mine. If similar transportation corridors would be used, the roadways potentially would experience a temporary increase in employee-related vehicle trips to, from, and within the study areas during peak construction. If alternate transportation corridors would be used, the transportation corridors currently used for existing operations would experience a decline in mine-related traffic (employee vehicles and delivery trucks [e.g., fuel]), and the future proposed transportation corridors would experience an increase in traffic levels.

Safety is an important criterion when evaluating a roadway. Many factors contribute to roadway safety including road conditions, sight distances, roadway geometry, and weather conditions. Possible effects of potential future surface coal or lignite mine expansion areas or satellite mines include changes to highway access points, changes in traffic patterns, and increases in oversized vehicles on public roadways.

*Study Areas 1-6*

The major roadways within the study areas are identified in **Table 3.10-1** and shown in **Figures 3.10-1** to **3.10-6**. There would be limited to no increase in traffic related to the Proposed Action as mine expansions and satellite mines would replace existing mines as their permits expire and the mineable coal or lignite is depleted. This would keep traffic levels mostly static as employees would be shifted to the new expansion areas and satellite mines, instead of adding additional employees to the employee base. Temporary increases to traffic levels are possible during operations, but specifically during peak construction in all the study areas; however, it is anticipated that any incremental increases in traffic levels during peak construction and operations would not contribute to a decrease in LOS, nor would safety on public roadways be meaningfully affected. If alternate transportation routes would be used for future mine expansion areas or satellite mines, the effects to LOS and safety as a result of increased traffic would need to be evaluated.

Short-term delays may result where roads would be affected by bridge or overpass construction to accommodate mining. Smaller roads within a future mine area would be closed incrementally by the jurisdictional agency in advance of mine operations, and alternate public and landowner access routes would be provided prior to road closures.

<u>Railroads</u>

It is anticipated that there would be little if any change in rail traffic on main lines as a result of a typical future surface coal or lignite mine expansion area or satellite mine in Study Areas 1 through 6. Therefore, effects on rail transportation would be expected to be minimal for lines serving those areas.

#### 3.10.2.2 No Action

The transportation activities associated with development of a future surface coal or lignite mine expansion area or satellite mine under the No Action Alternative would be the same as those described for the Proposed Action alternative. Therefore, the general impacts to transportation resources would be the same, but may be spread over a longer period of time due to the possibly lengthier permitting process.

### 3.10.3 Cumulative Impacts

The transportation CESAs includes the major traffic arteries within each of the six study areas and the portions of those networks extending beyond the study area boundaries to the nearest intersection with a major federal or state highway where potential future surface coal or lignite mine expansion-related traffic would be expected to meld into existing or anticipated traffic flows (see **Appendix A**, **Figures A-17** through **A-22**).

The past and present actions and RFFAs are identified in Section 2.4. Cumulative impacts to transportation resources would be the result of increased levels of traffic from actions including mining, infrastructure development, and oil and gas development. Impacts would be similar to those discussed in Section 3.10.2.

### 3.10.3.1 Study Area 1

Existing surface coal and lignite mines within the study area contribute to the current and future levels of traffic in the CESA. Current traffic levels on highways that service these actions are well within highway capacities.

Reasonably foreseeable future actions within the study area, such as 111 miles of state highway construction and 9 public water supply projects, would add vehicles to the local road network as construction commences, as well as potentially cause delays as roads may be temporarily closed and traffic routed through detours. Ultimately, state highway construction would add to a more efficient and safe road network, as lanes and safety enhancing features may be added. Both state highway construction and public water supply projects would be short-term. The Proposed Action and No Action alternatives would not add to current traffic levels within the CESA as the existing workforce would be utilized at future mine expansion areas and satellite mines.

The contribution to cumulative effects to rail traffic as a result of future mine expansion areas or satellite mines would negligible.

### 3.10.3.2 Study Area 2

Existing surface coal and lignite mines within the study area, as well as current oil and gas development, contribute to the existing and future levels of traffic in the CESA. Current traffic levels on highways that service these actions are well within highway capacities.

Reasonably foreseeable future actions within the study area, such as 98 miles of state highway construction and 8 public water supply projects, would add vehicles to the local road network as construction commences, as well as potentially cause delays as roads may be shut down and traffic routed through detours. Ultimately, state highway construction would add to a more efficient and safe road network, as lanes and safety enhancing features may be added. Both state highway construction and public water supply projects would be short-term. The Proposed Action and No Action alternatives would not add to current traffic levels within the CESAs as the existing workforce would be utilized at future mine expansion areas and satellite mines.

The contribution to cumulative effects to rail traffic as a result of future mine expansion areas or satellite mines would negligible.

### 3.10.3.3 Study Area 3

Existing surface coal and lignite mines within the study area contribute to the current and future levels of traffic in the CESA. Current traffic levels on highways that service these actions are well within highway capacities.

Reasonably foreseeable future actions within the study area, such as 117 miles of state highway construction and 16 public water supply projects, would add vehicles to the local road network as construction commences, as well as potentially cause delays as roads may be temporarily closed and traffic routed through detours. Ultimately, state highway construction would add to a more efficient and safe road network, as lanes and safety enhancing features may be added. Both state highway construction and public water supply projects would be short-term. The Proposed Action and No Action alternatives would not add to current traffic levels within the CESA as the existing workforce would be utilized at future mine expansion areas and satellite mines.

The contribution to cumulative effects to rail traffic as a result of future mine expansion areas or satellite mines would negligible.

#### 3.10.3.4 Study Area 4

Existing surface coal and lignite mines within the study area contribute to the current and future levels of traffic in the CESA. Current traffic levels on highways that service these actions are well within highway capacities.

Reasonably foreseeable future actions within the study area, such as 470 miles of state highway construction and 28 public water supply projects, would add vehicles to the local road network as construction commences, as well as potentially cause delays as roads may be temporarily closed and traffic routed through detours. Ultimately, state highway construction would add to a more efficient and safe road network, as lanes and safety enhancing features may be added. Both state highway construction and public water supply projects would be short-term. The Proposed Action and No Action alternatives would not add to current traffic levels in the CESA as the existing workforce would be utilized at future mine expansion areas and satellite mines.

The contribution to cumulative effects to rail traffic as a result of future mine expansion areas or satellite mines would negligible.

#### 3.10.3.5 Study Area 5

Existing surface coal and lignite mines, as well as oil and gas development, within the study area contribute to the current and future levels of traffic within the CESA. Current traffic levels on highways that service these actions are well within highway capacities.

Reasonably foreseeable future actions within the study area, such as 10 miles of state highway construction projects, would add vehicles to the local road network as construction commences, as well as potentially cause delays as roads may be temporarily closed and traffic routed through detours. Ultimately, state highway construction would add to a more efficient and safe road network, as lanes and safety enhancing features may be added. State highway construction projects would be short-term. The Proposed Action and No Action alternatives would not add to current traffic levels in the CESA as the existing workforce would be utilized at future mine expansion areas and satellite mines.

The contribution to cumulative effects to rail traffic as a result of future mine expansion areas or satellite mines would negligible.

#### 3.10.3.6 Study Area 6

Existing surface coal and lignite mines, as well as oil and gas development, within the study area contribute to the current and future levels of traffic within the CESA. Current traffic levels on highways that service these actions are well within highway capacities.

Reasonably foreseeable future actions within the study area, such as 46 miles of state highway construction and 7 public water supply projects, would add vehicles to the local road network as construction commences, as well as potentially cause delays as roads may be shut down and traffic routed through detours. Ultimately, state highway construction would add to a more efficient and safe road network, as lanes and safety enhancing features may be added. Both state highway construction and public water supply projects would be short-term. The Proposed Action and No Action alternatives would not add to current traffic levels in the CESA as the existing workforce would be utilized at future mine expansion areas and satellite mines.

The contribution to cumulative effects to rail traffic as a result of future mine expansion areas or satellite mines would negligible.

### 3.10.4 Monitoring and Mitigation Measures

No monitoring or mitigation is being considered for transportation.

### 3.10.5 Residual Adverse Effects

No residual adverse effect to transportation are anticipated as a result of a future mine expansion or satellite mine, as mine-related transportation impacts would be temporary and would cease following closure and reclamation.

# 3.11 Noise Resources

## 3.11.1 Affected Environment

### 3.11.1.1 Regional Overview

Noise can be defined a number of ways; however, it typically involves a produced sound that can range from unpleasant to damaging to auditory sensory organs. If not damaging, the response to noise is relative to external factors, such as ambient noise levels, desired activities and experiences, type and repetition of noise, individual sensitivity, topography and vegetation, and time of the day or night. Sensitive receptors are used to assess the overall impact created by a noise source. These receptors are typically residential areas, specific non-residential areas (e.g., churches, schools, or hospitals), or remote areas intended for recreational or aesthetic experiences.

Noise intensity measure in A-weighted decibels (dBA) most closely represents the manner in which noise is perceived by human auditory sensory organs. Compared to non-weighted decibels, A-weighted decibels reduce the value of sound at lower frequencies because the human ear is less sensitive to low frequency sounds. Non-weighted decibels make no correction for frequency. Sustained exposure to noise levels between 80 and 95 decibels (dB) may result in loss of hearing. At 120 dB, physical pain can be felt, and a noise level of 150 dB can result in eardrum rupture (Perdue University 2014). The following list presents representative noise sources and their associated noise levels (Industrial Noise, Inc. 2014):

- Quiet rural area – 30 dB
- Air conditioning unit at 100 feet – 60 dB
- Motorcycle at 25 feet – 90 dB
- Thunder or chainsaw – 120 dB

Ambient, or background noise, is the total volume of noise produced from nearby and distant sources. Study Areas 1 through 6 primarily encompass rural and unpopulated areas with scattered communities. Some of the most prominent noise-producing sources within the six study areas include interstate, U.S., and state highways; railroads; airports; and densely populated or industrial areas.

### 3.11.1.2 Study Areas

Noise transmission can differ greatly depending on the physical environment. Sound can travel very clearly over still water (for instance a lake or reservoir) but also can be relatively unheard when impaired by physical obstructions (e.g., trees, uneven terrain, manmade structures, etc.). The existing noise sources within the study areas, as well as the physical features that may affect noise transmission, are discussed below.

<u>Study Areas 1</u>

Transportation corridors, including highways and railroads, are prominent noise sources in Study Area 1. The primary existing industrial noise sources in Study Area 1 include scattered oil and gas facilities and surface lignite mining operations. Agricultural noise sources primarily include mechanized field work, which occurs sporadically for brief periods of time. Existing noise levels in areas of infrequent human activity are dominated by noise from wind and other natural sources.

The terrain in Study Area 1 is generally flat to rolling. The heavily forested areas in the southern portion of the study area and along the Cypress River corridor could provide a barrier to noise propagation, depending on the relationship between the noise producing sources and sensitive receptors in relation to the forested areas.

Study Area 2

The prominent noise-producing sources and the terrain in Study Area 2 are the same as described for Study Area 1, with the exception of a greater degree of oil and gas development.

Study Area 2 is heavily forested to the north and east, interspersed with pasture and hay lands more extensively in the western part of the study area. The heavily forested areas could provide a barrier to noise propagation, depending on the relationship between the noise producing sources and sensitive receptors in relation to the forested areas.

Study Area 3

The prominent noise-producing sources and the terrain in Study Area 3 are the same as described for Study Area 1.

