



**US Army Corps  
of Engineers®  
Fort Worth District**

**April 2016**

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**Final**

**Regional Environmental Impact Statement for  
Surface Coal and Lignite Mining in Texas**

**VOLUME I**

**Cooperating Agencies:**

**Office of Surface Mining, Reclamation, and Enforcement**

**Railroad Commission of Texas**

**Texas Parks and Wildlife Department**

**U.S. Environmental Protection Agency**

**U.S. Fish and Wildlife Service**





DEPARTMENT OF THE ARMY  
FORT WORTH DISTRICT, CORPS OF ENGINEERS  
P. O. BOX 17300  
FORT WORTH, TEXAS 76102-0300

April 29, 2016

Regulatory Division

Dear Reader:

The Final Regional Environmental Impact Statement (REIS) for Surface Coal and Lignite Mining in Texas is submitted for your review. The REIS considers the potential environmental impacts of future mine expansions or satellite mines in six study areas along the coal-bearing geological formations that run from southwest to northeast Texas (detailed maps within). The study areas encompass locations within the coal/lignite belt in Texas that were determined to be within reasonable proximity to existing surface coal and lignite mines with potential for future expansion.

The U.S. Army Corps of Engineers (USACE), Fort Worth District, is proposing changes to their regulatory framework for surface coal and lignite mines in Texas. The proposed regulatory framework includes the establishment of a Regional General Permit (RGP) and a revised Letter of Permission (LOP) procedure with modifications to aquatic resource impact thresholds and a change from agency concurrence to agency coordination as compared to the current process. No changes to the criteria for Nationwide Permit (NWP) 21 or NWP 49 are proposed. The REIS is intended to provide an environmental evaluation focusing on the potential direct, indirect, and cumulative aquatic resource impacts, in addition to other relevant environmental and human resources, that could be affected by future surface coal and lignite mining within defined geographic regions in Texas. The REIS would facilitate future tiering or supplementation of the NEPA analysis in the REIS in the evaluation of future project-specific Section 404/10 permit applications. It also is intended to provide a cohesive framework for stream mitigation, establishment of sound performance metrics, and enhance project monitoring efforts associated with these types of activities. The REIS is intended to avoid duplication and provide efficiency and effectiveness with future decisions. **The REIS does NOT render a project-specific permit decision.** Its purpose is to inform the public and decision maker of the impacts associated with implementing the proposal, to evaluate alternatives to the proposal, and to solicit other agencies and the public for comments.

The REIS has been prepared in compliance with the National Environmental Policy Act of 1969 (NEPA), the Council on Environmental Quality (CEQ) Regulations for Implementing the Procedural Provisions of NEPA (40 Code of Federal Regulations [CFR] 1500-1508), and the USACE Procedures for Implementing NEPA (33 CFR 230). An electronic copy of the document is available for review and/or download at:  
<http://www.swf.usace.army.mil/Missions/Regulatory/Permitting/REISforLigniteMininginTexas.aspx>

For further information, please contact Mr. Darvin Messer at 817-886-1744.

Sincerely,

  
Stephen L Brooks  
Chief, Regulatory Division



**FINAL REGIONAL ENVIRONMENTAL IMPACT STATEMENT  
SURFACE COAL AND LIGNITE MINING IN TEXAS**

Lead Agency: Department of the Army  
U.S. Army Corps of Engineers  
Fort Worth District

Project Location: Six defined study areas located along the southwest- to  
northeast-trending coal belt in Texas

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**ABSTRACT**

The U.S. Army Corps of Engineers (USACE), Fort Worth District, as lead federal agency, has prepared this Regional Environmental Impact Statement (REIS) to analyze potential impacts within defined geographic regions in Texas that may be affected by future USACE, Fort Worth District, permit decisions for future surface coal and lignite mine expansions within the District's area of responsibility. The REIS is being prepared in compliance with the National Environmental Policy Act of 1969 (NEPA), the Council on Environmental Quality (CEQ) Regulations for Implementing the Procedural Provisions of NEPA (40 Code of Federal Regulations [CFR] 1500-1508), and the USACE Procedures for Implementing NEPA (33 CFR 230).

The USACE, Fort Worth District, is proposing changes to the USACE regulatory framework for surface coal and lignite mines in Texas. The proposed regulatory framework includes the establishment of a Regional General Permit (RGP) and a revised Letter of Permission (LOP) procedure with modifications to aquatic resource impact thresholds and a change from agency concurrence to agency coordination as compared to the current process. No changes to the criteria for Nationwide Permit (NWP) 21 or NWP 49 are proposed.

The REIS considers the potential environmental impacts of future mine expansions or satellite mines in six study areas along the coal-bearing formations in Texas that run from southwest Texas to northeast Texas. The study areas encompass locations within the coal/lignite belt in Texas that were determined to be within reasonable proximity to existing surface coal and lignite mines with potential for future expansion.

Additions and changes to the Draft REIS are indicated in bold font, with a line in the margin to mark the locations of additions and deletions. Section 4.6 describes the public comment period. Public comments received during the Draft REIS public review period and the USACE's associated responses are included in **Appendix D** of this Final REIS.

The 30-day review (waiting) period for this Final REIS was initiated with publication of the Notice of Availability in the Federal Register on April 29, 2016.

Responsible Official for the EIS:



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Stephen L Brooks  
Chief, Regulatory Division



## Executive Summary

### ES1.1 Introduction and Background

The U.S. Army Corps of Engineers (USACE) Fort Worth District, as lead federal agency, **has** prepared this Regional Environmental Impact Statement (REIS) to analyze potential impacts within defined geographic regions in Texas that may be affected by future USACE Fort Worth District permit decisions for future surface coal and lignite mine expansions or satellite mines within the District's area of responsibility. The REIS **has been** prepared in compliance with the National Environmental Policy Act of 1969 (NEPA), the Council on Environmental Quality (CEQ) Regulations for Implementing the Procedural Provisions of NEPA (40 Code of Federal Regulations [CFR] 1500-1508), and the USACE Procedures for Implementing NEPA (33 CFR 230). The Office of Surface Mining, Reclamation, and Enforcement (OSMRE); Railroad Commission of Texas (RCT); **Texas Parks and Wildlife Department (TPWD)**; U.S. Environmental Protection Agency (USEPA); and U.S. Fish and Wildlife Service (USFWS) are serving as cooperating agencies.

The REIS considers six study areas along the coal-bearing formations in Texas that run from southwest Texas to northeast Texas (see **Figure ES-1**). The study areas encompass locations within the coal/lignite belt in Texas that were determined to be within reasonable proximity to existing surface coal and lignite mines with potential for future expansion.

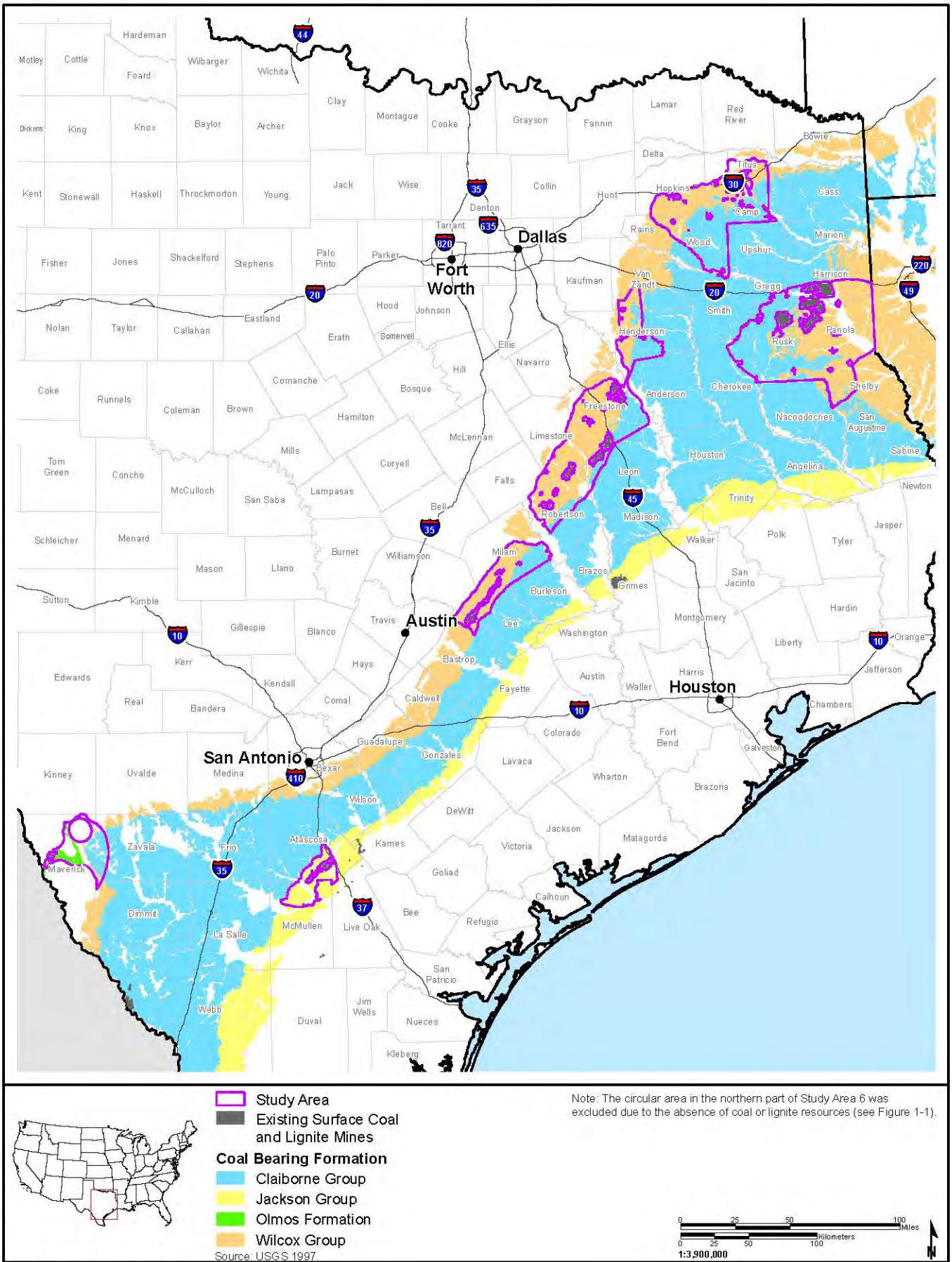
### ES1.2 USACE Purpose and Need for the Action

Currently operating surface coal and lignite mines in Texas provide a long-term, reliable, continuous, and economically stable fuel source to existing nearby power plants, with one mine providing raw lignite material to an existing carbon activation plant. As the existing permitted surface coal and lignite mines approach the extent of the reserves that can be safely and economically recovered within the limits of their current mine permit areas, expansion of mine areas would be required in order to continue to meet their supply obligations.