Study Area 3 is predominantly pasture and hay lands interspersed with forested patches. As such, forested areas that could provide a barrier to noise propagation are limited.

Study Area 4

The prominent noise-producing sources in Study Area 4 are the same as described for Study Area 1.

The terrain in Study Area 4 is generally flat. The study area is a patchwork of prairie grasslands, agricultural lands, and some forested land lending little to noise attenuation in the area.

Study Area 5

The prominent noise-producing sources in Study Area 5 are the same as described for Study Area 1. However, oil and gas production in Study Area 5 has been rapidly increasing, with a related increase in associated noise levels in urban and unpopulated areas.

The terrain in Study Area 5 is generally flat, and the area is dominated by shrublands and grasslands, lending little to noise attenuation in the area.

Study Area 6

The prominent noise-producing sources in Study Area 6 are the same as described for Study Area 1. However, oil and gas production in Study Area 6 has been rapidly increasing, with a related increase in associated noise levels in urban and unpopulated areas.

The terrain in Study Area 6 is generally flat, and the area is dominated by shrublands and badland areas, lending little to noise attenuation in the area.

## 3.11.2 Environmental Consequences

### 3.11.2.1 Proposed Action

The development of future coal or lignite mine expansion areas or satellite mines would be a source of noise transmission that may be noticed at noise-sensitive receptor locations. The direct and indirect study area for noise includes the six study areas.

Noise levels within the six study areas would increase within proximity to a future mine expansion area or satellite mine. Estimated noise levels near a mine would increase up to 22 dBA above ambient levels on a day-night average sound level ($L_{dn}$) basis (USACE 2010). The degree of increase at any one location would depend on the distance from the source, ambient noise levels, and obstructions such as hills, type of vegetation, and existing structures that would absorb sound frequencies. The different phases of mining and the equipment being used would produce different increases in noise levels.

The majority of the construction activities would occur during the first year of a mine. Typical mine construction activities primarily would include clearing of the area to be mined, construction of surface water control and ancillary facilities, and development of access roads. Mine operations and concurrent reclamation would be conducted for up to 30 years, followed by closure and final reclamation activities.

A noise study for a mine in Study Area 2 was prepared in 2010 to determine noise levels produced by various pieces of mining equipment and stages of mine development using a three dimensional noise model (HDR 2010). The study established 65 dBA $L_{dn}$ as the baseline for noise levels that are normally acceptable for an exterior residential environment. An increase of 10 dBA (relative criterion based on TxDOT [1997] guidelines) is considered to be substantial because it is perceived as a doubling in volume. **Table 3.11-1** provides noise estimates for mine construction, operation, and reclamation activities identified in the study.

**Table 3.11-1 Modeled Noise Levels Associated with Typical Mine Development**

| Mine Phase | Activity | Typical Equipment | Estimated Noise Level (dBA)[1] |
|---|---|---|---|
| Construction | Clearing | Dozers | 73-79 |
| | Road Construction | Compactors, Dozers, Excavators, Graders, Loaders, Scrapers | 75-88 |
| Operation | Equipment Operation | Compactors, Cranes, Draglines, Dozers, Excavators, Graders, Loaders, Scrapers, Tractors, Wheel Loaders | 72-92 |
| | Road Noise | Haulers, Heavy Trucks, Passenger Vehicles | 71-114 |
| Reclamation | Equipment Operation | Backhoes, Dozers, Graders, Scrapers, Wheel Loaders | 73-79 |

[1] Measured over a reflecting plane at a distance of 15 meters in accordance with International Standards Organization 6393.

Source: HDR 2010.

There are no federal, state, or local noise regulations that pertain to rural or unpopulated areas within Study Areas 1 through 6. However, RCT requires a minimum distance of 300 feet between mining operations and any occupied dwelling. Estimated noise levels at 300 feet for the various mine development activities are as follows (HDR 2010):

Construction

- Clearing: 38 dBA
- Road Construction: 52 dBA

Operations

- Heavy Equipment Operation: 65 to 73 dBA
- Road Noise (vehicle traffic): 35 dBA

Reclamation

- Equipment Operation: 73 dBA

Mining-related noise levels would be temporary and transitory as pits are sequentially developed, backfilled, and reclaimed. Noise levels at any given location would be dependent on the distance between mining activities and sensitive receptors, the intervening terrain, and the operating depth at any given time within a pit.

#### 3.11.2.2 No Action Alternative

Under the No Action Alternative, development of a future surface coal or lignite mine expansion area or satellite mine would be the same as those described for the Proposed Action alternative. Therefore, the general impacts to noise would be the same, but may be spread over a longer period of time due to the possibly lengthier permitting process.

### 3.11.3 Cumulative Impacts

The CESAs for noise encompass the outer boundaries of the six study areas plus a 3-mile buffer. The CESAs are shown in **Appendix A**, **Figures A-10** through **A-15**.

The past and present actions are described in Section 3.11.1.2. These actions have contributed to ambient noise levels in each study area. RFFAs that would contribute to noise levels in the study areas are identified in Section 2.4.2, and would include activities such as highway and road construction and oil and gas development. These activities would contribute to the general ambient noise levels in combination with future mine expansions. The physical features that may affect noise transmission in each CESA would be similar to those described for the study areas in Section 3.11.1.2. Additional noise sources in those CESAs with flatter terrain and fewer trees (CESAs 4, 5, and 6) would be more noticeable because sound would be likely to travel farther, especially in areas with few existing roads, urban development, and current low ambient noise levels. The forested and hilly areas within CESAs 1, 2, and 3 would be less likely to be affected by new noise-creating activities because noise would not travel as far. Also, CESAs 1, 2, and 3 are more populated and have more vehicle traffic and other noise-creating activities, so an increase of noise levels would be more likely to blend into the existing ambient noise levels.

Noise generated from a future mine expansion area or satellite mine would not travel far from the source, and would be minimized where there is terrain or vegetation to limit noise transmission distances. As a result, there would be little affect to cumulative noise levels from a typical mine, especially because a mine expansion would replace existing mine operations rather than adding to the current mine-related noise in the study areas.

### 3.11.4 Monitoring and Mitigation

The following mitigation measures are being considered to minimize noise levels, depending on the site-specific locations of potential future surface coal or lignite mining operations.

- All motorized equipment would be fitted with properly functioning mufflers.
- Mine planning would include berms and other noise barriers when operating at or near the surface in the vicinity of sensitive receptors.

### 3.11.5 Residual Adverse Impacts

Upon completion of mining activities and reclamation, no residual adverse noise effects would persist and noise levels would return to pre-mining conditions.

## 3.12 Visual Resources

The visual environment is characterized by a combination of the existing character and quality of a landscape and the sensitivity of likely viewers to visual change. The visual effects of a proposed project are evaluated based on the degree to which the altered landscape would contrast with the existing landscape and level of exposure of this change to sensitive viewers.

### 3.12.1 Affected Environment

#### 3.12.1.1 Assessing Visual Quality

Visual quality, or attractiveness, is determined by evaluating the overall character and diversity of the landform's vegetation, water, color, and cultural or manmade feature in a given landscape. Typically, more complex or distinct landscapes have higher visual quality. A landscape is assigned a "high," "moderate", or "low" rating based on a combination of the following elements:

**Vividness**: The memorability of the visual impression received from contrasting landscape elements as they combine to form a striking and distinctive visual pattern;

**Intactness**: The integrity of visual order in the natural and man-build landscape, and the extent to which the landscape is free from visual encroachment; and

**Unity**: The visual coherence and harmony of the landscape when considered as a whole.

For example, undeveloped land has a high degree of intactness and unity and, depending on the vividness or uniqueness of the landscape, would have a rating of moderate to high. A manmade landscape, such as a downtown historic district, also may have a high visual quality rating depending on a combination of the three elements. For the purpose of this analysis, the visual quality of the existing environment was based on general land uses found in the analysis area as summarized in **Table 3.12-1**.

**Table 3.12-1 Visual Quality by General Land Use Type**

| General Land Use Type | Description | Visual Quality Rating |
|---|---|---|
| Undeveloped | Landscape is intact and unified; vividness or uniqueness may vary. Typically, landscapes that have topographic relief changes such as mountains or cliffs are higher in visual quality. | Moderate to High |
| Communities | Variable based on community, district, or neighborhoods within a community | Variable |
| Parks/Trails | Typically a destination or recreation location visited for scenic attractiveness. | High |
| Agriculture | Landscape typically has a higher degree of intactness and unity, but low vividness and rarely unique in character. | Moderate |
| Mining | Mining operations visually encroach on a landscape by temporarily introducing new large-scale landforms, line, color, and texture. Vividness, intactness, and unity are all low. Following reclamation, visual quality is variable depending on designated post-mining land uses. | Low (operations) Variable (post-mining) |
| Oil and Gas Development | Oil and gas activities visually encroach on a rural landscape by inducing industrial features. Vividness, intactness, and unity are typically low. | Low |

### 3.12.1.2 Predicting Viewer Response

Viewer response is composed of two elements: viewer sensitivity and viewer exposure. These elements combine to form a method of predicting how the public may react to visual changes in the landscape.

Viewer exposure reflects how a change to the landscape would be seen. It typically is assessed by measuring the number of people that would view a landscape, the view duration, and their proximity to the subject landscape. Variables affecting visibility include vegetation or terrain screening, daytime verses nighttime conditions, and visual absorption capability of a landscape. The latter is defined as the extent to which the complexity of the landscape can absorb changes without affecting the overall visual character.

Visual sensitivity is a relative measure of the degree of concern by the viewer for changes in the landscape. Viewer sensitivity is determined by type of use, viewer attitude, and influence of adjacent land uses. Therefore, different viewer types would have different viewer sensitivity. Visually sensitive areas are typically residential communities, recreation areas, and primary travel routes.

Within the study areas and CESAs there are a number residential communities, primary travel routes, and recreational facilities where there would be higher viewer sensitivity to changes in the landscapes. The extent to which these sensitive viewers would be exposed to landscape changes would be project dependent.

### 3.12.1.3 Regional Overview

The analysis area is located in the West Gulf Interior Coastal Plains section of the Coastal Plain physiographic province and is characterized by parallel, northeast to southwest trending ridges and major river valleys that trend generally to the southeast (Fenneman 1928; Wermund 1996). In the northeast, hardwood and pine forests are the primary vegetation communities. To the southwest, the forests thin, and the pines largely disappear or are restricted to small areas. Farther to the southwest, grass and brush are dominant.

Texas is historically a coal producing region. Currently, Texas is the largest lignite producer and the sixth largest coal producer in the nation (U.S. Energy Information Administration 2014). Mining has influenced the character of the landscape in the analysis area, as has agriculture and forestry. Areas managed for forestry have been cut and replanted multiple times, resulting in stands of similar age trees, while agricultural lands have been recontoured and planted with crops and pasture grasses. Oil gas development has also influenced the character of the landscape in the region.

The study areas and CESAs are largely unpopulated with few highly distinct natural or cultural features, except for any major rivers and ridgelines associated with the Interior Costal Plains subdivision. Several segments of a trail system adopted by the Texas Historical Commission pass through the analysis area as discussed in Section 3.8, Land Use and Recreation. Local values influence what visually contributes to the identity or “sense of place” of an area; therefore, additional distinctive features may be present on a site-specific basis.

### 3.12.1.4 Study Areas

The Level III ecoregions identified below are based on Griffith et al. (2007), as summarized in Section 3.4, Vegetation.

<u>Study Area 1</u>

Study Area 1 is within the Northern Post Oak Savannah and South Central Plains ecoregions. The southern portion of the study area and the area along the Cypress River corridor are heavily forested. Non-forested areas are primarily pasture or hay meadows. The topography is generally flat to rolling, with incised stream courses. There are numerous large lakes dispersed throughout the area. Potentially sensitive viewpoints include several communities and major highways, including I-30 and U.S. Highways 67 and 271.

Study Area 2

Study Area 2 is within the South Central Plains ecoregion. It is generally heavily forested to the north and east, with interspersed pasture and hay lands more extensive in the western part of the study area. The topography is generally flat to rolling, with incised stream courses. There are numerous lakes dispersed through the study area, some of which are quite large. Numerous oil and gas well pads also occur throughout the area. Potentially sensitive viewpoints include several communities and major highways, including I-20 and U.S. Highways 59, 79, 84, and 259.

Study Area 3

Study Area 3 is primarily in the East Central Texas Plains ecoregion. The study area is predominantly pasture and hay lands interspersed with forested patches. The topography is generally flat, and the area is heavily developed with oil and gas well pads. Potentially sensitive viewpoints include several communities and major highways, including I-45, U.S. Highway 79, 84, 175, and 287.

Study Area 4

Study Area 4 is primarily in the East Central Texas Plains ecoregion. The study area is a patchwork of pasture and hay lands, with cropland on the north along the Brazos River valley. The topography is generally flat. Bastrop and Buescher state parks are located at the very southern edge of the Study Area 4 CESA. Potentially sensitive viewpoints include the state parks, several communities, and major highways, including U.S. Highways 77, 79/190, and 290.

Study Area 5

Study Area 5 is located entirely in the Southern Texas Plains ecoregion. It is dominated by thornscrub vegetation, which is characterized by short trees (primarily mesquite) and numerous shrub species. There are patches of pasture and hay lands interspersed in the scrub lands. The topography is flat. Choke Canyon State Park and reservoir are located in the southeast portion of Study Area 5. There is extensive oil and gas development throughout the study area. Potentially sensitive viewpoints include the state park, a few small communities, and one major highway (I-37/U.S. Highway 281).

Study Area 6

Study Area 6 is located entirely in the Southern Texas Plains ecoregion and is dominated by thornscrub vegetation. There are areas of badlands, and much of the area is barren of ground cover among the shrub growth. The topography is flat. The area is dotted with small reservoirs. Potentially sensitive viewpoints include the communities of the Rio Grande Valley around Eagle Pass, and two major highways (U.S. Highways 57 and 277).

### 3.12.2 Environmental Consequences

#### 3.12.2.1 Proposed Action

Visual effects of the Proposed Action would result from construction and operation of future mine expansion areas and satellite mines. The main visual features of a typical mine would include:

- Introduction of new landforms, including mine pits, spoil piles, and road overpasses that would contrast with the existing characteristic landscape on the basis of form, line, color, or texture;
- Removal of vegetation, including some currently densely forested areas;
- Introduction of new structural elements associated with a new 138-kV transmission line;

- Operation of draglines for overburden and interburden removal;
- Use of lighting during nighttime operating hours; and
- Generation of fugitive dust by earth-moving activities and haul truck transport of coal or lignite, which would be visible outside of a mine boundary.

Sensitive viewers in high visual quality landscapes would be most affected by the construction and operation of a typical mine. The more exposure one has to these mining-related facilities, the greater the impact. The extent to which these sensitive viewers would be exposed to impacted views would be site-dependent and would need to be evaluated once the future proposed mine locations are specified and specific mine authorizations are requested.

*Construction*

Under the Proposed Action, construction of typical mine facilities would introduce new landforms, lines, colors, and textures into the characteristic landscape. Some of these facilities, such as mine haul roads, would be constructed and removed incrementally as mining advances, while other features such as the mine pit would become long-term changes in the landscape.

During construction, mobile light plants would be used in the pit areas as required by MSHA to provide for night-time construction and pre-mining activity. Mobile equipment also would be used to provide lighting for the transportation and utility corridors. Should night operations be necessary, they would introduce or amplify existing mine lighting into what is now a rural and generally dark area. Unless the lights used are aimed downward, there would be an overall increase in ambient light levels in the area. In clear, dry weather, the additional light would be less visible, whereas low clouds or hazy conditions would tend to reflect the light outward to a greater degree. The effects would vary with the location of construction activity at any particular time. The farther the construction activities are from these non-mine-related activity centers, the less the lighting would be noticeable.

Mining and coal or lignite hauling would generate a certain amount of fugitive dust; however, dust suppression measures would be employed throughout the life of a mine, so visual effects from dust likely would be minor.

*Operations*

During mining, night lighting would introduce moderate to strong contrast with existing dark night skies. Even though lights would not be directed at any populated or other off site areas, the lighting still would be visible. Night operations would introduce night lighting into rural areas that are currently generally dark. Although the lights used to light the pit areas would be shielded and aimed downward, consistent with safety and MSHA regulations, there would be an overall increase in ambient light levels in the mining area. The lights would be least noticeable under clear skies, whereas during cloudy or hazy conditions, the lights would tend to reflect the light outward to a greater degree. The effects of night lighting would vary with the proximity to an active pit area and would change location over the life of a mine. Lighting for the transportation and utility corridor would be provided by headlight systems on the mobile equipment using the corridor, including haul trucks, water trucks, and light vehicles. Although somewhat more intense than lighting on common road-going vehicles, the effect would be intermittent and essentially the same as one might experience from a highway at a distance of 0.25 mile or more from the viewer. This lighting would not be expected to have a noticeable effect on overall night light levels.

*Reclamation*

As mining progresses, mine pits incrementally would be reclaimed to support post-mining land uses. Reclamation would involve recontouring the mined area to approximate original topography, blending slope transitions with existing landforms, seeding areas that are designed to return to pasture or grazing land uses, and replanting trees in areas designated for forestry. After reclamation is completed in the areas surrounding retained sediment control ponds, they may be viewed in the long-term as beneficial scenic elements in the landscape as viewers are often attracted to water features.

A typical mine would change the visual character and quality of higher rated landscapes for the life of the mine. The most noticeable effects would involve changes in landforms, color, and texture. The mine pits and spoil piles would contrast strongly with the existing flat to gently rolling terrain. Exposed soil would contrast strongly with existing plant materials. There also would be moderate textural contrasts as the generally smooth soil would be exposed in contrast to the more variable vegetative textures ranging from fine grasses to coarse forested areas. These visual impacts would be temporary, lasting until each mined area is progressively reclaimed and revegetated, which would occur over an estimated 2 to 12 years after initiating mining in any particular area. Landforms largely would be returned to pre-mining conditions within 2 to 5 years; initial revegetation would mute or eliminate strong color contrast within an additional 1 to 2 years. Reclamation of forested areas would occur as tree stands mature over a longer time frame (up to 20 years).

#### 3.12.2.2 No Action Alternative

Under the No Action Alternative, proposed changes to the USACE Fort Worth District's regulatory framework for the permitting of surface coal and lignite mines in Texas would not be implemented; therefore, the timeframe for USACE Fort Worth District review and evaluation of future mine permit applications may be longer than under the Proposed Action. However, future mine-related impacts to visual resources under the No Action Alternative would be similar to those described under the Proposed Action.

### 3.12.3 Cumulative Impacts

The CESAs for visual resources include the area within the six study areas identified for potential future mine expansion, plus an additional 5 mile buffer (see **Appendix A**, **Figure A-23**). The 5 mile buffer was included because this distance would be the likely limit that a typical mine would be noticeable. The acreage of past and present surface disturbance in each CESA is shown in **Table 3.6-3** in the Cultural Resources section. RFFAs include future coal and lignite mine expansion areas or satellite mines and other activities such as those listed in Section 2.4.2.

Visual effects of past and present actions are considered in the discussion of existing visual conditions for the study areas, Section 3.12.1. The CESAs vary in topography, vegetative cover, and viewing distance, similar to the study areas. Consequently, the cumulative impacts of past and present actions in combination with RFFAs in each CESA would be similar to those described above in Section 3.12.2.1, Environmental Consequences. The Proposed Action and No Action alternatives would involve mine expansions and, therefore, likely would affect currently impacted views and would introduce additional night lighting a fugitive dust until mining and reclamation are completed.

### 3.12.4 Monitoring and Mitigation Measures

Additional mitigation measures that are recommended include the following:

- In addition to the reclamation procedures for a typical mine, as discussed in Section 2.2.4, visual screening should be employed where the edges of an active mining area would be near the permit boundary and there are potentially sensitive public viewpoints nearby. In particular, existing vegetation should be preserved and augmented, as necessary, to maximize visual screening for sensitive viewers. Planting should mimic natural vegetative patterns and plant materials to the degree possible to provide the most natural appearing screening effects. Existing groves of trees should be retained where possible to provide visual buffers.

### 3.12.5 Residual Adverse Effects

Implementation of the mitigation measures would decrease the visual impacts of a typical mine under the Proposed Action and No Action alternatives, so that the long-term visual character of the study areas would be largely indistinguishable from the surrounding area. Following completion of mining and reclamation of the disturbance areas, residual visual effects would be minimal.

## 3.13 Hazardous Materials and Solid Waste

### 3.13.1 Affected Environment

The affected environment for hazardous materials and solid waste includes air, water, soil, and biological resources within the analysis area that could be affected by an accidental release of hazardous materials or solid wastes during transportation to or from potential future surface coal or lignite mine expansion areas or satellite mines or during on site storage and use.

#### 3.13.1.1 Hazardous Materials

Hazardous materials, which are defined in various ways under a number of regulatory programs, can represent potential risks to both human health and to the environment when not managed properly. The term hazardous materials include the following materials that may be utilized or disposed of in conjunction with a potential future surface coal or lignite mine expansion area or satellite mine:

- Substances covered under the Occupational Safety and Health Administration Hazard Communication Standard (29 CFR 1910.1200) and MSHA Communication Standards (30 CFR Part 47) – the types of materials that may be used in mining activities and that would be subject to these regulations would include almost all of the materials covered by the regulations identified below.
- Hazardous materials as defined under the U.S. Department of Transportation (USDOT) regulations in 29 CFR, Parts 170-177 – the types of materials that may be used in mining activities and that would be subject to these regulations would include fuels, some paints and coatings, and other chemical products.
- Hazardous substances as defined by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and listed in 40 CFR Table 302.4 – the types of materials that may contain hazardous substances that are used in mining activities and that would be subject to these requirements include solvents, solvent-containing materials (e.g., paints, coatings, degreasers), acids, and other chemical products.
- Hazardous wastes as defined in the Resource Conservation and Recovery Act (RCRA) – procedures in 40 CFR 262 are used to determine whether a waste is hazardous – the types of materials used in mining activities and that would be subject to these requirements could include liquid waste materials with a flash point less than 140°F, spent solvent-containing wastes, and corrosive liquids. Hazardous waste is regulated by the TCEQ under 30 TAC, Chapter 335 (TCEQ 2014d).
- Any hazardous substances and extremely hazardous substances as well as petroleum products (e.g., gasoline, diesel, or propane) that are subject to reporting requirements (Threshold Planning Quantities) under Sections 311 and 312 of the Superfund Amendment and Reauthorization Act (SARA) – the types of materials that may be used in mining activities and that would be subject to these requirements include fuels, coolants, acids, and solvent-containing products such as paints and coatings.
- Petroleum products defined as “oil” in the Oil Pollution Act of 1990 – the types of materials used in mining activities and that would be subject to these requirements include fuels, lubricants, hydraulic oil, and transmission fluids.