Surface coal and lignite mining projects typically conduct work that results in impacts to waters of the U.S. Such work requires authorization under Section 404 of the Clean Water Act, and for projects affecting navigable waters, authorization under Section 10 of the Rivers and Harbors Act of 1899. These programs are administered by the USACE. As part of the permit evaluation process associated with Section 404 and Section 10 permit authorizations, the USACE is also required to comply with the regulatory requirements of NEPA in evaluating the potential impacts of a proposed action.

A majority of the future surface coal and lignite mining proposals will require Section 404 (and in some cases Section 10) permits and associated NEPA compliance documents. The anticipated number of future permit applications requiring USACE Fort Worth District compliance with NEPA, along with agency resource constraints, could result in lengthy review times. Historic permit evaluations associated with mine expansions have required substantial time periods. These timeframes have been influenced in part by the need to develop resource information, undertake data gathering efforts, as well as coordination with various agencies and their permit review processes. The USACE Fort Worth District also needs to ensure it can adapt and efficiently respond to multiple concurrent requests for permits that may occur in the future. In addition, mine operators also have to coordinate with and obtain authorizations from other agencies which can contribute to additional time for other evaluation and regulatory decisions they are pursuing.

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1/8/2018

Figure ES-1 Study Areas



Many of the federal and state agency regulatory requirements and environmental issues associated with surface coal and lignite mining projects are similar, such as large landscape alterations, economic effects, impact avoidance, mitigation measures, performance metrics/monitoring, and the contribution to cumulative impacts. Therefore, the USACE Fort Worth District is undertaking the REIS to streamline the NEPA aspect of the District's Section 404/10 permitting process, as well as to develop information, data, and analysis to be used in Section 404(b)(1) guidelines and public interest review analyses for future coal and lignite mine expansions and satellite mines in Texas. The USACE Fort Worth District's purpose for the REIS is to provide a NEPA-compliant environmental evaluation focusing on potential direct, indirect, and cumulative aquatic resource impacts, in addition to all other relevant environmental and human resources within the defined geographic regions in Texas that would be associated with and affected by future USACE Fort Worth District permit decisions. Additionally, this REIS will serve to establish a cohesive framework for stream mitigation, establish sound performance metrics, and enhance project monitoring efforts. This assessment would facilitate future tiering or supplementation in the evaluation of future project-specific Section 404/10 permit applications for surface coal and lignite mines. A single regional NEPA document is intended to avoid duplication and be more efficient and effective for the lead and cooperating agencies involved in the regional NEPA process in making future decisions under their respective authorities.

### ES1.3 Alternatives Analyzed in Detail

#### ES1.3.1 Proposed Action

The USACE Fort Worth District is proposing changes to the District's regulatory framework for surface coal and lignite mines in Texas. The proposed regulatory framework, as presented in **Table ES-1**, includes the establishment of a Regional General Permit (RGP) and a revised Letter of Permission (LOP) procedure with modifications to aquatic resource impact thresholds and a change from agency concurrence (agreement) to agency coordination as compared to the process for the existing LOP-3. **Development of a RGP and/or a revised LOP would include issuance of a Public Notice to solicit comments from interested agencies and the public and consideration of any comments received in evaluating the respective proposed procedure. The evaluation process, supporting analysis, and final decision would be documented in the administrative record.** Resulting thresholds that would trigger evaluation of a potential future surface coal or lignite mine expansions and satellite mines under the existing Individual Permit (IP) process also are shown in the table. No changes to the criteria for Nationwide Permit (NWP) 21 or NWP 49 are proposed.

**Table ES-1 Proposed USACE Fort Worth District Regulatory Framework**

Permit Type <sup>1</sup>	Acreage Limit	Linear Footage Limit	Agency Coordination Requirement	Resource Limitations (type)
NWP 21 <sup>2</sup>	0.5	300 linear feet of stream (perennial, ephemeral, or intermittent), unless waived for ephemeral and intermittent streams	Coordination for waiver	No regional conditions limiting use
NWP 49 – Coal Remining Activities <sup>2,3</sup>	None	None	No	Mine, reclamation and mitigation plan must result in a net increase in aquatic resource functions
RGP	0.5 – 10 acres	Study Areas 1-4: 20,000 linear feet all	<b>Yes</b>	Forested wetlands cannot make up

**Table ES-1 Proposed USACE Fort Worth District Regulatory Framework**

Permit Type <sup>1</sup>	Acreage Limit	Linear Footage Limit	Agency Coordination Requirement	Resource Limitations (type)
		stream types, with no more than 1,000 total linear feet for perennial streams Study Areas 5-6: 30,000 linear feet all stream types, with no more than 1,000 total linear feet for perennial streams		more than 50 percent of the waters of the U.S. impact area; no impacts to bogs; no impacts to bald cypress-tupelo swamps
LOP	10 – 25 acres	No limit <sup>4</sup>	Yes	Forested wetlands cannot make up more than 50 percent of the waters of the U.S. impact area
IP	>25 acres	No limit	Yes	None

<sup>1</sup> A proposed project could have up to the acreage limit for wetlands and the linear foot limit for streams and still qualify for the respective permit type.

<sup>2</sup> Reflects existing thresholds and resource limitations for the NWP 21 and NWP 49; no changes are proposed.

<sup>3</sup> May be authorized for mining and reclamation of lands previously mined for coal/lignite if the proposed activities are currently authorized, or are in the process of being authorized, under the Surface Mining Control and Reclamation Act SMCRA of 1977. New coal/lignite mining activities may be authorized in conjunction with the remaining activities if: 1) the proposed new mining disturbance is 40 percent or less of the proposed total disturbance and 2) the overall mining plan would result in a net increase in aquatic resource functions.

<sup>4</sup> USACE Fort Worth District will review each proposed action on a case-by-case basis.

No changes to the USACE Fort Worth District’s current Section 404 mitigation guidelines for surface coal and lignite mines in Texas are proposed. As such, the current Section 404 mitigation guidelines would continue to be implemented under the Proposed Action. Under this REIS the USACE Fort Worth District will not render a decision on any specific mine project. Rather, submittal of project-specific permit applications, development and evaluation of separate project-specific NEPA analyses, and subsequent issuance of all required local, state, and federal permits would be required prior to development of any future surface coal or lignite mine expansion area or satellite mine in any of the study areas. The study areas for this REIS are summarized in **Table ES-2**.

**Table ES-2 Summary of Study Areas**

Study Areas	Approximate Total Acreage in Study Area	Estimated Maximum Disturbance Acreages Associated with Potential Requests for Future Authorizations	Estimated Percent of Study Area Potentially Disturbed under Anticipated Requests for Future Authorizations
Study Area 1	912,500	13,500	1.5
Study Area 2	1,449,300	50,200	3.5
Study Area 3	1,219,200	50,600	4.2
Study Area 4	365,300	9,800	2.7

**Table ES-2 Summary of Study Areas**

Study Areas	Approximate Total Acreage in Study Area	Estimated Maximum Disturbance Acreages Associated with Potential Requests for Future Authorizations	Estimated Percent of Study Area Potentially Disturbed under Anticipated Requests for Future Authorizations
Study Area 5	180,800	9,500	5.3
Study Area 6	<b>249,000</b>	25,000	<b>10.0</b>
Total	<b>4,376,100</b>	158,600	3.6

**ES1.3.2 No Action Alternative**

Under the No Action Alternative, the existing USACE Fort Worth District regulatory framework for surface coal and lignite mines in Texas, and the District’s current Section 404 mitigation guidelines, would continue to be used. The existing regulatory framework is presented in **Table ES-3**.

**Table ES-3 Existing USACE Fort Worth District Regulatory Framework**

Permit Type	Acreage Limit	Linear Footage Limit	Agency Coordination Requirement	Resource Limitations
NWP 21	0.5	300 linear feet of stream (perennial, ephemeral, or intermittent), unless waived for ephemeral and intermittent streams	Coordination for waiver	No regional conditions limiting use
NWP 49 – Coal Remining Activities <sup>1</sup>	None	None	No	Mine, reclamation and mitigation plan must result in a net increase in aquatic resource functions
LOP-3	20 acres	20,000 linear feet of stream, with no more than 1,000 linear feet for perennial streams	Yes <sup>2</sup>	Forested wetlands cannot make up more 50 percent of the waters of the U.S. impact area
IP	>20 acres	No limit	Yes	None

<sup>1</sup> May be authorized for mining and reclamation of lands previously mined for coal/lignite if the proposed activities are currently authorized, or are in the process of being authorized, under SMCRA. New coal/lignite mining activities may be authorized in conjunction with the remining activities if: 1) the proposed new mining disturbance is 40 percent or less of the proposed total disturbance and 2) the overall mining plan would result in a net increase in aquatic resource functions.

<sup>2</sup> LOP-3 requires agency concurrence.

**ES1.4 Summary of Impacts**

**Table ES-4** summarizes the potential impacts for each resource that would be affected by the implementation of the Proposed Action or No Action Alternative. The construction, operation, and closure/final reclamation activities and mine components of a typical surface coal or lignite mine expansion area or satellite mine were used to facilitate the impact analysis for this REIS. The need for

additional mitigation may be identified during the project-specific NEPA and 404(b)(1) analyses that would be conducted at the time future mine expansion areas or satellite mines are proposed.

## **ES1.5 Coordination and Consultation**

### **ES1.5.1 Public Participation and Scoping**

Public participation for the REIS began with the scoping process. The USACE Fort Worth District initiated the scoping process by publishing the Notice of Intent to prepare the REIS in the Federal Register on October 24, 2013. Additionally, a Public Notice was mailed to over 485 federal, state, and local government agencies; private businesses and organizations; private landowners; and tribes. Public notices were also placed in 18 local newspapers announcing the public scoping meetings. The USACE Fort Worth District conducted public scoping meetings on December 3, 2014, in Uvalde, Texas; December 4, 2014, in Temple/Belton, Texas; and December 5, 2014, in Tyler, Texas. A total of 110 meeting participants signed their attendance at the meetings.

The USACE Fort Worth District coordinated a meeting with interested agencies on July 16, 2013, to provide detailed technical information about the REIS and to solicit agency input regarding the scope, issues, and potential alternatives to be considered. Attendees included representatives from OSMRE, RCT, USFWS, Texas Parks and Wildlife Department, and Texas Commission on Environmental Quality.

At the end of the comment period, the scoping comments were compiled and analyzed to identify key issues and concerns. Some of the scoping comments were eliminated from consideration in the REIS because they addressed issues outside of the scope of the NEPA analyses, or the comment stated an opinion rather than a substantive comment that could be addressed in the REIS. A Scoping Summary Report was prepared and posted to the USACE Fort Worth District's public website for the REIS. The scope of the REIS reflects input received from the public and from government agencies.

### **ES1.5.2 Consultation and Coordination with Federal, State, and Local Government Agencies**

Specific regulations require the USACE to coordinate and consult with federal, state, and local agencies about the potential for a proposed action and alternatives to affect sensitive environmental and human resources. For the REIS, the USACE Fort Worth District initiated these coordination and consultation activities through the scoping process. In addition, the USACE Fort Worth District invited interested agencies to serve as cooperating agencies for preparation of the REIS; OSMRE, USEPA, USFWS, RCT, and TPWD are serving as cooperating agencies.