In conjunction with the definitions noted above, the following lists provide information regarding management requirements during transportation, storage, and use of particular hazardous chemicals, substances, or materials:

- SARA Title III List of Lists or the Consolidated List of Chemicals Subject to the Emergency Planning and Community Right-to-Know Act and Section 112(r) of the CAA.
- USDOT listing of hazardous materials in 49 CFR 172.101.

In addition to the definitions of hazardous materials described above, the State of Texas defines certain materials as Nonhazardous Industrial Wastes that, while not classified as hazardous, may pose a potential threat to human health and the environment if not managed properly. These materials are classified as Class I Nonhazardous Industrial Waste under 30 TAC, Chapter 335, Subchapter R Sections 335.501 to 335.508 (TCEQ 2014d). An example of a Class I Nonhazardous Industrial Waste would be water that is contaminated with ethylene glycol (antifreeze).

### 3.13.1.2 Solid Waste

Solid waste consists of a broad range of materials that include garbage, refuse, wastewater treatment plant sludge, non-hazardous industrial waste, and other materials (i.e., solid, liquid, or contained gaseous substances) resulting from industrial, commercial, mining, agricultural, and community activities (USEPA 2011). Solid wastes are regulated under different subtitles of RCRA and include hazardous waste and non-hazardous waste. Hazardous waste is regulated under TAC 30, Chapter 335 as discussed above. Non-hazardous municipal solid wastes are regulated under RCRA Subtitle D; the regulatory program has been delegated to the TCEQ and regulated under 30 TAC, Chapter 330 (TCEQ 2014d).

Certain types of materials, while they may contain potentially hazardous constituents, are specifically exempt from regulation as hazardous waste. Used oil, for example, may contain toxic metals; however, it would not be considered a hazardous waste unless it meets certain criteria (Characteristics of Hazardous Waste 40 CFR 261). Used oil recycling is regulated under 30 TAC Chapter 324 (TCEQ 2014d).

A solid waste that is not directly generated by coal mining is coal combustion waste or coal combustion residue (CCR). CCR is essentially the ash and other by-products from burning coal in power plants. Currently the USEPA and National Research Council (NRC) prefer the term CCR since a substantial amount of coal ash is a marketable product and does not fit the definition of solid waste (NRC 2006). Also, with prior approval by TCEQ and RCT, bottom ash (a type of CCR) may be used as a road surfacing material or placed as backfill in surface coal and lignite mines in Texas. Currently, CCR use at surface coal and lignite mines is regulated under Subtitle D of RCRA and the SMCRA (USEPA 2013). Texas surface mine rules have additional restrictions and conditions for the use of CCR as a backfill material (NRC 2006).

### 3.13.1.3 Uncontrolled Hazardous Materials Sites

Oil and gas production and other industrial activities (e.g., wood treating) have occurred historically or currently in the study areas. These industrial activities have the potential to have spilled or released hazardous materials to the environment in an uncontrolled manner. These sites may be regulated under a variety of remedial programs, including CERCLA, Brownfields, leaking underground storage tanks, the Texas Voluntary Cleanup Program, and remediation programs supervised by the RCT.

## 3.13.2 Environmental Consequences

Issues related to hazardous materials include the potential impacts to the environment from an accidental release of hazardous materials during transportation to and from a typical mine or from use, storage, or a potential release at the site. Other issues relate to the potential presence of uncontrolled hazardous materials sites where historic releases have potentially impacted the environment.

The following discussion of hazardous materials and solid waste applies to all six study areas. The estimated types and amounts of hazardous materials and solid wastes used or generated by a typical surface coal or lignite mine, as discussed below, reflect an average of the current transport, storage, and use of these materials by some of the existing surface mines in the study areas (Luminant Mining Company, LLC 2014).

### 3.13.2.1 Proposed Action

Hazardous Materials

Typically, surface coal and lignite mines do not generate large amounts of RCRA hazardous waste and are classified as Small Quantity Generators or Conditionally Exempt Small Quantity Generators (BLM 2012). Typical hazardous waste would be spent solvent generated from equipment repair. Waste that is considered hazardous must be accumulated, transported, and disposed of under specific requirements.

Hazardous materials or substances that would be transported to a future mine expansion area or satellite mine would be stored on site or at existing mine facilities located in reasonably close proximity. Diesel fuel, gasoline, and other materials would be stored in aboveground tanks or other appropriate containers. Secondary containment would be provided and materials would be stored in a containment structure that would comply with regulatory volumetric requirements. Other materials would be stored in accordance with applicable rules and BMPs. Fuels, oils, and lubricants are the hazardous materials that would be transported and used in the largest quantities. The estimated annual use of these materials at a typical mine is listed in **Table 3.13-1**. For purposes of this analysis, the estimated annual used for a typical mine was based on the average of estimated annual consumption at eight existing surface lignite mines in Texas.

**Table 3.13-1 Estimated Annual Major Hazardous Material Use**

| Material | Estimated Annual Use[1] | Unit |
|---|---|---|
| Diesel | 2,185,000 | Gallons |
| Gasoline | 33,800 | Gallons |
| Lubrication oil | 18,200 | Gallons |
| Gear Oil | 15,800 | Gallons |
| Hydraulic Oil | 23,000 | Gallons |
| Vehicle antifreeze | 13,000 | Gallons |

[1] Quantities reflect averages based on estimated annual consumption for eight existing surface lignite mines in Texas as provided by Luminant Mining Company, LLC (2014).

A release of a reportable quantity of a hazardous substance to the environment must be reported within 24 hours to the National Response Center (40 CFR Part 302). Sections 327.1 to 327.5 of the TAC contain spill response and reporting rules. Also, the Texas Water Code Sections 26.039 and 26.262 contain provisions for reporting and abatement of a spill of a reportable quantity of a hazardous substance to the waters of the State. If a reportable spill should occur, it would be mitigated, and contaminated materials would be disposed of in accordance with these federal and state regulations.

*Transportation of Hazardous Materials*

Hazardous materials would be transported by commercial carriers in accordance with requirements of Title 49 of the CFR. Carriers would be licensed and inspected as required by the TxDOT. Tanker trucks would be inspected and would have to be properly certified by the State of Texas. These permits, licenses, and certificates would be the responsibility of the carrier. Title 49 of the CFR requires that all shipments of hazardous substances be properly identified and placarded. Shipping papers must be accessible and include Material Safety Data Sheets (MSDS) describing the substance, immediate health hazards, fire and explosion risks, immediate precautions, fire-fighting information, procedures for handling leaks or spills, first aid measures, and emergency response telephone numbers.

In the event of a release en route to a mine prior to entry into the property, the transportation company would be responsible for response and cleanup. Trucks would be used to transport hazardous materials to the mine. In Study Areas 1, 2 and 3, shipments would most likely originate from cities such as Dallas, Tyler, or Longview, Texas, or Shreveport, Louisiana, and would be transported via I-20, I-35, federal and state highways, to local farm-to-market (FM) roads to the mine and then on mine roads to the on site storage facilities. For Study Area 4, major transportation routes would probably include I-45, I-35, SH 6, and local FM roads from major cities such as Waco, Bryan-College Station, Dallas, and Houston, Texas. For Study Areas 5 and 6, major transportation routes would include I-10 from Houston, Texas, and I-35 from Austin and San Antonio and then to the mine site via state highways or local FM roads.

For this analysis, diesel fuel shipment distances were estimated from likely points of origin for each of the study areas. It is assumed the deliveries would be coming from vendors located along the major transportation routes indicated above. Therefore, for analysis purposes, it is assumed that shipments would average 50 miles for all of the study areas. Based on the information presented in **Table 3.13-2**, there would be a low probability for a hazardous material incident to occur over a 20-year life of mine.

**Table 3.13-2 Potential for Hazardous Material Incident during a 20-year Mine Life**

| Material | Annual Use (gallons) | Shipment Quantity (gallons) | Number of Shipments[1] | Distance (miles)[2] | Incident Rate per Million Miles[3] | Calculated Number of Incidents[4] |
|---|---|---|---|---|---|---|
| Diesel Fuel | 2,185,000 | 10,500 | 4,160 | 208,000 | 0.0000007 | 0.15 |

[1] 20-year life of mine (208 shipments X 20 years).

[2] 208 trips per year x 50 miles; 10400 miles x 20 years.

[3] Battelle (2001) includes accidents and en route leaks, but not loading/unloading incidents.

[4] Number of incidents = distance X (incident rate).

The environmental effects of a transportation–related release would depend on the substance, quantity, timing, and location of the release. Some of the materials could have immediate adverse effects on water quality and aquatic resources if a spill were to enter surface water. However, the probability of a spill directly into a waterway during transport to the mine site would be very low. Therefore, it is unlikely that spills of these materials would affect waterways. With rapid cleanup actions, a spill would not be anticipated to result in long-term impacts to soils, surface water, or groundwater.

A large-scale release of diesel fuel or several of the other substances delivered to a site could have implications for public health and safety. The location of a release again would be the primary factor in determining the effects of a release. However, the probability of a release anywhere along the anticipated transportation routes to the study area is expected to be low; the probability of a release within a populated area would be even lower; and the probability of a release involving an injury or fatality would be still lower. Therefore, it is not anticipated that a release involving a severe effect to human health or safety would occur during the life of any particular future mine expansion area or satellite mine.

Several major rivers (Brazos, Colorado, Sabine, Trinity rivers) are crossed by the transportation routes mentioned above. A nominal 200 diesel fuel deliveries annually to a mine in any of the study areas has high probability of crossing any of the major rivers; however, the number of deliveries would be very small compared to the volume of fuel that would be transported over those rivers on public roads throughout the region. For drainages and watercourses adjacent to a mine, on site speed limits for mine traffic would provide a further safety factor, lessening the risk of an accident resulting in a release. Given the foregoing and the low overall probability of an accident resulting in a release as discussed above, there is low potential for a fuel spill to impact surface waters.

*Storage and Use of Hazardous Materials*

Over a 20- to 30-year operational life of a typical mine, the probability of minor spills of materials such as fuel and lubricants would be relatively high. These releases could occur during fueling operations or from equipment failure (e.g., hydraulic hose failure). A minor oil spill on a mine site where cleanup equipment would be readily available would be localized, contained, and disposed of in accordance with the applicable laws and regulations. Accidents involving other hazardous materials also could occur during mine operation. Mine operators would develop and maintain a site-specific SPCC Plan to deal with unplanned releases of petroleum products and would prepare an Emergency Response Plan that establishes procedures for responding to accidental spills or releases of other hazardous materials to minimize health risks and environmental effects. The plan would include procedures for evacuating personnel, maintaining safety, cleanup and neutralization activities, emergency contacts, internal and external notifications to regulatory authorities, and incident documentation. Proper implementation of the Emergency Response Plan would be expected to minimize the potential for significant impacts associated with potential releases of hazardous materials. Using proper handling and storage procedures, impacts resulting from potential spills of hazardous materials should be minimal. MSDSs for the hazardous materials stored and used at the mine would be maintained on site.