### **ES1.5.3 Tribal Government-to-Government Consultation**

In compliance with the National Historic Preservation Act and USACE Policy Guidance Letter No. 57 (Indian Sovereignty and Government-to-Government Relations with Indian Tribes) the USACE is required to establish regular and meaningful consultation and collaboration with Native American tribal governments on development of regulatory policies that could significantly or uniquely affect their communities. As such, the USACE Fort Worth District initiated consultation with Native American tribes **by sending letters to federally recognized tribes (as identified below) on November 1, 2013. No formal responses were received.**

- **Comanche Nation, Oklahoma**
- **Tonkawa Tribe of Indians of Oklahoma**
- **Kickapoo Traditional Tribe of Texas**
- **Kiowa Indian Tribe of Oklahoma**
- **Caddo Nation**
- **Wichita and Affiliated Tribes**
- **Mescalero Apache Tribe of The Mescalero Reservation**

- **Choctaw Nation of Oklahoma**
- **Alabama-Coushatta Tribe of Texas**

#### **ES1.5.4 Public Comments and USACE Responses**

**A 60-day public comment period for the Draft REIS commenced on July 10, 2015, with publication of the Notice of Availability in the Federal Register. Additionally, notifications were sent via email to the USACE public notice list that was current at the time of the Draft REIS distribution. In addition to the USACE list, notifications of the availability of the Draft REIS were sent via email to 24 individuals who submitted public scoping comments and requested email notification. Postcard notifications were mailed to 52 scoping commenters without email addresses who supplied addresses. The notification of the availability of the Draft REIS and the schedule for public hearings was published in 18 local and regional newspapers. Copies of the Draft REIS (hard copy, compact disk, or both) were sent to seven federal agencies (including cooperating agencies), one state agency, 32 main county libraries in Texas, six Texas Mining and Reclamation Association members, and seven individuals.**

**During the public comment period the USACE Fort Worth District conducted both informal public information meetings and formal public hearings at Eagle Pass, Texas, on August 10, 2015; Pleasanton, Texas, on August 11, 2015; Belton, Texas, on August 12, 2015; and Tyler, Texas, on August 13, 2015. The total number of people that signed in at each of the meetings/hearings was 88, 7, 14, and 5, respectively. A court reporter was present at each of the public hearings to record formal oral comments. Also, a Spanish-speaking interpreter was present at the Eagle Pass and Pleasanton meetings, and the Draft REIS Executive Summary was available in Spanish at all locations. The public comments and associated USACE responses are presented in the Final REIS.**

**Table ES-4 Summary of Direct and Indirect Impacts by Resource or Impact Issue and Recommended Monitoring and Mitigation**

Resource/Impact Issue	Proposed Action Alternative	No Action Alternative	Recommended Monitoring and Mitigation Measures
<b>Geology/Minerals/Paleontology</b>			
Modification of topography	Topography would be altered by the removal of overburden and coal or lignite on approximately 158,600 acres. Effects minimized through regrading to approximate original contour.	Same as the Proposed Action.	<ul style="list-style-type: none"> <li>No monitoring or mitigation is recommended for geology, paleontological, or mineral resources.</li> </ul>
Removal of coal and lignite resources making it unavailable in the future	Permanent removal of an estimated 35 million tons of coal or lignite annually	Same as the Proposed Action.	
Access to oil and gas resources	Access to oil and gas resources would be precluded or limited during active mining unless horizontal drilling were implemented.	Same as the Proposed Action.	
Damage to fossils	Mining may directly damage or destroy common fossils; however, the potential for impact to significant fossils is low.	Same as the Proposed Action.	
<b>Water Resources</b>			
<b>Groundwater</b>			
Drawdown of aquifers	Maximum extent of projected mine-related 5-foot groundwater contour as a result of dewatering and depressurization would vary across the study areas, ranging from a high of 15 miles in Study Area 4 to zero in Study Area 6. 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.	Same as the Proposed Action.	<ul style="list-style-type: none"> <li>No monitoring or mitigation measures are recommended.</li> </ul>

**Table ES-4 Summary of Direct and Indirect Impacts by Resource or Impact Issue and Recommended Monitoring and Mitigation**

Resource/Impact Issue	Proposed Action Alternative	No Action Alternative	Recommended Monitoring and Mitigation Measures
Groundwater quantity	<p>The effects on other groundwater uses would vary depending on the extent of required mine depressurization and dewatering. Impacts would be confined to the portion of the affected aquifers within a mine-related groundwater drawdown area until mining ends and groundwater levels recover.</p> <p>In accordance with RCT requirements, water supply would be replaced if water supply wells are impacted by mining operations.</p>	Same as the Proposed Action.	
Groundwater quality	Groundwater quality in mine pit backfill areas may have elevated levels of salinity; however, impacts to groundwater due to increased salinity would be minimal in all study areas.	Same as the Proposed Action.	
<b>Surface Water</b>			
Removal of surface water features <sup>1</sup>	<p>Direct effects to surface water features from mining would vary by study area. It is estimated that the occurrence of streams within future mining areas would range from a high of approximately 56 miles of perennial streams and 187 miles of intermittent streams potentially affected in Study Area 2 to a low of approximately 0.3 miles of perennial streams and 81 miles of intermittent streams in Study Area 6. A currently unquantifiable portion of these 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.</p>	Same as the Proposed Action.	<ul style="list-style-type: none"> <li>• No <b>additional</b> monitoring or <b>mitigation</b> beyond that <b>currently</b> required by <b>the USACE Fort Worth District and other</b> jurisdictional agencies is recommended for surface water.</li> </ul>

**Table ES-4 Summary of Direct and Indirect Impacts by Resource or Impact Issue and Recommended Monitoring and Mitigation**

Resource/Impact Issue	Proposed Action Alternative	No Action Alternative	Recommended Monitoring and Mitigation Measures
Flow effects from watershed modifications	Changes to flow patterns and increased storm water runoff from bare ground may alter stream flows. Compliance with federal and state regulations would minimize flow increases from disturbed areas.	Same as the Proposed Action.	
Surface water quality	<p>Surface water runoff from disturbed areas would contain increased turbidity and possibly higher concentrations of salinity and other contaminants. These adverse impacts would be largely confined to the future mine permit areas. Impacts would be minimized through compliance with RCT and USACE Fort Worth District permit requirements.</p> <p>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 analysis of overburden and underburden through appropriate acid-base accounting or other assessments. Selective handling plans and follow-up testing would be developed and implemented to ensure that acid- or toxic-forming material are not placed in the upper 4 feet of the backfill profile.</p>	Generally similar to the Proposed Action. Restrictions on impacts would not be applied for smaller mine expansion areas (0.5 to 10 acres), which could allow greater surface water-related impacts in some areas. The resource benefits from concentrating regulatory efforts and specific mitigation on future mine expansion areas or satellite mines with greater potential for surface water impacts would not occur.	
<b>Waters of the U.S., including wetlands</b>			
Impacts to waters of the U.S., including wetlands <sup>2</sup>	Assuming that the acreage of waters of the U.S., including wetlands, projected to be impacted by future mining would be proportional to the size of the study area and the projected acreage that would be mined in each study area, most of the wetlands projected to be impacted by future mining would be palustrine because this type covers the largest acreage within the study areas. It is estimated that the acreage of wetlands projected to be impacted would range from approximately 3,655 acres in Study Area 2 to 110 acres in Study Area 5.	Same as the Proposed Action.	<ul style="list-style-type: none"> <li>No additional monitoring or mitigation beyond that currently required by the USACE Fort Worth District is recommended.</li> </ul>



**Table ES-4 Summary of Direct and Indirect Impacts by Resource or Impact Issue and Recommended Monitoring and Mitigation**

Resource/Impact Issue	Proposed Action Alternative	No Action Alternative	Recommended Monitoring and Mitigation Measures
<b>Soils and Reclamation</b>			
Impacts to soil resources	Direct incremental disturbance of soil resources may cause associated increased erosion, alteration of soil structure, and reduction in soil productivity. Implementation of erosion control measures, soil and suitable growth media salvage, and a mine-specific reclamation plan would minimize the impacts. The projected acreage of soils anticipated to be affected equates to the amount of surface disturbance projected in each study area.	Same as the Proposed Action.	<ul style="list-style-type: none"> <li>• Rough and final grading should occur when the soils are dry to minimize soil compaction during reclamation.</li> <li>• Compacted surface or subsurface soils should be treated for compaction by deep ripping or subsoiling, prior to revegetation efforts.</li> </ul>
<b>Vegetation (including special status species)</b>			
Impacts to vegetation	Up to 158,600 acres of vegetation or approximately 3.6 percent of the 4,376,100 acres within all study areas is projected to be disturbed by mine development, ranging from 1.5 percent of the acreage in Study Area 1 to 10.0 percent in Study Area 6. There would be a long-term loss of woody species and short-term loss of herbaceous species following reclamation. Implementation of compensatory mitigation plans would minimize impacts to vegetation in each study area.	Same as the Proposed Action.	<ul style="list-style-type: none"> <li>• Conduct of special status plant species surveys in areas of potentially suitable habitat prior to ground-disturbing activities is recommended.</li> <li>• Development of appropriate mitigation and monitoring in coordination with USFWS and TPWD, as applicable, to minimize impacts to identified special status plant species is recommended.</li> </ul>
Establishment of noxious weeds or invasive plants	Surface disturbance from future mining would increase the potential for the spread and establishment of noxious weeds or invasive plant species,	Same as the Proposed Action.	<ul style="list-style-type: none"> <li>• Where possible, surface disturbance should be at least 100 feet from any non-jurisdictional wetland or riparian area, with a vegetation buffer maintained.</li> </ul>
Impacts to special status plant species (i.e., species afforded protection under federal and state laws)	Surface disturbance in Study Areas 2, 3, 4, and 6 may affect populations or habitat for the six federal or state listed plant species, but adverse impacts would be minimized through consultation with USFWS under the ESA and compliance with state laws and regulations.	Same as the Proposed Action.	<ul style="list-style-type: none"> <li>• Prior to ground disturbance, select plant species (e.g., pitcher-plant) may be relocated to suitable habitat in coordination with the appropriate jurisdictional agency.</li> </ul>

**Table ES-4 Summary of Direct and Indirect Impacts by Resource or Impact Issue and Recommended Monitoring and Mitigation**

Resource/Impact Issue	Proposed Action Alternative	No Action Alternative	Recommended Monitoring and Mitigation Measures
<b>Fish and Wildlife Resources (including special status species)</b>			
<b>Terrestrial Wildlife</b>			
Loss or alteration of terrestrial habitats	Direct impacts would include habitat loss and alteration, habitat fragmentation, wildlife displacement, and wildlife mortality. Indirect impacts would include effects related to increased noise, light, and human presence. Long-term impacts would 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 habitats would be altered for a long time period, particularly woody-species dominated habitats. Larger species displaced during mining would return following reclamation as long as suitable habitat is re-established. The regional carrying capacity for birds may be reduced by the incremental loss of available nest and roost sites depending on the species affected and the site-specific conditions.	Same as the Proposed Action.	<ul style="list-style-type: none"> <li>• 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.</li> <li>• 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.</li> <li>• 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.</li> <li>• For the protection of wildlife and special status species, dark-sky lighting should be installed that is fully shielded.</li> </ul>
Changes in wetland and riparian habitat	Resident and migratory bird species and reptiles would be affected by an incremental reduction in available habitat where directly removed or where impacted by mine-related groundwater drawdown. Mine discharges to surface water channels may increase flows downstream and could support additional riparian areas or wetlands that could be used by terrestrial species during active mining operations.	Same as the Proposed Action.	
Effects on special status wildlife species populations and habitat (i.e., species afforded protection under federal and state laws)	Potential impacts to special status species including 14 bird species, 4 mammal species, and 7 reptile species are anticipated to be minor as long as field surveys and mitigation or avoidance measures are completed in advance of ground-disturbing activities. Potential types of impacts would parallel those described above for general wildlife species.	Same as the Proposed Action.	