Solid Waste

Typical solid wastes that may be generated at a typical mine would include floor sweepings, empty containers, scrap metal, tires, filters, office trash, and food waste, petroleum contaminated soil, spent grease, construction debris, asbestos containing materials (BLM 2012; Luminant 2014). Some of these items may be disposed of within the mine boundaries in accordance with TCEQ-solid waste disposal rules or off site at permitted disposal facilities (e.g., municipal waste landfills). Other typical special waste that may be generated include used oil and batteries that would be recycled.

CCR is not directly generated by coal mines, but mainly by burning coal in power plants. CCR consists of a range of combustion products depending the particular burning process in use at a given power plant. CCR has been used as part of the reclamation process at some of the Texas coal mines (NRC 2006). Although a regulated practice, there are continuing concerns about the use of such material as backfill. The major concern is that constituents could be leached out of CCR and degrade surface and groundwater quality. Such constituents are toxic metals, organic compounds, and radionuclides. Texas regulations governing the use of CCR as backfill are essentially the same as the SMCRA regulations (NRC 2006). There are requirements under which the use can occur and include pre-placement assessment, engineering and operational controls, and specifically excluded areas: geologic faults, floodplains, wetlands, seismic impact zones, and unstable areas. There are also long-term monitoring and financial responsibility requirements (USEPA 2002).

Non-hazardous solid waste that would be generated at a typical mine would be disposed of in accordance with state and federal regulations. With proper handling and disposal in accordance with applicable rules and regulations, solid waste would have minimal impacts.

Uncontrolled Hazardous Materials Sites

If historic leaks or spills exist in a future surface coal or lignite mine area, there would be potential for worker exposure to hazardous substances and environmental impacts if contaminated water or soil are encountered during facilities construction or mine operations.

In areas of century-old oil and gas production, there is the potential that unplugged or improperly abandoned wells may exist. Mining into unidentified abandoned wells may pose a risk of degradation to soil and groundwater or encountering stray methane gas. It is expected that individual mine operators would implement measures for both identified wells and previously unidentified wells that may be encountered in proposed disturbance areas, thereby minimizing the potential for potential contamination and health and safety impacts. Oil and gas wells within a mine area would be sealed in accordance with RCT regulations in advance of mining. Oil and gas wells that would be mined through would be plugged in accordance with 16 TAC 3.14.

Not all contaminated sites have been discovered, and uncontrolled sites continue to be found. Therefore, it is incumbent on the individual mine operators to determine the location of identified active or closed remediation sites or undiscovered potential sites through due diligence examination to identify the extent of soil and groundwater impacts and to take steps to avoid such areas and not incur liability. In order to minimize the potential for worker exposure and environmental impacts, the mine operators should have plans to deal with unanticipated discoveries of contaminated sites.

### 3.13.3 No Action Alternative

Under the No Action Alternative, potential impacts associated with hazardous materials, solid waste, and uncontrolled hazardous material sites would be the same as described for the Proposed Action.

### 3.13.4 Cumulative Impacts

The hazardous materials and solid waste CESAs encompass the outer boundaries of the study areas plus the transportation routes included in the Transportation CESAs (see **Appendix A**, **Figures A-17** through **A-22**). The past and present actions and RFFAs are identified in Section 2.4. Neither the Proposed Action or No Action Alternative would result in an incremental increase in the annual amount of hazardous materials shipped along the identified transportation routes; however, there would be an incremental increase in the duration of hazardous materials transport along the identified routes during the life of a future mine (up to 30 years for each future mine expansion area or satellite mine).

The continued transportation of hazardous materials over an extended period of time would represent a small incremental increase in the risk of a spill during transport. With proper implementation of spill prevention and emergency response plans, cumulative impacts associated with the transport, storage, and use of hazardous substances are not anticipated. Future mines would contribute to a small cumulative increase in the amount of solid waste that would be generated and transported in the study areas; however, impacts would be expected to be minimal.

Future mine expansion areas and satellite mines would continue the approximate current levels of vehicle traffic to transport hazardous and solid waste to approved locations. In combination with the heavy and likely increasing transport of wastes from oil and gas development and other current and future actions, the incremental contribution of traffic carrying waste would be low.

### 3.13.5 Monitoring and Mitigation Measures

The transportation, storage, and handling of hazardous materials and the disposal of solid wastes would be conducted in compliance with applicable rules and regulations. Due to the historic oil and gas production in CESAs, there is a potential for the presence of historic leaks and spills. Therefore, the following mitigation is recommended to minimize the potential for worker exposure and environmental impacts in the event an unanticipated contaminated site is discovered.

- To minimize the potential for worker exposure or environmental impacts in the event of an unanticipated discovery of a contaminated site during mine construction or operation, the mine operator would develop protocol for handling contaminated sites to ensure protection of workers and to minimize potential environmental impacts.

### 3.13.6 Residual Adverse Effects

Residual adverse effects as a result of a hazardous material spill could include potential effects to a populated area or a sensitive environmental resource along a transportation route. However, due to the low probability of a spill on water resources or within populated areas, the potential for residual adverse impacts are anticipated to be minimal. Residual adverse effects from the use of hazardous materials on a mine site would depend on the substance, quantity, timing, location, and response involved in the event of an accidental spill or release. Prompt cleanup of spills and releases would minimize the potential for any residual adverse effects of such events.

## 3.14 Public Health

### 3.14.1 Affected Environment

The resources that comprise the affected environment for public health include groundwater and surface water quality, air quality, noise, and visual (as related to lighting). The affected environment descriptions for these resources are presented in Sections 3.2.3.1, 3.2.4.1, 3.71, 3.11.1, and 3.12.1.

### 3.14.2 Environmental Consequences

Public health issues associated with a typical surface coal or lignite mine would include potential water quality effects from the mining operation, including use of chemicals during reclamation; air quality effects from mine related air emissions; and noise and lighting effects on sensitive receptors. The potential direct/indirect impacts to these resources are discussed in Sections 3.2.3.2, 3.2.4.2, 3.7.2, 3.11.2, and 3.12.2. A summary of the potential related public health effects is presented below.

#### 3.14.2.1 Water Quality Effects

During construction and operations at a typical surface coal or lignite mine, surface water discharges from mine disturbance areas would be required to meet TPDES permit requirements, and the mine would be required to maintain the water quality of receiving waters within standards under the TCEQ water quality antidegradation rules. During operations at a typical mine, spoils would be selectively placed in backfill areas to ensure that naturally occurring acid- or toxic-forming materials are 4 feet or greater below the final grade. During concurrent and final reclamation, all pesticides would be applied under the supervision of a certified applicator. The use, application, and disposal of pesticides would be conducted in accordance with all applicable federal and state regulations. Potential impacts as a result of a spill or release of a hazardous material would be minimized through implementation of a mine-specific state-required SPCC Plan; SWPPP; and Emergency Response Plan. Assuming successful implementation of these measures and programs and compliance with permit requirements, construction, operation, and reclamation/closure activities would not be anticipated to contribute directly or cumulatively to health effects associated with water quality.

#### 3.14.2.2 Air Quality Effects

As discussed in Section 3.7.1.1, the criteria for impacts to air quality are the lowest concentrations at which adverse human health effects from exposure to air pollution are known or suspected to occur. The primary NAAQS set limits to protect public health, including the health of “sensitive” populations such as asthmatics, children, and the elderly.

The main criteria pollutant standards applicable to a typical surface coal or lignite mine are the $PM_{10}$ and $PM_{2.5}$ NAAQS. Fugitive dust emissions (i.e., $PM_{10}$ and $PM_{2.5}$) from disturbance areas at a typical mine would be controlled by minimizing the acreage of coal or lignite mining disturbance at any given time; the application of water sprays, chemical dust suppressants, and routine maintenance and/or slow-curing liquid asphalt as allowed by TCEQ; prompt revegetation of regraded lands; and restricting fugitive dust causing activities during periods of air stagnation. In addition, particulate emissions related to potential spontaneous coal combustion would be minimized by promptly extinguishing areas of burning or smoldering coal and conducting periodic inspections for burning areas whenever the potential for spontaneous combustion is high. Assuming successful implementation of these measures, and based on the low density of typical coal or surface mine-related emissions sources of gaseous pollutants (e.g., vehicles and other fuel-fired equipment), it is anticipated that criteria pollutant emissions from a typical mine would remain well below the NAAQS (levels determined to be protective of public health and welfare). As a result, a typical surface coal or lignite mine would not be anticipated to contribute directly or cumulatively to health effects associated with air quality.

#### 3.14.2.3 Noise Effects

There are no federal, state, or local noise regulations that pertain to rural or unpopulated areas within Study Areas 1 through 6. However, RCT requires a minimum distance of 300 feet between mining operations and any occupied dwellings.

A noise study previously conducted at an existing surface lignite mine in Study Area 2 (HDR 2010) established 65 dBA $L_{dn}$ as the baseline for noise levels that are normally acceptable for an exterior residential environment. Per HDR (2010), estimated noise levels at 300 feet for the various phases of a surface lignite mine are below 65 dBA, with the exception of equipment operation during operations and reclamation which were predicted at 73 dBA (see Section 3.11.2.1). Mining-related noise levels would be temporary and transitory as pits are sequentially developed, backfilled, and reclaimed. Noise levels at any given location would be dependent on the distance between mining activities and sensitive receptors, the intervening terrain, and the operating depth at any given time within a pit. The temporary/transitory noise levels associated with a typical mine would not expected to cause adverse health effects or contributed to noise-related cumulative public health effects.

#### 3.14.2.4 Light Effects

During mining, nighttime operations would introduce night lighting into rural areas that are currently generally dark. Although the lights used to light the pit areas would be shielded and aimed downward, consistent with safety and MSHA regulations, there would be an overall increase in ambient light levels in the mining area. The lights would be least noticeable under clear skies, whereas during cloudy or hazy conditions, the lights would tend to reflect the light outward to a greater degree. The effects of night lighting would vary with the proximity to an active pit area and would change locations over the life of a mine. Lighting for a transportation and utility corridor would be provided by headlights on mobile equipment using the corridor. Although somewhat more intense than lighting on common road-going vehicles, the effect would be intermittent and essentially the same as one might experience from a highway at a distance of 0.25 mile or more from the viewer. This lighting would not be expected to have a noticeable effect on overall night light levels. As such, mining-related night lighting is not expected to result in adverse health effects. No cumulative light effects to public health are anticipated.

### 3.14.3 No Action Alternative

Under the No Action Alternative, typical mining-related effects identified for water quality, air quality, noise, and lighting would be the same as discussed under the Proposed Action.

### 3.14.4 Cumulative Impacts

Based on the impact analysis presented above, a future mine expansion area or satellite mine would not contribute to cumulative health effects.

### 3.14.5 Monitoring and Mitigation Measures

No monitoring or mitigation measures have been identified for public health.

### 3.14.6 Residual Adverse Effects

No residual adverse effects to public health would be anticipated.

## 3.15 Environmental Justice

### 3.15.1 Affected Environment

EO 12898, “Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations,” was issued by President Clinton on February 11, 1994 (59 Federal Register 7629). EO 12898 “is intended to promote nondiscrimination in federal programs substantially affecting human health and the environment, and to provide minority communities and low-income communities access to public information on, and an opportunity for participation in, matters relating to human health and the environment.”

Pursuant to EO 12898, the President’s CEQ prepared “Environmental Justice: Guidance Under the Environmental Policy Act” (1997) to assist federal agencies with their NEPA procedures “… so that environmental justice concerns are effectively identified and addressed.” This analysis was conducted with the assistance of the CEQ guidance document.