**Table ES-4 Summary of Direct and Indirect Impacts by Resource or Impact Issue and Recommended Monitoring and Mitigation**

Resource/Impact Issue	Proposed Action Alternative	No Action Alternative	Recommended Monitoring and Mitigation Measures
<b>Fisheries and Other Aquatic Biological Resources</b>			
Loss or alteration of aquatic habitat	<p>Surface disturbance of streams that are ecologically important to fisheries and aquatic habitat is expected to occur during mine-related activities. Compliance with state and federal permit requirements would minimize long-term impacts, but disturbance of habitat would occur where streams cannot be avoided by surface mining operations. The impacts would vary by study area, based on the projected maximum acreage of surface disturbance and the amount of perennial streams.</p> <p>Flow reductions resulting from mine-related groundwater drawdown and stream flow increases due to mine water discharge may alter aquatic habitat near active mines.</p>	Same as the Proposed Action.	<ul style="list-style-type: none"> <li>• If direct disturbance occurs in a waterbody with invasive aquatic species, all vehicles and equipment would be cleaned and dried prior to working in adjacent drainages.</li> <li>• Avoid important spawning or nursery areas for special status fish species.</li> <li>• Where there is potential habitat, conduct special status mussel species surveys within the proposed disturbance areas. Relocate to similar habitat if disturbance cannot be avoided.</li> </ul>
Effects of water quality changes	<p>Surface water quality may be affected due to surface disturbance within or near waterbodies that may increase sedimentation and turbidity. Off site impacts on aquatic habitat from mining operations would be minimized through compliance with federal and state permit requirements, such as erosion controls and storm water management.</p>	Same as the Proposed Action.	<ul style="list-style-type: none"> <li>• Avoid mining-related construction and operations in designated critical habitat for Houston toad in Study Area 4.</li> </ul>
Effects on special status aquatic species and habitat (i.e., species afforded protection under federal and state laws)	<p>Changes in water flow and quality and the disturbance of perennial streams, contributing drainages, and upstream watersheds may result in adverse impacts to habitat important to listed species. Impacts would vary depending on the location of future mine expansion areas or satellite mines in relation to the rivers and perennial streams containing habitat for federal and state listed species.</p>	Same as the Proposed Action.	

**Table ES-4 Summary of Direct and Indirect Impacts by Resource or Impact Issue and Recommended Monitoring and Mitigation**

Resource/Impact Issue	Proposed Action Alternative	No Action Alternative	Recommended Monitoring and Mitigation Measures
<b>Cultural Resources</b>			
Direct impacts to cultural resources	Historic properties representing numerous cultures, both historic and prehistoric, occur in each study area. Mining-related disturbance would alter archaeological stratigraphy that provides context for buried historic properties, if present. Surface disturbance may modify cultural landscapes, and historic structures and buried archaeological sites may be adversely affected by earth-moving and vibrations from mining activities. Adverse impacts to NRHP-eligible sites would be minimized through survey and documentation in advance of surface disturbance and avoidance or mitigation as determined by the USACE Fort Worth District and THC.	Same as the Proposed Action.	<ul style="list-style-type: none"> <li>• Monitoring of mine-related construction activities (i.e., new surface disturbance) conducted by knowledgeable professionals to avoid recorded NRHP-eligible or state protected cultural resources and minimize damage to previously unknown sites.</li> <li>• Each mining company would educate on site mine personnel as to the sensitive and confidential nature of cultural resources and implement a strict policy against illegal collection.</li> </ul>
Potential impacts to previously undiscovered significant sites	Previously unidentified sites could be discovered during construction and operations. Implementation of committed measures to protect a site until it can be evaluated by the THC potentially would minimize impacts.	Same as the Proposed Action.	
Potential indirect impacts to cultural resources	Potential indirect impacts to NRHP-eligible sites within and outside a mine area may result from increased runoff or water discharge. Implementation of surface water controls and erosion control measures would minimize these effects. Other possible indirect adverse impacts could include illegal collection, inadvertent damage, and vandalism associated with increased access and human presence.	Same as the Proposed Action.	

**Table ES-4 Summary of Direct and Indirect Impacts by Resource or Impact Issue and Recommended Monitoring and Mitigation**

Resource/Impact Issue	Proposed Action Alternative	No Action Alternative	Recommended Monitoring and Mitigation Measures
<b>Air Quality</b>			
Potential exceedence of ambient air quality standards	There would be temporary air quality impacts due to increases in local fugitive dust levels. Concentrations of criteria pollutants generated from mining-related activities would not exceed National Ambient Air Quality Standards (NAAQS).	Same as the Proposed Action.	<ul style="list-style-type: none"> <li>No additional monitoring or mitigation measures are recommended.</li> </ul>
Greenhouse gas emissions	Potential contribution to manmade global climate effects would be immeasurably small.	Same as the Proposed Action.	
<b>Land Use and Recreation</b>			
Impacts to urban growth	Development of future mine expansion areas or satellite mines could delay adjacent urban growth until areas are mined and successfully reclaimed, depending on the proposed location of a future mine area in relation to urban areas.	Same as the Proposed Action.	<ul style="list-style-type: none"> <li>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.</li> </ul>
Impacts to agricultural uses	Agricultural uses would not be available in mine-related disturbance areas until reclamation is completed.	Same as the Proposed Action.	
Impacts to industrial uses	The primary industrial land use in the study areas is oil and gas development. Access to new oil and gas resources may be restricted during active mining. Gathering lines, access roads, and other facilities and associated infrastructure may need to be relocated to allow for mining operations.	Same as the Proposed Action.	

**Table ES-4 Summary of Direct and Indirect Impacts by Resource or Impact Issue and Recommended Monitoring and Mitigation**

Resource/Impact Issue	Proposed Action Alternative	No Action Alternative	Recommended Monitoring and Mitigation Measures
Impacts to availability of dispersed recreational uses	Potential future mining locations temporarily would be inaccessible while mining operations progress through an area and reclamation is completed. Mine construction and operation could disturb recreationists on lands outside of the mine area. Potential impacts would be related to mine-related noise and ground vibrations, fugitive dust emissions, increased human presence, and the visual intrusion of mine equipment and components where solitude and remote experiences are desired. Mining operations may cause game and aquatic species to relocate, changing the experience for hunters and fishers in some areas.	Same as the Proposed Action.	
<b>Social and Economic Values</b>			
Population and housing changes	No measureable effects to population are anticipated.	Same as the Proposed Action.	No monitoring or mitigation measures are recommended.
Employment and income change	No substantial changes to employment or income patterns are anticipated, with the possible exception of a beneficial impact on the high unemployment rate in Study Area 6. There may be a minor shift in income and employment from one county to another within each study area depending on future mine locations. There would be a temporary increase of contract construction workers at the start of mine development.	Same as the Proposed Action.	
Changes to local public finances	Little or no change in public finance is anticipated. Future mine expansion areas and satellite mines would extend the taxable revenue for a longer time period and may move into and out of taxing jurisdictions.	Same as the Proposed Action.	
Impacts on public education	Little or no change in tax payments to schools would result.	Same as the Proposed Action.	

**Table ES-4 Summary of Direct and Indirect Impacts by Resource or Impact Issue and Recommended Monitoring and Mitigation**

Resource/Impact Issue	Proposed Action Alternative	No Action Alternative	Recommended Monitoring and Mitigation Measures
Impacts on residences	Potential future surface coal and lignite mine expansion areas and satellite mines may result in resident displacement, depending on the location of mining operations. Displacement would continue for the life of the disturbance and reclamation.	Same as the Proposed Action.	
<b>Transportation</b>			
Changes to roadways	Limited to no increase in traffic would be anticipated, with the possible exception of temporary increases during mine construction. Mine-related traffic may use different public roadways depending on the location of future mine expansion areas or satellite mines in relation to existing operations. No change in level of service (LOS) on affected roadways is anticipated.	Same as the Proposed Action.	No monitoring or mitigation measures are recommended.
Road closures	Short-term delays may occur where roads are temporarily affected by bridge or overpass construction to accommodate mining. County and local roads within future mine disturbance areas would be closed incrementally by the jurisdictional agency in advance of mine operations; alternate public and landowner access routes would be provided prior to road closures.	Same as the Proposed Action.	
Changes to railroads	Effects on rail transportation would be expected to be minimal.	Same as the Proposed Action.	

**Table ES-4 Summary of Direct and Indirect Impacts by Resource or Impact Issue and Recommended Monitoring and Mitigation**

Resource/Impact Issue	Proposed Action Alternative	No Action Alternative	Recommended Monitoring and Mitigation Measures
<b>Noise</b>			
Change in ambient noise levels	Mining-related noise levels would be temporary and transitory. Impacts at any specific location would depend on the distance between mining activities and sensitive receptors, the intervening terrain, and the in-pit operating depth of the equipment.	Same as the Proposed Action.	<ul style="list-style-type: none"> <li>• Noise generation in the vicinity of sensitive receptors should be minimized by restricting the simultaneous operation of noise producing equipment.</li> <li>• All motorized equipment should be fitted with properly functioning mufflers.</li> <li>• Mine planning should include berms and other noise barriers when operating at or near the surface in the vicinity of sensitive receptors.</li> </ul>
<b>Visual Resources</b>			
Effects to visual landscape	<p>Existing landscape character would be changed from the time of initial clearing until reclamation is successfully completed. The extent of the impact would vary depending on how visible the mining operations are, as determined by the terrain, height and type of vegetation, and location of sensitive viewers.</p> <p>Although 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.</p>	Same as the Proposed Action.	<ul style="list-style-type: none"> <li>• Visual screening should be employed near the permit boundary where there are nearby potentially sensitive public viewpoints. Existing vegetation should be preserved and augmented and groves of trees should be retained where possible to provide visual buffers.</li> </ul>



**Table ES-4 Summary of Direct and Indirect Impacts by Resource or Impact Issue and Recommended Monitoring and Mitigation**

Resource/Impact Issue	Proposed Action Alternative	No Action Alternative	Recommended Monitoring and Mitigation Measures
<b>Hazardous Materials and Solid Waste</b>			
Hazardous materials transport and usage	No general increase in hazardous materials transport or usage; duration of hazardous materials transport would be extended up to 30 years, based on the typical life of mine.	Same as the Proposed Action.	<ul style="list-style-type: none"> <li>Develop a protocol for handling contaminated sites to ensure protection of workers and to minimize potential environmental impacts.</li> </ul>
Spill of hazardous materials during transport	Small probability of a spill or release during the life of a mine. The greatest potential impacts would occur if a spill occurred in proximity to a major river. Implementation of SPCC Plan and Emergency Response Plan would minimize potential impacts of an on site spill or release.	Same as the Proposed Action.	
Generation of hazardous and solid wastes	Hazardous and solid wastes would be stored, used, and disposed of in accordance with current regulations.	Same as the Proposed Action.	
<b>Public Health</b>			
Impact to health of local populations	No adverse public health impacts are anticipated due to water quality, air quality, noise, or lighting effects.	Same as the Proposed Action.	No monitoring or mitigation measures are recommended.
<b>Environmental Justice</b>			
Potential disproportionate effects to low-income or minority populations	No disproportionate effects to low income or minority populations are anticipated.	Same as the Proposed Action.	No monitoring or mitigation measures are recommended.