EO 12898 states that population groups defined as minorities include: American Indian or Alaskan Native; Asian or Pacific Islander; Black, not of Hispanic/Latino origin; or Hispanic/Latino. CEQ guidelines for evaluating potential adverse environmental justice effects indicate minority populations should be identified when either: 1) a minority population exceeds 50 percent of the population of the affected area or 2) a minority population represents a meaningfully greater increment of the affected area population than the population of some appropriate larger geographic unit, as a whole.

Low-income populations are those communities or sets of individuals whose median income is below the current poverty level of the general population. According to the guidance, low-income populations in an affected area should be identified using the annual statistical poverty thresholds from the Bureau of the Census’ Current Population Reports, Series P-60 on Income and Poverty. In identifying low-income populations, federal agencies may consider as a community either a group of individuals living in geographic proximity to one another or a set of individuals (such as migrant workers or Native Americans) where either type of group experiences common conditions of environmental exposure or effect.

#### 3.15.1.1 Minority Populations

The 2010 census (U.S. Census Bureau 2010a) provides the most recent official population counts, which provide the basis for the environmental justice analysis. The overall minority population in the 43 counties in the analysis areas is 42.8 percent, with the highest rate of minority population in Analysis Area 6 (88.1 percent) and the lowest (32.2 percent) in Analysis Area 1 (**Table 3.15-1**). Texas has a 54.7 percent minority population, and Louisiana has 39.7 percent. As shown in **Table 3.15-2**, the counties in Analysis Area 6 all have substantial Hispanic or Latino populations (55.7 to 95.7 percent), while most other counties have lower percentages. Among the six analysis areas, Analysis Area 2 has the highest rate of Black or African American population (27.0 percent) (**Table 3.15-1**). The minority population in the analysis area counties primarily is classified as Hispanic or Latino (24.7 percent) and Black or African American (13.2 percent), with the remaining minority groups combining to 4.9 percent of the total population (**Table 3.15-2**).

**Table 3.15-1 2010 Analysis Area Populations by Race**

| Analysis Area | Total Population | Non-Hispanic - White Alone | Minority Populations | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Non-Hispanic - Black or African American Alone | Non-Hispanic - American Indian and Alaska Native Alone | Non-Hispanic – Asian Alone | Non-Hispanic - Native Hawaiian and Other Pacific Islander Alone | Non-Hispanic - Some Other Race | Non-Hispanic - Two or More Races | Hispanic or Latino (of any race)[2] |
| | | (percent) | | | | | | | |
| Analysis Area 1 | 405,336 | 67.8 | 13.3 | 0.4 | 0.9 | 0.0 | 0.1 | 1.3 | 16.3 |
| Analysis Area 2 | 905,508 | 58.6 | 27.0 | 0.4 | 0.9 | 0.0 | 0.1 | 1.2 | 11.7 |
| Analysis Area 3 | 526,644 | 66.2 | 11.8 | 0.4 | 2.2 | 0.1 | 0.1 | 1.2 | 18.1 |
| Analysis Area 4 | 1,401,443 | 55.5 | 8.0 | 0.3 | 5.0 | 0.1 | 0.2 | 1.7 | 29.4 |
| Analysis Area 5 | 57,149 | 41.2 | 1.3 | 0.4 | 0.3 | 0.0 | 0.1 | 0.6 | 56.2 |
| Analysis Area 6 | 105,934 | 11.9 | 0.3 | 0.6 | 0.3 | 0.0 | 0.1 | 0.2 | 86.7 |
| Total of the Six Analysis Areas[1] | 3,370,529 | 57.2 | 13.2 | 0.3 | 3.0 | 0.1 | 0.1 | 1.4 | 24.7 |
| Texas | 25,145,561 | 45.3 | 11.5 | 0.3 | 3.8 | 0.1 | 0.1 | 1.3 | 37.6 |
| Louisiana | 4,533,372 | 60.3 | 31.8 | 0.6 | 1.5 | 0.0 | 0.1 | 1.3 | 4.2 |
| U.S. | 308,745,538 | 63.7 | 12.2 | 0.7 | 4.7 | 0.2 | 0.2 | 1.9 | 16.3 |

[1] Smith County falls within Analysis Areas 1 and 2, and Robertson and Brazos counties fall within Analysis Areas 3 and 4. As a result, the sum total for the six analysis areas is greater than the actual total for the overall analysis area.

[2] People who identify their origin as Hispanic, Latino, or Spanish may be of any race.

Source: U.S. Census 2010a.

**Table 3.15-2 2010 County Populations by Race**

| County[1] | Total Population | Non-Hispanic - White Alone | Minority Populations | | | | | | | Analysis Area |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Non-Hispanic - Black or African American Alone | Non-Hispanic - American Indian and Alaska Native Alone | Non-Hispanic – Asian Alone | Non-Hispanic - Native Hawaiian and Other Pacific Islander Alone | Non-Hispanic - Some Other Race | Non-Hispanic - Two or More Races | Hispanic or Latino (of any race)[2] | |
| | | (percent) | | | | | | | | |
| Camp County | 12,401 | 58.9 | 17.2 | 0.3 | 0.5 | 0.1 | 0.0 | 1.6 | 21.4 | 1 |
| Franklin County | 10,605 | 81.1 | 3.9 | 0.6 | 0.5 | 0.0 | 0.1 | 1.3 | 12.6 | 1 |
| Hopkins County | 35,161 | 75.4 | 7.0 | 0.5 | 0.5 | 0.0 | 0.1 | 1.4 | 15.3 | 1 |
| Morris County | 12,934 | 66.8 | 22.8 | 0.6 | 0.3 | 0.0 | 0.1 | 1.6 | 7.8 | 1 |
| Rains County | 10,914 | 87.5 | 2.3 | 0.9 | 0.5 | 0.0 | 0.0 | 1.1 | 7.7 | 1 |
| Titus County | 32,334 | 49.2 | 9.3 | 0.4 | 0.7 | 0.0 | 0.1 | 0.8 | 39.6 | 1 |
| Upshur County | 39,309 | 82.1 | 8.6 | 0.5 | 0.4 | 0.0 | 0.1 | 1.7 | 6.6 | 1 |
| Wood County | 41,964 | 84.9 | 4.6 | 0.5 | 0.4 | 0.0 | 0.0 | 1.1 | 8.5 | 1 |
| Smith County | 209,714 | 62.1 | 17.7 | 0.4 | 1.2 | 0.0 | 0.1 | 1.2 | 17.2 | 1&2 |
| Caddo Parish, Louisiana | 254,969 | 47.8 | 46.9 | 0.4 | 1.0 | 0.0 | 0.1 | 1.2 | 2.4 | 2 |
| DeSoto Parish, Louisiana | 26,656 | 56.6 | 39.0 | 0.7 | 0.1 | 0.0 | 0.0 | 1.0 | 2.5 | 2 |
| Cherokee County | 50,845 | 62.7 | 14.6 | 0.2 | 0.4 | 0.0 | 0.1 | 1.3 | 20.6 | 2 |
| Gregg County | 121,730 | 60.8 | 19.8 | 0.4 | 1.1 | 0.0 | 0.1 | 1.4 | 16.4 | 2 |
| Harrison County | 65,631 | 65.0 | 21.8 | 0.4 | 0.5 | 0.0 | 0.1 | 1.1 | 11.1 | 2 |
| Nacogdoches County | 64,524 | 61.5 | 17.9 | 0.4 | 1.2 | 0.0 | 0.1 | 1.3 | 17.6 | 2 |
| Panola County | 23,796 | 73.6 | 16.2 | 0.4 | 0.3 | 0.0 | 0.1 | 1.1 | 8.3 | 2 |
| Rusk County | 53,330 | 66.1 | 17.5 | 0.4 | 0.4 | 0.0 | 0.1 | 1.2 | 14.3 | 2 |
| San Augustine County | 8,865 | 69.7 | 22.7 | 0.2 | 0.2 | 0.0 | 0.1 | 1.0 | 6.0 | 2 |
| Shelby County | 25,448 | 65.0 | 17.3 | 0.2 | 0.3 | 0.0 | 0.1 | 0.7 | 16.4 | 2 |

**Table 3.15-2 2010 County Populations by Race**

| County[1] | Total Population | Non-Hispanic - White Alone | Minority Populations | | | | | | | Analysis Area |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Non-Hispanic - Black or African American Alone | Non-Hispanic - American Indian and Alaska Native Alone | Non-Hispanic – Asian Alone | Non-Hispanic - Native Hawaiian and Other Pacific Islander Alone | Non-Hispanic - Some Other Race | Non-Hispanic - Two or More Races | Hispanic or Latino (of any race)[2] | |
| | | (percent) | | | | | | | | |
| Anderson County | 58,458 | 61.2 | 20.9 | 0.3 | 0.5 | 0.0 | 0.1 | 1.1 | 15.9 | 3 |
| Falls County | 17,866 | 52.5 | 25.0 | 0.3 | 0.3 | 0.1 | 0.1 | 0.9 | 20.8 | 3 |
| Freestone County | 19,816 | 68.9 | 16.0 | 0.4 | 0.3 | 0.0 | 0.0 | 0.8 | 13.6 | 3 |
| Henderson County | 78,532 | 80.9 | 6.1 | 0.4 | 0.4 | 0.0 | 0.1 | 1.2 | 10.8 | 3 |
| Leon County | 16,801 | 77.8 | 7.0 | 0.3 | 0.4 | 0.0 | 0.0 | 0.9 | 13.5 | 3 |
| Limestone County | 23,384 | 61.7 | 17.3 | 0.3 | 0.4 | 0.0 | 0.1 | 1.2 | 19.1 | 3 |
| Navarro County | 47,735 | 59.9 | 13.6 | 0.3 | 0.5 | 0.8 | 0.1 | 1.0 | 23.8 | 3 |
| Van Zandt County | 52,579 | 85.8 | 2.7 | 0.7 | 0.3 | 0.1 | 0.0 | 1.2 | 9.2 | 3 |
| Robertson County | 16,622 | 59.1 | 21.1 | 0.3 | 0.6 | 0.0 | 0.1 | 0.9 | 18.0 | 3&4 |
| Brazos County | 194,851 | 59.1 | 10.7 | 0.2 | 5.1 | 0.0 | 0.1 | 1.3 | 23.3 | 3&4 |
| Bastrop County | 74,171 | 57.2 | 7.5 | 0.4 | 0.6 | 0.1 | 0.2 | 1.4 | 32.6 | 4 |
| Burleson County | 17,187 | 68.1 | 12.0 | 0.3 | 0.1 | 0.0 | 0.0 | 1.0 | 18.4 | 4 |
| Lee County | 16,612 | 65.0 | 10.7 | 0.3 | 0.3 | 0.1 | 0.0 | 1.2 | 22.4 | 4 |
| Milam County | 24,757 | 65.5 | 9.6 | 0.3 | 0.4 | 0.0 | 0.0 | 0.8 | 23.3 | 4 |
| Travis County | 1,024,266 | 50.5 | 8.1 | 0.3 | 5.7 | 0.1 | 0.2 | 1.7 | 33.5 | 4 |
| Williamson County | 422,679 | 63.8 | 5.9 | 0.3 | 4.8 | 0.1 | 0.2 | 1.9 | 23.2 | 4 |
| Atascosa County | 44,911 | 36.3 | 0.6 | 0.3 | 0.3 | 0.0 | 0.1 | 0.5 | 61.9 | 5 |
| Live Oak County | 11,531 | 59.0 | 3.9 | 0.5 | 0.5 | 0.0 | 0.1 | 0.7 | 35.2 | 5 |
| McMullen County | 707 | 61.1 | 1.1 | 0.0 | 0.4 | 0.0 | 0.0 | 0.4 | 36.9 | 5 |