<sup>1</sup> National Hydrograph Dataset (NHD) data lump ephemeral streams with intermittent streams.

<sup>2</sup> For purposes of the regional analysis, potential impacts to waters of the U.S. are assumed to be similar to the impacts described above for surface water. Delineations of waters of the U.S. as required for mine-specific Section 404/10 permit applications will be taken into consideration in future mine-specific NEPA analyses at the time they are proposed.



## Acronyms and Abbreviations

°F	degrees Fahrenheit
µg/m <sup>3</sup>	micrograms per cubic meter
AAQS	Ambient Air Quality Standards
ACHP	Advisory Council on Historic Preservation
AIRFA	American Indian Religious Freedom Act
amsl	above mean sea level
APE	Area of Potential Effect
APLIC	Avian Power Line Interaction Committee
AQRV	air quality related values
AQS	air quality station
BCC	Birds of Conservation Concern
BGEPA	Bald and Golden Eagle Protection Act
bgs	below ground surface
BMP	best management practice
CAA	Clean Air Act
CAAA	Clean Air Act Amendment
CBNG	coal bed natural gas
CCR	coal combustion residue
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CESA	cumulative effects study area
CFR	Code of Federal Regulations
cfs	cubic feet per second
CH <sub>4</sub>	Methane
CHIA	Cumulative Hydrologic Impact Assessment
CO	carbon monoxide
CO <sub>2</sub>	Carbon dioxide
CO <sub>2</sub> e	carbon dioxide equivalents
CTA	Council of Texas Archaeologists
CWA	Clean Water Act
dB	Decibels
dBA	decibels on the A-weighted scale

EA	Environmental Assessment
EIA	Energy Information Administration
EIS	Environmental Impact Statement
EO	Executive Order
ESA	Endangered Species Act
ESCTP	Ecological Systems Classification of Texas Project
FEMA	Federal Emergency Management Agency
FM	farm-to-market
FONSI	Finding of No Significant Impact
GHG	Greenhouse gas
gpm	gallons per minute
GtC	Gigatonnes of carbon
HAP	hazardous air pollutant
HB	House Bill
HDR	HDR Engineering, Inc.
HSS	historic standing structure
HUC	Hydrologic Unit Code
HUD	U.S. Department of Housing and Urban Development
IBWC	International Boundary Waters Commission
IP	individual permit
IPaC	Information, Planning, and Conservation
IPCC	Intergovernmental Panel on Climate Change
kg/ha	kilograms per hectare
km	kilometer
kV	kilovolt
L <sub>dn</sub>	day-night (average sound) level
LDWF	Louisiana Department of Wildlife and Fisheries
LOP	Letter of Permission
LOS	level of service
LRP	low revegetation potential
MACT	Maximum Achievable Control Technology
MBTA	Migratory Bird Treaty Act
mg/L	milligrams per liter
mg/m <sup>3</sup>	milligrams per cubic meter
MLRA	Major Land Resource Area

MOA	Memorandum of Agreement
MSDS	Material Safety Data Sheets
MSHA	Mine Safety and Health Administration
NAAQS	National Ambient Air Quality Standards
NFIP	National Flood Insurance Program
NACD	Native American Consultation Database
NADP	National Atmospheric Deposition Program
NAGPRA	Native American Graves Protection and Repatriation Act
NEPA	National Environmental Policy Act
NHD	National Hydrography Dataset
NHPA	National Historic Preservation Act
NO <sub>2</sub>	nitrogen dioxide
NO <sub>x</sub>	oxides of nitrogen
NPDES	National Pollutant Discharge Elimination System
NPS	National Park Service
NRC	National Research Council
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
NSPS	new source performance standard
NWI	National Wetlands Inventory
NWIS	National Water Information Service
NWP	Nationwide Permit
P.L.	Public Law
OSMRE	Office of Surface Mining, Reclamation, and Enforcement
PCR1	Primary Contact Recreation category 1
PFYC	Potential Fossil Yield Classification
PM <sub>10</sub>	particulate matter with an aerodynamic diameter of 10 microns or less
PM <sub>2.5</sub>	particulate matter with an aerodynamic diameter of 2.5 microns or less
ppm	parts per million
PSD	Prevention of Significant Deterioration
RCRA	Resource Conservation and Recovery Act
RCT	Railroad Commission of Texas
REA	Rural Electrification Administration
REIS	Regional Environmental Impact Statement
RFFA	reasonably foreseeable future action

RGP	Regional General Permit
RHA	Rivers and Harbors Act
ROG	reactive organic gas
ROW	right-of-way
RTHL	Recorded Texas Historic Landmark
RUSLE	Revised Universal Soil Loss Equation
SAL	State Antiquities Landmark
SARA	Superfund Amendment and Reauthorization Act
SHPO	State Historic Preservation Office
SMCRA	Surface Mining Control and Reclamation Act
SO <sub>2</sub>	sulfur dioxide
SO <sub>4</sub>	sulfates
SPCC Plan	Spill Prevention, Control, and Countermeasure Plan
SWPPP	Storm Water Pollution Prevention Plan
TAC	Texas Administrative Code
TCEQ	Texas Commission on Environmental Quality
TDAT	Tribal Directory Assessment Tool
TDS	total dissolved solid
THC	Texas Historical Commission
THPO	Tribal Historic Preservation Officer
THSA	Texas Historic Sites Atlas
TMDL	Total Maximum Daily Load
TPDES	Texas Pollutant Discharge Elimination System
TPWD	Texas Parks and Wildlife Department
tpy	tons per year
TSHA	Texas State Historical Association
TWDB	Texas Water Development Board
TxDOT	Texas Department of Transportation
U.S.	United States
USACE	U.S. Army Corps of Engineers
USC	United States Code
USDA	U.S. Department of Agriculture
USDI	U.S. Department of the Interior
USDOT	U.S. Department of Transportation
USEPA	U.S. Environmental Protection Agency

USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VMT	vehicle miles traveled
yr BP	Years Before Present
WMA	Wildlife Management Area





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## 1.0 Introduction

Surface coal and lignite mining operations typically conduct work that results in impacts to waters of the U.S. Such work requires permitting under Section 404 of the Clean Water Act, and for projects affecting navigable waters, permitting under Section 10 of the Rivers and Harbors Act of 1899 (RHA). These programs are administered by the U.S. Army Corps of Engineers (USACE). As part of the permit evaluation process associated with Section 404 and Section 10 permit authorizations, the USACE is also required to comply with the regulatory requirements of the National Environmental Policy Act of 1969 (NEPA) in evaluating the potential impacts of an action.

The USACE Fort Worth District is proposing changes to the USACE regulatory framework for surface coal and lignite mines in Texas. The proposed revisions would include the addition of a Regional General Permit (RGP) and a revised Letter of Permission (LOP). Thresholds that would trigger an Individual Permit (IP) would reflect the upper thresholds of the proposed LOP. No changes to the existing criteria for a Nationwide Permit (NWP) 21 or NWP 49, or to the District's current Section 404 mitigation guidelines for surface coal and lignite mines in Texas, are proposed.

Historically, permit evaluations associated with surface coal and lignite mine expansions have required substantial time periods for review. These timeframes have been influenced in part by the need to develop resource information, undertake data gathering efforts, and coordinate with various agencies and their permit review processes. The anticipated number of future permit applications requiring USACE compliance with NEPA, along with agency resource constraints, could further extend review times. The USACE seeks to ensure it can adapt and efficiently respond to multiple concurrent requests for permits that could occur in the future and reduce the need for duplicative data collection.

The USACE, as lead federal agency, **has prepared** this Regional Environmental Impact Statement (REIS) to analyze potential impacts within defined geographic regions in Texas that may be affected by future USACE permit decisions for future surface coal and lignite mine expansion areas and satellite mines within the District's area of responsibility. The REIS **has been** prepared in compliance with NEPA, the Council on Environmental Quality (CEQ) Regulations for Implementing the Procedural Provisions of NEPA (40 Code of Federal Regulations [CFR] 1500-1508), and the USACE Procedures for Implementing NEPA (33 CFR 230). The Office of Surface Mining, Reclamation, and Enforcement (OSMRE); Railroad Commission of Texas (RCT); **Texas Parks and Wildlife Department (TPWD)**; U.S. Environmental Protection Agency (USEPA); and U.S. Fish and Wildlife Service (USFWS) are serving as cooperating agencies.

Many of the federal and state agency regulatory requirements and environmental issues associated with surface coal and lignite mining projects are similar, such as large landscape alterations, impact avoidance, mitigation measures, performance metrics/monitoring, and contributions to cumulative impacts. Therefore, the USACE Fort Worth District is undertaking the REIS to make the NEPA aspect of the USACE's Section 404/10 permitting processes more efficient through the development of information, data, and analysis to be used in 404(b)(1) guidelines and public interest review analyses for potential future surface coal and lignite mine expansion areas and satellite mines in Texas.

The USACE Fort Worth District's goals for the REIS are to:

- Provide a NEPA-compliant, scientifically-based regional environmental analysis, including an interdisciplinary cumulative impact assessment, of all relevant resources within the defined geographic regions;
- Develop datasets to assist with the formulation of a categorized permit process;

- Facilitate future NEPA tiering or supplementation for the evaluation of future project-specific Section 404/10 permit applications for surface coal and lignite mines;
- Establish a cohesive framework for stream mitigation, establish sound performance metrics, and enhance monitoring efforts;
- Assist in streamlining the NEPA aspect of USACE Fort Worth District Section 404/10 permitting for surface coal and lignite mines so that the process is more consistent and efficient; and
- Address, as feasible, other agency issues related to resource mitigation.

The REIS will:

- Not render a decision on any specific mine project;
- Not provide complete NEPA compliance for future proposed surface coal or lignite mine expansion areas or satellite mines; and
- Not provide NEPA documentation for any new power plants.

Both tiering and supplementation allow an agency to avoid duplication of effort through incorporation of relevant information and analyses from one NEPA document (e.g., environmental impact statement [EIS]) into another NEPA document. In general, both tiered and supplemented NEPA documents for future surface coal and lignite mines would rely on the REIS analysis plus the future project-specific permit applications and environmental baseline field studies to provide the level of detail needed to support the project-specific NEPA analyses. A supplemented NEPA document would require a greater level of additional information and an expanded analysis due to project-specific issues or updated information since preparation of the REIS.

### **1.1 Study Area Setting**

The REIS considers six study areas along the coal-bearing formations in Texas that run from southwest Texas to northeast Texas (see **Figure 1-1**). A more detailed discussion of these areas is presented in Chapter 2.0, Section 2.2. The study areas encompass locations within the coal/lignite belt in Texas that were determined to be within reasonable proximity to existing surface coal and lignite mines with potential for future expansion.

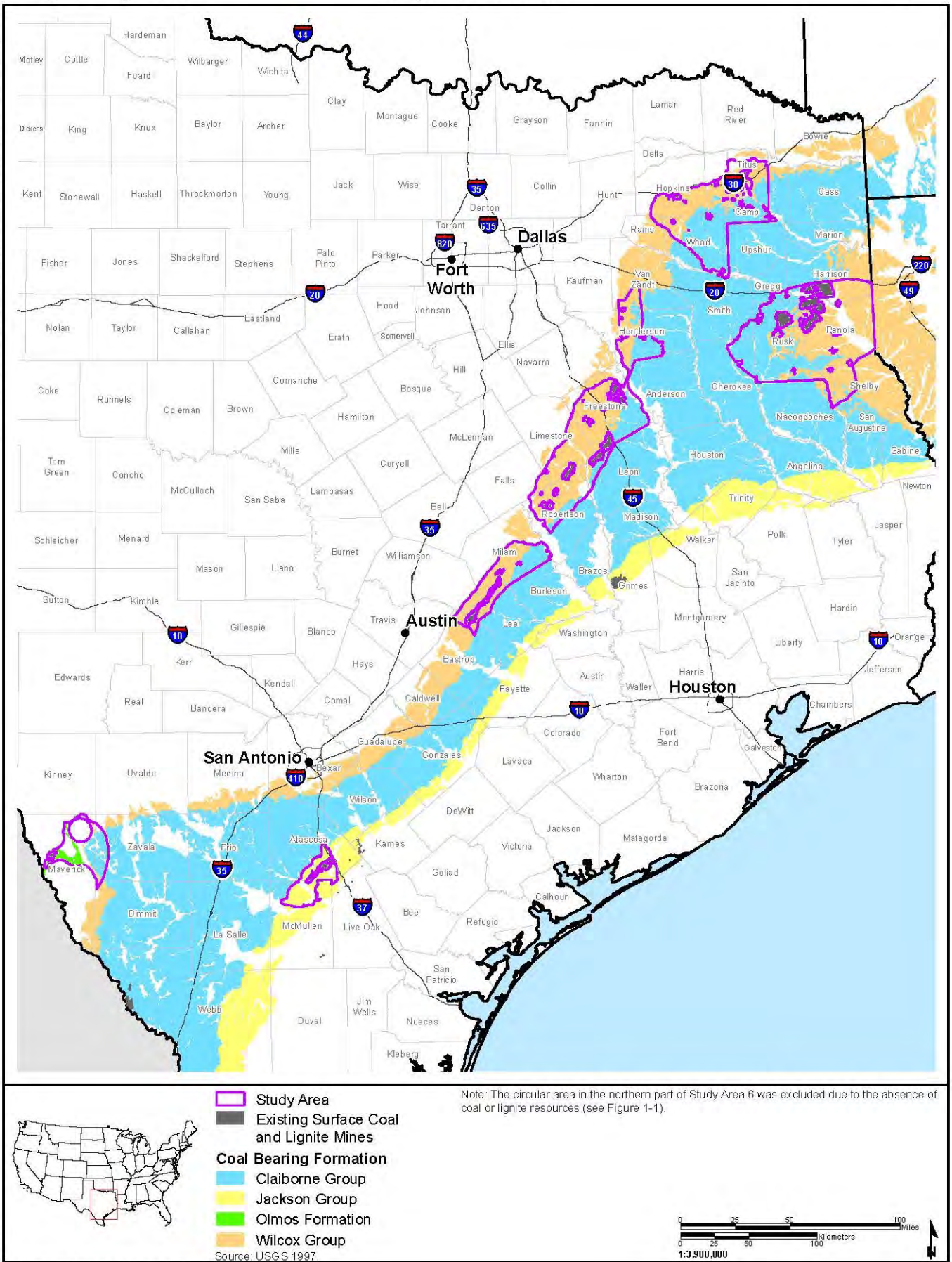
### **1.2 USACE Purpose and Need for Action**

Currently operating surface coal and lignite mines in Texas provide a long-term, reliable, continuous, and economically stable fuel source to existing nearby power plants, with one mine providing raw lignite material to an existing carbon activation plant. As the existing permitted surface coal and lignite mines approach the extent of the reserves that can be safely and economically recovered within the limits of their current mine areas, expansion of mine areas will be required in order to continue to meet their supply obligations.

Surface coal and lignite mining projects typically conduct work that results in impacts to waters of the U.S. Such work requires authorization under Section 404 of the Clean Water Act, and for projects affecting navigable waters, authorization under Section 10 of the RHA of 1899. These programs are administered by the USACE. As part of the permit evaluation process associated with Section 404 and Section 10 permit authorizations, the USACE is also required to comply with the regulatory requirements of NEPA in evaluating the potential impacts of a proposed action.



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1/8/2018

Figure 1-1 Study Areas

A majority of the future surface coal and lignite mining proposals will require Section 404 (and in some cases Section 10) permits and associated NEPA compliance documents. The anticipated number of future permit applications requiring USACE Fort Worth District compliance with NEPA, along with agency resource constraints, could result in lengthy review times. Historic permit evaluations associated with mine expansions have required substantial time periods. These timeframes have been influenced in part by the need to develop resource information, undertake data gathering efforts, as well as coordination with various agencies and their permit review processes. The USACE Fort Worth District also needs to ensure it can adapt and efficiently respond to multiple concurrent requests for permits that may occur in the future. In addition, mine operators also have to coordinate with and obtain authorizations from other agencies which can contribute to additional time for other evaluation and regulatory decisions they are pursuing.

Many of the federal and state agency regulatory requirements and environmental issues associated with surface coal and lignite mining projects are similar, such as large landscape alterations, economic effects, impact avoidance, mitigation measures, performance metrics/monitoring, and the contribution to cumulative impacts. Therefore, the USACE Fort Worth District is undertaking the REIS to streamline the NEPA aspect of the District’s Section 404/10 permitting process, as well as to develop information, data, and analysis to be used in Section 404(b)(1) guidelines and public interest review analyses for future coal and lignite mine expansion areas and satellite mines in Texas. The USACE Fort Worth District’s purpose for the REIS is to provide a NEPA-compliant environmental evaluation focusing on potential direct, indirect, and cumulative aquatic resource impacts, in addition to all other relevant environmental and human resources within the defined geographic regions in Texas that would be associated with and affected by future USACE permit decisions. Additionally, this REIS will serve to establish a cohesive framework for stream mitigation, establish sound performance metrics, and enhance project monitoring efforts. This assessment would facilitate future tiering or supplementation in the evaluation of future project-specific Section 404/10 permit applications for surface coal and lignite mines. A single regional NEPA document is intended to avoid duplication and be more efficient and effective for the lead and cooperating agencies involved in the regional NEPA process in making future decisions under their respective authorities.

**1.3 Typical Permits, Approvals, and Authorizations for Surface Coal and Lignite Mines**

The typical federal, state, and local permits and approvals that may be required for a future proposed surface coal or lignite mine expansion are identified in **Tables 1-1** and **1-2**. The final list of required permits and approvals for a proposed mine expansion would be determined at the time of permit application submittal and, in part, would depend on site-specific conditions and resources within a future proposed disturbance area.

**Table 1-1 Typical Environmental Permits**

Authorizing Agency	Permit
<b>Federal</b>	
USACE	Clean Water Act (CWA), Section 404 Permit
	Rivers and Harbors Act (RHA), Section 10 Permit
U.S. Fish and Wildlife (USFWS)	Threatened and Endangered Species Relocation Permit
<b>State of Texas</b>	
Railroad Commission of Texas (RCT)	Surface Coal Mining and Reclamation Permit
Texas Commission on Environmental Quality (TCEQ)	Section 401 Water Quality Certification
	Waste Discharge Permit
	Water Rights Exemption
	Water Right Appropriation

**Table 1-1 Typical Environmental Permits**

Authorizing Agency	Permit
	Water Supply Contract
	Storm Water Notice of Intent for Construction Activities
	Storm Water General Permit for Industrial Activities
	Air Quality Permit
Texas Parks and Wildlife Department (TPWD)	Threatened and Endangered Species Relocation Permit

**Table 1-2 Typical Requirements, Approvals, and Coordination**

Agency	Requirements, Approvals, or Coordination
<b>Federal</b>	
U.S. Environmental Protection Agency (USEPA)	NEPA Document Review
	RCT Permit Review
USFWS	Endangered Species Act (ESA) Section 7 Consultation
Mine Safety and Health Administration (MSHA)	Identity Report Training Plan
<b>State of Texas</b>	
Texas Department of Transportation (TxDOT)	Approval for Road Closures
Texas Historical Commission (THC)	Compliance with Nation Historic Preservation Act (NHPA)
	Section 106 Consultation
	Compliance with American Indian Religious Freedom Act
TCEQ	Notification of Open Burning
<b>Local</b>	
County Sheriffs	Notification of Open Burning
Commissioners Court	Approval for County Road Closures

**1.4 Organization of the REIS**

This REIS complies with CEQ requirements (40 CFR 1502.10) and the USACE’s requirements (33 CFR 325, Appendix B). Chapter 1.0 provides descriptions of the USACE’s purpose and need and the typical regulatory actions that would be required for a potential future surface coal or lignite mine expansion. Chapter 2.0 describes the alternatives, including the Proposed Action and No Action, as well as the past, present, and reasonably foreseeable future actions (RFFAs) considered in the cumulative effects analysis. Chapter 3.0 describes the affected environment and the potential direct, indirect, and cumulative impacts associated with the Proposed Action and No Action alternatives; mitigation measures being considered by the USACE Fort Worth District to minimize potential impacts; and residual adverse effects. Chapter 4.0 summarizes public participation and the scoping process, as well as the consultation and coordination undertaken to prepare the REIS. Chapter 5.0 presents the list of REIS preparers and reviewers. Chapter 6.0 provides the list of references. Chapters 7.0 and 8.0 contain the glossary and index, respectively. Copies of supporting documents are available for public review on the USACE Fort Worth District website at: <http://www.sfw.usace.army.mil/Missions/Regulatory/ProjectsofInterest.aspx>.