**Table 3.15-2 2010 County Populations by Race**

| County[1] | Total Population | Non-Hispanic - White Alone | Minority Populations | | | | | | | Analysis Area |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Non-Hispanic - Black or African American Alone | Non-Hispanic - American Indian and Alaska Native Alone | Non-Hispanic – Asian Alone | Non-Hispanic - Native Hawaiian and Other Pacific Islander Alone | Non-Hispanic - Some Other Race | Non-Hispanic - Two or More Races | Hispanic or Latino (of any race)[2] | |
| | | (percent) | | | | | | | | |
| Dimmit County | 9,996 | 12.2 | 0.8 | 0.1 | 0.5 | 0.0 | 0.1 | 0.1 | 86.2 | 6 |
| Kinney County | 3,598 | 41.6 | 1.1 | 0.5 | 0.3 | 0.0 | 0.2 | 0.7 | 55.7 | 6 |
| Maverick County | 54,258 | 2.9 | 0.1 | 0.9 | 0.3 | 0.0 | 0.0 | 0.1 | 95.7 | 6 |
| Uvalde County | 26,405 | 29.0 | 0.4 | 0.2 | 0.4 | 0.0 | 0.1 | 0.4 | 69.3 | 6 |
| Zavala County | 11,677 | 5.5 | 0.3 | 0.1 | 0.0 | 0.0 | 0.0 | 0.1 | 93.9 | 6 |
| Louisiana | 4,533,372 | 60.3 | 31.8 | 0.6 | 1.5 | 0.0 | 0.1 | 1.3 | 4.2 | |
| Texas | 25,145,561 | 45.3 | 11.5 | 0.3 | 3.8 | 0.1 | 0.1 | 1.3 | 37.6 | -- |
| U.S. | 308,745,538 | 63.7 | 12.2 | 0.7 | 4.7 | 0.2 | 0.2 | 1.9 | 16.3 | -- |

[1] Counties in Texas, unless otherwise noted.

[2] People who identify their origin as Hispanic, Latino, or Spanish may be of any race.

Source: U.S. Census 2010a.

#### 3.15.1.2 Low-Income Populations

U.S. Census poverty thresholds were used to identify potential low-income populations within the six analysis areas. The thresholds are dependent on the number of people and if the householder is over the age of 65. The poverty threshold for a three-person household is $17,373 (U.S. Census 2010c). **Table 3.15-3** shows the median household income and the percentage of persons living below the poverty line for each analysis area. Analysis Area 6 has the highest percentage of people below the poverty line (34.8 percent); most of the other analysis areas have percentages much closer to the Texas and Louisiana state percentages (16.6 and 23.7 percent, respectively). Of the eight counties with poverty levels above 22 percent, five are in Analysis Area 6 (**Table 3.15-4**); however, all have a median household income above the poverty threshold.

**Table 3.15-3 2010 Median Household Income and Low Income Populations by Analysis Area**

| Analysis Area | Median Household Income | Percent of People Living Below the Poverty Line |
|---|---|---|
| Analysis Area 1 | $42,115 | 16.6 |
| Analysis Area 2 | $40,420 | 18.9 |
| Analysis Area 3 | $38,226 | 23.7 |
| Analysis Area 4 | $53,102 | 17.3 |
| Analysis Area 5 | $41,789 | 19.9 |
| Analysis Area 6 | $28,698 | 34.8 |
| Total of the Six Analysis Areas[1] | $46,625 | 18.6 |
| Texas | $48,622 | 17.9 |
| Louisiana | $42,510 | 18.8 |
| U.S. | $50,046 | 15.3 |

[1] Smith County falls within Analysis Areas 1 and 2, and Robertson and Brazos counties fall within Analysis Areas 3 and 4. As a result, the sum total for the six analysis areas is greater than the actual total for the overall analysis area.

Source: U.S. Census 2010d.

**Table 3.15-4 2010 Median Household Income and Low Income Populations by County**

| County[1] | Median Household Income | Percent of People Living Below the Poverty Line | Analysis Area |
|---|---|---|---|
| Camp County | $37,704 | 21.3 | 1 |
| Franklin County | $40,579 | 15.9 | 1 |
| Hopkins County | $40,446 | 18.0 | 1 |
| Morris County | $34,451 | 19.2 | 1 |
| Rains County | $40,966 | 16.7 | 1 |
| Titus County | $37,818 | 20.7 | 1 |
| Upshur County | $42,508 | 16.3 | 1 |
| Wood County | $40,149 | 18.3 | 1 |
| Smith County | $44,249 | 15.0 | 1&2 |
| Caddo Parish, Louisiana | $37,739 | 19.5 | 2 |

**Table 3.15-4 2010 Median Household Income and Low Income Populations by County**

| County[1] | Median Household Income | Percent of People Living Below the Poverty Line | Analysis Area |
|---|---|---|---|
| DeSoto Parish, Louisiana | $37,379 | 21.2 | 2 |
| Cherokee County | $34,910 | 24.7 | 2 |
| Gregg County | $41,623 | 20.5 | 2 |
| Harrison County | $44,506 | 17.3 | 2 |
| Nacogdoches County | $35,854 | 25.5 | 2 |
| Panola County | $48,621 | 13.8 | 2 |
| Rusk County | $43,318 | 15.3 | 2 |
| San Augustine County | $31,729 | 21.2 | 2 |
| Shelby County | $34,490 | 21.9 | 2 |
| Anderson County | $40,482 | 20.9 | 3 |
| Falls County | $30,576 | 25.3 | 3 |
| Freestone County | $42,266 | 18.1 | 3 |
| Henderson County | $37,137 | 19.3 | 3 |
| Leon County | $40,847 | 14.4 | 3 |
| Limestone County | $37,438 | 19.0 | 3 |
| Navarro County | $37,864 | 21.5 | 3 |
| Van Zandt County | $41,476 | 16.8 | 3 |
| Robertson County | $36,935 | 21.6 | 3&4 |
| Brazos County | $37,468 | 30.8 | 3&4 |
| Bastrop County | $49,812 | 15.5 | 4 |
| Burleson County | $41,273 | 15.2 | 4 |
| Lee County | $45,661 | 13.1 | 4 |
| Milam County | $36,799 | 19.8 | 4 |
| Travis County | $51,905 | 18.8 | 4 |
| Williamson County | $66,152 | 7.9 | 4 |
| Atascosa County | $42,439 | 20.4 | 5 |
| Live Oak County | $39,091 | 18.6 | 5 |
| McMullen County | $44,541 | 11.9 | 5 |
| Dimmit County | $29,685 | 31.0 | 6 |
| Kinney County | $35,725 | 24.7 | 6 |
| Maverick County | $27,710 | 39.9 | 6 |
| Uvalde County | $31,941 | 26.4 | 6 |
| Zavala County | $22,948 | 36.9 | 6 |
| Louisiana | $42,510 | 18.8 | |
| Texas | $48,622 | 17.9 | |
| U.S. | $50,046 | 15.3 | |

[1] Counties in Texas, unless otherwise noted.

Source: U.S. Census 2010d.

### 3.15.2 Environmental Consequences

The environmental justice analysis addresses the potential for the Proposed Action and the No Action alternatives to adversely affect minority or low income populations to a disproportionate degree, relative to their representation in the larger population.

A recommended screening process to identify environmental justice concerns includes a two-step process to define criteria for this analysis. If either of the criteria are not met, there is little likelihood of adverse environmental justice effects occurring. The two-step process is:

- Does the potentially affected community include minority or low-income populations?
- Are the environmental impacts likely to fall disproportionately on minority and/or low-income members of the community?

If the two-step process indicates that a potential exists for adverse environmental justice effects to occur, the following are considered in the analysis:

- Whether there exists a potential for disproportionate risk of high and adverse human health or environmental effects;
- Whether communities have been sufficiently involved in the decision-making process; and
- Whether communities currently suffer, or historically have suffered, from environmental and health risks and hazards.

This step-wise process was used to evaluate the Proposed Action and No Action alternatives for potential adverse environmental justice effects.

The analysis area for direct and indirect environmental justice impacts includes 43 counties within or adjacent to the six study areas, two of which are in the State of Louisiana, and the remaining counties are in the State of Texas.

#### 3.15.2.1 Proposed Action

A typical mine expansion area or satellite mine may displace households in any of the six study areas; however, the displacement is not anticipated to be concentrated in one particular study area or county. The displacement effects would be unlikely to fall disproportionately on the minority community. All property owners and residents would be in a comparable position to negotiate the terms of selling or leasing their properties, as well as the terms of their moves to other locations. All residents would experience similar circumstances of noise and visual effects, depending on the locations of their properties, irrespective of their income or race. Although the median income for Study Area 6 is notably lower than other study areas, it is higher than the poverty threshold and does not qualify the area as a low-income community.

As part of this NEPA process, an extensive effort was made to provide all interested parties in the vicinity of the study areas with access to public information and opportunities to participate by providing scoping comments. The public involvement process is described in Chapter 4.0. Efforts were made to ensure that access to information was available to all interested parties in a non-discriminatory manner.

While minority populations in some of the study areas are proportionately larger than in the state as a whole, any environmental effects that may occur from the development of future mine expansion areas or satellite mines would affect the population in each study area equally, without regard to race, ethnicity, age, or income level. Without knowing the precise location of mine expansion areas or satellite mines, it is not possible to determine whether displaced residents or those living near enough to be directly affected by noise or visual impacts would be members of disproportionately low-income or minority populations.

### 3.15.2.2 No Action

Under the No Action Alternative, the development of a typical surface coal or lignite mine expansion area or satellite mine would be the same as those described for the Proposed Action. Therefore, impacts on minority and low-income populations would be similar to those described for the Proposed Action. There would be no identifiable adverse environmental effects on minority, low-income, or other communities in the vicinity.

## 3.15.3 Cumulative Impacts

The CESAs for environmental justice encompass 43 counties, inclusive of the study areas (see **Appendix A**, **Figure A-16**). When the past and present actions and RFFAs described in Section 2.4 are considered in combination with the projected future mine development, it is anticipated that the effects from surface disturbance and other mine-related effects would be distributed across each CESA. Until site-specific locations for future mine expansion areas or satellite mines are proposed and are determined to be concentrated in areas in which minority or low-income populations reside, it must be concluded that there would be no disproportionate and adverse effects on minority or low-income populations.

## 3.15.4 Monitoring and Mitigation Measures

No monitoring or mitigation measures are recommended to address environmental justice concerns.

## 3.15.5 Residual Adverse Effects

There would be no residual disproportionate and adverse effects from the Proposed Action or No Action alternatives.

## 3.16 Energy Requirements and Conservation Potential

Energy for the typical surface coal or lignite mine primarily would be supplied by electricity and diesel fuel. Electricity would be used to power draglines and ancillary facilities, pump water during operations, and provide lighting for mining activities. Diesel fuel would be used to power mobile equipment. The annual electrical load and diesel fuel consumption rate for potential future mines would vary.