## 2.0 Alternatives Including the Proposed Action

### 2.1 Evolution of Current USACE Fort Worth District Regulatory Framework and Section 404 Mitigation Guidelines for Surface Coal and Lignite Mines in Texas

#### 2.1.1 Evolution of Current USACE Fort Worth District Regulatory Framework

USACE evaluation of applications for authorization of surface coal and lignite mining operations in the USACE Fort Worth District historically relied on environmental analyses in EISs prepared by the USEPA in the 1980s and 1990s for the respective mining operations. These EISs were prepared at a time when USEPA was responsible for administering the National Pollution Discharge Elimination System (NPDES) program relative to Section 402 of the CWA. Following USEPA’s delegation of the NPDES program to the State of Texas, the USACE became the lead federal agency relative to NEPA compliance due to its Section 404 jurisdiction over surface coal and lignite mining operations in Texas.

Utilizing the USEPA EISs afforded the USACE Fort Worth District the opportunity to authorize many past surface coal and lignite mining proposals under different types of General Permits. The ongoing operations at existing mines and continued need for coal/lignite as a fuel source has resulted in more recent applications for authorization of proposed surface coal and lignite mine expansion areas and satellite mines beyond the geographic limits of the study areas in the USEPA EISs. These more recent applications typically have been evaluated under more rigorous Standard Permit review procedures involving public participation through Public Notice distribution and NEPA documentation (environmental assessments [EAs]) commensurate primarily with the potential impacts to aquatic resources. Project-specific EISs were prepared by the USACE (as lead federal agency) for two large mine expansion areas (Three Oaks Mine and Rusk Permit Area), based on USACE’s determination that these projects had the potential to result in significant impacts.

In 2011, facing uncertainty with the potential 2012 reissuance of NWP 21 for Surface Coal Mining Activities, the Fort Worth District initiated development of an expedited Standard Permit procedure (i.e., LOP) – CESWF-11-LOP-3. This LOP was developed to provide a potential permitting option for: 1) projects anticipated to require re-authorization of existing permits for which previously authorized impacts were not expected to be completed during the authorized NWP 21 term, and 2) possibly other proposed surface coal and lignite expansion areas or new mine locations with potential aquatic resource impacts below the thresholds prescribed in the LOP. The LOP-3 procedure was finalized in January 2012 and has been utilized to authorize several relatively small mining projects. For projects that would exceed the LOP thresholds, a more substantive review process through evaluation as an individual permit (IP) would be required. The LOP-3 aquatic resource impact thresholds are identified in **Table 2-1**. The thresholds that would trigger a review under an IP, as well as the thresholds for NWP 21 and NWP 49, also are presented in the table.

**Table 2-1 Existing Regulatory Framework**

Permit Type	Acreage Limit	Linear Footage Limit	Agency Coordination Requirement	Resource Limitations
NWP 21	0.5	300 linear feet of stream (perennial, ephemeral, or intermittent), unless waived for ephemeral and intermittent streams	Coordination for waiver	No regional conditions limiting use

**Table 2-1 Existing Regulatory Framework**

Permit Type	Acreage Limit	Linear Footage Limit	Agency Coordination Requirement	Resource Limitations
NWP 49 – Coal Remining Activities <sup>1</sup>	None	None	No	Mine, reclamation and mitigation plan must result in a net increase in aquatic resource functions
LOP-3	20 acres	20,000 linear feet of stream, with no more than 1,000 linear feet for perennial streams	Yes <sup>2</sup>	Forested wetlands cannot make up more 50 percent of the waters of the U.S. impact area
IP	>20 acres	No limit	Yes	None

<sup>1</sup> May be authorized for mining and reclamation of lands previously mined for coal/lignite if the proposed activities are currently authorized, or are in the process of being authorized, under the Surface Mining Control and Reclamation Act (SMCRA) of 1977. New coal/lignite mining activities may be authorized in conjunction with the remining activities if: 1) the proposed new mining disturbance is 40 percent or less of the proposed total disturbance and 2) the overall mining plan would result in a net increase in aquatic resource functions.

<sup>2</sup> LOP-3 requires agency concurrence.

**2.1.2 Evolution of Current USACE Fort Worth District Section 404 Mitigation Guidelines**

The USACE Fort Worth District applies a consistent approach to Section 404 mitigation guidelines, compliant with the 2008 Mitigation Rule, irrespective of project type or permitting mechanism. While the site selection, goals and objectives, and implementation plans of compensatory mitigation proposals required few edits, other elements required by the Mitigation Rule necessitated changes and/or additions. These changes or additions included: 1) long-term protection of compensatory mitigation sites through an acceptable and appropriate real-estate covenant (e.g., conservation easement); 2) financial assurances of compensatory mitigation success through an acceptable and appropriate financial instrument (e.g., escrow account, letter of credit, or performance bond); and 3) long-term monitoring of sound, measurable, ecologic condition-based performance metrics as success criteria for compensatory mitigation projects. Also, coordination of recent project-specific proposals with resource agencies has resulted in the addition of standard language to compensatory mitigation plans requiring submittal of post-reclamation aquatic resource design plans to USACE and the resource agencies for review and USACE approval prior to construction. These design plans include but are not limited to plan, profile, and dimension measurements based on appropriate regional hydrographic and geomorphological data **obtained from least disturbed streams and wetlands** and successful as-built streams/systems on and/or near the respective mitigation site. This additional mitigation plan element goes beyond the Mitigation Rule requirements to further ensure aquatic resource reclamation success.

**2.2 Proposed Action**

Under the Proposed Action, the USACE Fort Worth District’s current regulatory framework for surface coal and lignite mines in Texas (as described in Section 2.1.1, Evolution of Current USACE Fort Worth District Regulatory Framework) would be modified as discussed below. Also, USACE’s permit review for potential future surface coal and lignite mine expansion areas and satellite mines proposed within the study areas for this REIS would follow the USACE proposed categories for future NEPA tiering or supplementation.

No changes to the USACE Fort Worth District’s current Section 404 mitigation guidelines for surface coal and lignite mines in Texas are proposed. As such, the current Section 404 mitigation guidelines described in Section 2.1.2, Evolution of Current USACE Fort Worth District Section 404 Mitigation Guidelines, would continue to be implemented under the Proposed Action. As discussed in Chapter 1.0, under this REIS the USACE will not render a decision on any specific mine project. Rather, submittal of project-specific permit applications, development and evaluation of separate project-specific NEPA and 404(b)(1) analyses, and subsequent issuance of all required local, state, and federal permits would be required prior to development of any future surface coal or lignite mine expansion area or satellite mine in any of the study areas.

**2.2.1 Proposed USACE Fort Worth District Regulatory Framework for Surface Coal and Lignite Mines in Texas**

The proposed USACE Fort Worth District regulatory framework for surface coal and lignite mines in Texas is presented in **Table 2-2**. The proposed framework includes the establishment of a Regional General Permit (RGP) and a new LOP that includes modifications to the acreage and a change from agency concurrence (agreement) to agency coordination as compared to the process for the existing LOP-3. **Development of a RGP and/or a revised LOP would include issuance of a Public Notice to solicit comments from interested agencies and the public and consideration of any comments received in evaluating the respective proposed procedure. The evaluation process, supporting analysis, and final decision would be documented in the administrative record.** Resulting thresholds that would trigger evaluation of a potential future surface coal/lignite mine expansion under the existing IP process also are shown in the table. Changes to the terms and general conditions of NWP’s may only occur at the USACE Headquarters level; USACE Districts may elect to add regional conditions to NWP’s, after public review and USACE Division approval. At this time, no regional conditions are proposed to be added to NWP 21 or NWP 49.

**Table 2-2 Proposed Regulatory Framework**

Permit Type <sup>1</sup>	Acreage Limit	Linear Footage Limit	Agency Coordination Requirement	Resource Limitations (type)
NWP 21 <sup>2</sup>	0.5	300 linear feet of stream (perennial, ephemeral, or intermittent), unless waived for ephemeral and intermittent streams	Coordination for waiver	No regional conditions limiting use
NWP 49 – Coal Remining Activities <sup>2,3</sup>	None	None	No	Mine, reclamation and mitigation plan must result in a net increase in aquatic resource functions
RGP	0.5 – 10 acres	Study Areas 1-4: 20,000 linear feet all stream types, with no more than 1,000 total linear feet for perennial streams Study Areas 5-6: 30,000 linear feet all stream types, with no	<b>Yes</b>	Forested wetlands cannot make up more than 50 percent of the waters of the U.S. impact area; no impacts to bogs; no impacts to bald cypress-tupelo

**Table 2-2 Proposed Regulatory Framework**

Permit Type <sup>1</sup>	Acreage Limit	Linear Footage Limit	Agency Coordination Requirement	Resource Limitations (type)
		more than 1,000 total linear feet for perennial streams		swamps
LOP	10 – 25 acres	No limit <sup>4</sup>	Yes	Forested wetlands cannot make up more than 50 percent of the waters of the U.S. impact area
IP	>25 acres	No limit	Yes	None

<sup>1</sup> A proposed project could have up to the acreage limit for wetlands and the linear foot limit for streams and still qualify for the respective permit type.

<sup>2</sup> Reflects existing thresholds and resource limitations for the NWP 21 and NWP 49; no changes are proposed.

<sup>3</sup> May be authorized for mining and reclamation of lands previously mined for coal/lignite if the proposed activities are currently authorized, or are in the process of being authorized, under SMCRA. New coal/lignite mining activities may be authorized in conjunction with the remaining activities if: 1) the proposed new mining disturbance is 40 percent or less of the proposed total disturbance and 2) the overall mining plan would result in a net increase in aquatic resource functions.

<sup>4</sup> USACE Fort Worth District will review each proposed action on a case-by-case basis.

**2.2.2 Categories for Future NEPA Tiering or Supplementation**

Tiered and supplemented NEPA documents for potential future surface coal and lignite mine expansion areas or satellite mines within the REIS study areas would incorporate by reference the REIS analysis and rely on future project-specific Section 404/10 and RCT permit applications, site-specific environmental baseline field studies, and project-specific plans for life-of-mine development and reclamation/closure to provide the level of detail needed to support the future project-specific NEPA analyses. A supplemented NEPA document also would require additional information to support the analysis due to project-specific issues or updated information since preparation of the REIS (e.g., newly listed threatened or endangered species with the potential to occur in the future proposed mine area). The preparation of future tiered and supplemented NEPA documents would be in accordance with the CEQ Regulations for Implementing the Procedural Provisions of NEPA (40 CFR 1500-1508).

The USACE proposed categories for future project-specific surface coal and lignite mining NEPA tiering or supplementation are described below. The Section 404/10 permit requirements also are identified for each category.