## 3.17 Relationship between Short-term Uses of the Human Environment and the Maintenance and Enhancement of Long-term Productivity

For impact analysis purposes for a typical surface coal or lignite mine expansion area or satellite mine, short-term is defined as the operational life of a mine plus the closure and reclamation period; long-term is defined as the future following final reclamation. This section identifies the tradeoffs between the short-term impacts to environmental resources during mine construction, operation, and reclamation versus long-term impacts to resource productivity that extend beyond the end of reclamation. Note that this discussion is not applicable to hazardous materials, public health, environmental justice, and energy requirements and conservation potential.

### 3.17.1 Geology, Mineral, and Paleontological Resources

Short-term coal or lignite mining at a typical mine would not affect the long-term potential for development of mineral resources. Access to oil and gas resources in a mine area would be temporarily restricted (in the short term) during active mining and reclamation; access to these resources would resume following mining and reclamation.

Short-term impacts to paleontological resources would include the loss of fossils, if present, on or within the formations within a mine disturbance area. However, based on the type and prevalence of the fossils that would be lost, the short-term impacts would be minor and would not affect the long-term potential for recovery of similar fossil resources regionally.

### 3.17.2 Water Resources

Short-term groundwater impacts would include effects to groundwater wells within a mine disturbance area, which would be removed, and wells located within the area of potential groundwater drawdown associated with mine-related dewatering. Short-term impacts from groundwater pumping could also affect groundwater levels and some surface water features up to a few miles beyond a drainage divide. These impacts would occur during mining operations and for a period following the completion of mining until the recovery of groundwater levels in the aquifer. The period of long-term impact would depend on site-specific conditions. Groundwater quality may be affected prior to resaturation of the pits. A future mine expansion area or satellite mine would be responsible for the mitigation of mine-related impacts to groundwater wells in compliance with RCT requirements, thereby minimizing the duration of the impact.

Short-term surface water impacts would include increased runoff volumes and associated sediment transport. However, storm water releases from a mine site would be attenuated by a water management system (i.e., sediment control ponds and TPDES-regulated outfalls). In the long-term, runoff modifications would be reduced by recontouring, growth media restoration, and revegetation.

There would be a short-term impact to waters of the U.S., including wetlands, streams (perennial, intermittent, and ephemeral), and ponds as a result of typical mine construction and operation. These impacts would occur incrementally over the life of a mine. Successful implementation of a site-specific detailed compensatory mitigation plan would reduce these impacts over the long term.

### 3.17.3 Soils

A typical mine would result in short-term impacts to soil productivity. With successful implementation of a site-specific reclamation plan, soil productivity would improve with vegetative growth and decomposition. Long-term impacts to soils would be associated with any permanent conversion of native non-hydric soils to hydric soils associated with wetland compensatory mitigation. Alteration of prime farmland soils, where present, would be a long-term impact.

### 3.17.4 Vegetation

A typical mine would result in short-term impacts to vegetation during project construction and operations. These impacts would be mitigated in the long term with successful implementation of a site-specific reclamation plan; however, tree species would require 20 plus years following reclamation to mature, resulting in a long-term impact.

Impacts to the long-term productivity of a mine area would depend primarily on the effectiveness of reclamation of the disturbance areas. In accordance with RCT requirements, disturbance areas would be reclaimed to productive post-mining land uses. Revegetation also would stabilize disturbance areas and help control soil erosion and the establishment of invasive plant species. Over the long term, there may be a permanent conversion of upland vegetation to wetland vegetation associated with wetland compensatory mitigation.

### 3.17.5 Fish and Wildlife Resources

A typical mine would result in a short-term incremental loss of aquatic and terrestrial habitat available to fish and wildlife resources, including special status species. These impacts would be mitigated in the long-term with successful implementation of a site-specific reclamation plan and detailed compensatory mitigation plan; however, forested habitats would require 20 plus years following reclamation to mature, resulting in a long-term impact.

The potential loss or reduction in available surface water as a result of groundwater level changes could result in long-term changes in riparian and wetland habitats where the surface water sources are hydraulically connected to the drawdown area in the affected aquifer. These changes could affect wildlife habitat until riparian and wetland habitats become re-established following reclamation and groundwater recovery.

Impacts to long-term productivity of aquatic communities (primarily macroinvertebrates) would occur due to the loss of streams (i.e., perennial, intermittent, and ephemeral) and other aquatic habitat (e.g., ponds). Long-term, there may be a permanent conversion of upland habitat to wetland habitat associated with wetland compensatory mitigation.

### 3.17.6 Cultural Resources

Short-term and long-term impacts to cultural resources would include the permanent direct loss of any archaeological sites and historic resources identified within a mine-related disturbance area during required baseline surveys. Treatment for any NRHP-eligible sites would be completed prior to ground disturbance; the scientific information associated with these resources would be preserved for the long term. Although NRHP-eligible sites would be mitigated through implementation of data recovery or other forms of mitigation, some of the cultural value associated with these sites would not be fully mitigated; therefore, long-term impacts to these resources would be anticipated.

A typical mine would result in the loss of any cultural resources within the disturbance area that are not eligible for the NRHP. Although these sites would be recorded to USACE and THC standards and the information integrated into local and statewide databases, the sites ultimately would be destroyed by mine construction and operation, resulting in long-term impacts.

### 3.17.7 Air Quality

Short-term temporary impacts to air quality would occur from emissions associated with mine construction and operation; however, these impacts would not be expected to exceed federal or state AAQS. These impacts would cease following the completion of mining and successful reclamation.

### 3.17.8 Land Use and Recreation

Short-term use of a typical mine area temporarily would replace existing land uses potentially including forestry resources, pasture and cropland, industrial/commercial facilities, developed water resources, and residential areas. Prior uses, dependent on landowners preferences, would be reinstated after reclamation. The commercial value of re-established forest lands would not be realized for a number of years, resulting in a long-term impact.

### 3.17.9 Social and Economic Values

The short-term maintenance of existing employment, population, and economic activity would accrue for the duration of a typical mine. Residents within a mine disturbance area would be displaced for the duration of operations and reclamation.

### 3.17.10 Transportation

There would be an incremental short-term increase in traffic on affected roadways during the life of a typical mine. There also would be short-term and long-term impacts as a result of road closures, until reconstructed roads are reopened.

### 3.17.11 Noise Resources

Elevated noise levels would occur in and near a typical mine in the short term; however, mine-related noise would cease following closure and final reclamation.

### 3.17.12 Visual Resources

Visual degradation would occur in the short-term during active mining; however, the rural landscape character gradually would be re-established throughout the disturbance area with concurrent reclamation. It would take several years beyond the life of the mine for adverse visual effects to diminish in the later disturbance areas while shrubs and trees become re-established.

## 3.18 Irreversible and Irretrievable Commitment of Resources

A typical surface coal or lignite mine expansion area or satellite mine would result in the irreversible commitment (e.g., loss of future options for resource development or management, especially of nonrenewable resources, such as minerals and cultural resources) or the irretrievable commitment of resources (e.g., the lost production or use of natural resources during the life of operations). Irreversible and irretrievable impacts of a typical mine are summarized for each resource in **Table 3.18-1**.

**Table 3.18-1 Irreversible and Irretrievable Commitment of Resources by the Proposed Action**

| Resource | Irreversible Impacts | Irretrievable Impacts | Description |
|---|---|---|---|
| Geology and Mineral Resources | Yes | Yes | Coal or lignite mining would cause an irreversible change in the topography of the disturbance area, and an irreversible and irretrievable commitment of the coal or lignite resources that would be mined and would not be available for future use.<br><br>Access to oil and gas resources, if present, temporarily may be restricted during active mining and reclamation unless the resources can be accessed through horizontal drilling to avoid surface conflicts; this would not be considered an irreversible or irretrievable resource commitment. |
| Paleontological Resources | No | No | No irretrievable or irreversible impacts would be anticipated to unique or scientifically important or valuable paleontological resources. |
| Water Resources | No | Yes | Groundwater levels and groundwater quality affected by typical mine dewatering/depressurization would recover in the long term. The groundwater lost during mine operations would be considered an irretrievable resource commitment.<br><br>There would be an irretrievable loss of surface water resources associated with the removal of perennial, ephemeral, and intermittent streams and impoundments associated with typical mine construction and operation. These impacts would be reversible with successful implementation of a mine-specific compensatory mitigation plan. Over time, surface water runoff modifications would be reduced by reclamation and revegetation; irreversible surface water impacts would not be anticipated.<br><br>There would be an irretrievable loss of waters of the U.S., including wetlands, perennial and intermittent streams, and ponds during mine operations. These impacts would be reversible with successful implementation of a mine-specific compensatory mitigation plan. |
| Soils | Yes | Yes | Suitable soils from mine-related disturbance areas would be salvaged for use in reclamation; however, there would be an irretrievable commitment of soil resources in mine disturbance areas until successful reclamation is completed. Prime farmland soils may be irreversibly altered, depending on the success of reclamation. There may be an irreversible conversion of native non-hydric soils to hydric soils associated with wetland compensatory mitigation. |
| Vegetation | Yes | Yes | There would be an irretrievable commitment of vegetation resources in mine disturbance areas until reclamation is completed. There may be an irreversible commitment of upland vegetation to wetland vegetation associated with wetland compensatory mitigation. |

**Table 3.18-1 Irreversible and Irretrievable Commitment of Resources by the Proposed Action**

| Resource | Irreversible Impacts | Irretrievable Impacts | Description |
|---|---|---|---|
| Fish and Wildlife Resources | Yes | Yes | There would be an irretrievable loss of stream (perennial, ephemeral, and intermittent), pond, wetland, and upland habitats associated with typical mine construction and operation. These impacts would be reversible with successful implementation of a mine-specific compensatory mitigation plan and reclamation plan. There may be an irreversible commitment of upland habitat to wetland habitat associated with wetland compensatory mitigation. |
| Cultural Resources | Yes | Yes | Cultural resources would be irreversibly and irretrievably lost through disturbance; however, significant (NRHP-eligible) cultural resources would be mitigated through avoidance or data recovery. |
| Air Quality | No | No | There would be no irretrievable or irreversible impacts to air quality. Air quality impacts for a typical mine would not exceed federal or state AAQS. The air quality would return to pre-mining levels after construction, mining, and reclamation activities cease to be sources of pollutants and as soils are stabilized and vegetation is re-established. |
| Land Use and Recreation | No | Yes | There would be irretrievable impacts to land use associated with mine construction and operation. Changes in land use generally would be reversible through reclamation efforts in consultation with landowners. There would be no irreversible or irretrievable loss of developed recreation resources. Major utilities would be rerouted during typical mine construction and operation; rerouting may be permanent at the discretion of the owner. |
| Social and Economic Values | No | Yes | Social and economic effects of a typical mine would be reversible following mine closure. |
| Transportation | No | Yes | Mine-related traffic impacts would continue for the life of a typical mine, but would be reversible and would cease at mine closure. |
| Noise Resources | No | Yes | Noise effects would be considered reversible, as they would cease on completion and closure of a mine. |
| Visual Resources | No | Yes | Certain visual effects, particularly removal of mature trees, would persist for a number of years; however, in the long term, the adverse visual effects would be largely obscured by successful reclamation and revegetation. |
| Hazardous Materials | No | No | No irreversible or irretrievable commitment of resources or impacts would be anticipated. However, if a spill were to affect a sensitive resource, an irretrievable impact could occur pending the recovery of the resource. |
| Public Health | No | No | Adverse public health impacts are not anticipated. |
| Environmental Justice | No | No | There would be no irreversible or irretrievable impacts to low-income or minority populations. |