**Category 1:** Those projects that meet the criteria for a NWP, RGP, or LOP as specified in **Table 2-2**. Other factors related to future project-specific impacts also would be considered in the USACE’s decision relative to the use of these permits versus an IP. From a NEPA perspective, Category 1 projects would have no net anticipated significant impacts, as would be determined by the USACE under their authority as the lead federal agency for NEPA compliance.

Category 1 projects typically would require a NWP, RGP, LOP, or IP and a basic EA with a potential Finding of No Significant Impact (FONSI).

**Category 2:** Those projects that would result in impacts to waters of the U.S. in excess of the LOP criteria specified in **Table 2-2**. From a NEPA perspective, Category 2 projects would have no net



anticipated significant impacts, as would be determined by the USACE under their authority as the lead federal agency for NEPA compliance.

Category 2 projects would require an IP and a more robust EA with a potential FONSI or mitigated FONSI.

**Category 3:** Those projects that would result in impacts to waters of the U.S. in excess of the LOP criteria as specified in **Table 2-2** (similar to Category 2). From a NEPA perspective, Category 3 projects would have the potential for significant impacts, as would be determined by the USACE under their authority as the lead federal agency for NEPA compliance.

Category 3 projects would require an IP and an EIS.

In accordance with the requirements of NEPA, if an EA analysis of projects in Categories 1 or 2 results in the identification of previously unanticipated significant impacts that cannot be mitigated, a subsequent EIS would be required. USACE, as the lead federal agency for NEPA compliance, also would have the authority to require an EIS without the preparation of an EA if it is determined that the action would have the potential to result in significant impacts, even if the impacts could be mitigated to a less than significant level.

**2.2.3 Study Areas**

Six study areas have been identified for the REIS as shown in **Figure 1-1**. The study areas were delineated by the USACE Fort Worth District in coordination with Texas Mining and Reclamation Association to define areas within the coal/lignite belt in Texas that are in reasonable proximity to existing surface coal and lignite mines with potential for future development of mine expansion areas or satellite mines. Locations within each of the study areas that would not be available for future surface coal or lignite mine development, including existing development areas (e.g., existing mines, towns, reservoirs, etc.), parks (federal, state, and local), and National Wildlife Refuges, were excluded from the study areas. The resulting total acreage of each study area, the estimated maximum disturbance acreage associated with anticipated requests for future surface coal and lignite mining authorizations, and the resulting estimated percent of each study area that potentially would be affected are identified in **Table 2-3**.

**Table 2-3 Summary of Study Areas**

<b>Proposed Action Study Areas</b>	<b>Approximate Total Acreage in Study Area</b>	<b>Estimated Maximum Disturbance Acreages Associated with Potential Requests for Future Authorizations</b>	<b>Estimated Percent of Study Area Potentially Disturbed under Anticipated Requests for Future Authorizations</b>
Study Area 1	912,500	13,500	1.5
Study Area 2	1,449,300	50,200	3.5
Study Area 3	1,219,200	50,600	4.2
Study Area 4	365,300	9,800	2.7
Study Area 5	180,800	9,500	5.3
Study Area 6	<b>249,000</b>	25,000	<b>10.0</b>
Total	<b>4,376,100</b>	158,600	3.6

**2.2.4 Description of a Typical Surface Coal and Lignite Mine**

To facilitate the analysis of direct, indirect, and cumulative impacts associated with potential future development of coal and lignite mine expansion areas or satellite mines in Texas, a description of the typical construction, operations, and closure/reclamation activities and typical mine components are summarized below. Ranges are provided, as needed, to bracket the potential development activities associated with both a typical mine expansion and a typical satellite mine, as well as to account for regional differences. For these descriptions, a mine expansion, based on its proximity to the existing mine, is anticipated to utilize some or most of the ancillary facilities (e.g., mine offices, truck shop, warehouse facilities, coal or lignite storage facilities, etc.) at the existing mine. A satellite mine, due to its distance from the existing mine, is anticipated to require construction of some additional separate ancillary facilities.

A list of equipment that would be used at a typical mine expansion area or satellite mine is presented in **Table 2-4**. The estimated number of personnel that potentially would be employed by phase of activity is presented in **Table 2-5** by study area. Operations would be conducted 24 hours per day, 365 days per year. The estimated annual payroll including benefits for each study area is presented in **Table 2-6**.

**Table 2-4 Typical Equipment List**

Equipment <sup>1</sup>	Quantity	Horsepower Rating	Average Annual Operating Hours/Unit
Dragline (up to 120-cubic yard)	1 – 6	Electric	3,000 – 7,000
Continuous-miner	1 – 2	950 – 1,200	2,000 – 5,000
Excavator/Backhoe (3- to 18-cubic yard)	1 – 5	404 – 1,400	2,000 – 6,800
Front-end Loader (5- to 15-cubic yard)	1 – 9	272 – 880	2,000 – 6,000
Haul Truck (120- to 240-ton)	2 – 15	469 – 1,450	2,000 – 6,000
Shovel	1	1,400 – 2,000	5,000 – 6,000
Scraper	1 – 2	250 – 950	100 – 4,500
Grader	1 – 7	165 – 350	2,000 – 6,000
Dozer	2 – 7	200 – 580	2,800 – 7,000
Crawler Dozer	3 – 25	449 – 700	2,000 – 8,000
Rubber Tired Dozer	1	498 – 500	1,000 – 4,700
Bottom Dump Truck (240-ton)	9	--	Up to 4,600
Water Truck	1 – 7	469 – 1,487	1,600 – 5,600
Long-haul Truck	3 – 18	924 – 1,450	Up to 5,000
End-dump Truck	4 – 21	925 – 1,450	2,500 – 5,800
Utility Front-end Loader, Tool Carrier, Cable Reeler	1 – 23	149 – 200	500 – 1,000
Utility Backhoe	1 – 3	450	Up to 3,000
Passenger Van (12- to 15-passenger)	1 – 5	245 – 315	1,000 – 3,000
Pick-up Truck	6 – 111	300 – 315	1,000 – 5,000
Fuel/Lube Truck	1 – 5	280 – 469	1,000 – 7,200
Welders Truck	1 – 2	300 – 310	50 – 3,000
Mechanics Truck	1 – 9	280 – 330	100 – 3,000
Boom Truck	1 – 12	300 – 310	500 – 3,000

**Table 2-4 Typical Equipment List**

Equipment <sup>1</sup>	Quantity	Horsepower Rating	Average Annual Operating Hours/Unit
Lowboy w/Tractor	1 – 6	300 – 1,350	500 – 3,000
Tire Truck	1 – 3	300 – 310	—
Hydromulcher	1	140	—
Diesel Pumps	4 – 73	71 – 160	500 – 1,250
Electric Pumps	2 – 34	75 – 125	Up to 1,000
Generator	1 – 14	—	Up to 50
Poly Pipe Fusion Machine	1	2	Up to 250
Welders, Diesel or Gasoline	7 – 40	64	Up to 50
Pump Tractor/Skidder	1 – 2	95 – 250	500 – 2,000
Cable Tractors	1 – 4	100 – 120	2,000 – 3,600
Crane (50- to 65-ton)	1 – 3	250 – 300	250 – 750

<sup>1</sup> Contractor equipment for earth moving and reclamation also would be used, as needed.

**Table 2-5 Estimated Employment Numbers by Mine Phase**

Study Area	Mine Phase	Existing Employees <sup>1</sup>	New Hires	Contract Workers <sup>2</sup>	Total
Study Area 1	Construction	50 – 200	0	0 – 100	50 – 300
	Operations	100 – 300	0	0 – 90	100 – 390
	Closure/Final Reclamation	50 – 100	0	0 – 50	50 – 150
Study Area 2	Construction	10 – 260	0	30 – 150	40 – 410
	Operations	10 – 260	0-30	10 – 40	50 – 300 <sup>3</sup>
	Closure/Final Reclamation	10 – 100	0-30	10 – 40	50 – 140 <sup>3</sup>
Study Area 3	Construction	20	0	300	320
	Operations	105 – 320	0	4 – 50	109 – 370
	Closure/Final Reclamation	80	0	0	80
Study Area 4	Construction	50 – 200	0	0 – 100	50 – 300
	Operations	100 – 300	0	0 – 90	100 – 390
	Closure/Final Reclamation	50 – 100	0	0 – 50	50 – 150
Study Area 5	Construction	0	0	45	45
	Operations	232	30	0	262
	Closure/Final Reclamation	60	0	0	60
Study Area 6	Construction	14	0	30	44
	Operations	14	251	0	265
	Closure/Final Reclamation	30	0	30	60

<sup>1</sup> Assumes existing work force would transition from existing operations to the potential future mine expansion area or satellite mine.

<sup>2</sup> The majority of the contract workers would be new hires.

<sup>3</sup> Values not additive as they reflect the variables for a typical mine expansion area or satellite mine.

**Table 2-6 Estimated Annual Payroll including Benefits**

Study Area	Estimate Annual Payroll including Benefits <sup>1,2</sup> (million dollars)
Study Area 1	25
Study Area 2	4.5 – 63
Study Area 3	37 – 50
Study Area 4	30
Study Area 5	20
Study Area 6	27

<sup>1</sup> Values in 2013 dollars.

<sup>2</sup> Values do not include estimated payroll/benefits for contract workers.

Prior to initiation of mining, proposed ancillary facilities (e.g., equipment fueling and parking area, temporary or long-term coal or lignite storage areas, office and shop facilities) and primary haul roads and utility corridors necessary to provide access between the initial mining area and existing or proposed ancillary facilities would be constructed. Erosion control measures and surface water control facilities for the initial development area also would be installed and constructed, respectively. These construction activities primarily would occur during the first year of the mine life and typically would result in the largest annual disturbance acreage. Surface disturbance would continue to occur incrementally throughout the life of the 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 total disturbance area for any specific future surface coal or lignite mine expansion area or satellite mine would vary depending on a variety of factors, primarily including the tons of recoverable coal or lignite per acre (which would vary with location) and the annual production rate required to continue to meet supply obligations. The total maximum estimated acreage of potential future mine-related disturbance within each of the study areas is identified in **Table 2-3**.

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).

Overburden and interburden (the material to be removed above and between, respectively, the coal and lignite seams) primarily would be removed using draglines to uncover the coal or lignite seams. Both highwall and spoil side positions may be used by the draglines. A truck and shovel fleet or dozers may be used in addition to, or in place of, draglines for overburden and interburden removal. Blasting typically would not be required. If blasting is required, it would be conducted in accordance with RCT regulations. The volume of overburden production would vary with the depth at which the recoverable coal or lignite resource occurs; interburden production also would vary. The minimum mineable coal or lignite thickness considered to be recoverable varies but typically ranges from 0.5 to 4.0 feet. The range of overburden/interburden to coal/lignite stripping ratios and the estimated future annual coal/lignite production by study area are presented in **Table 2-7**.

**Table 2-7 Typical Stripping Ratios and Estimated Future Annual Coal/Lignite Production by Study Area**

Study Area	Range of Overburden/Interburden to Coal/Lignite Stripping Ratios <sup>1</sup>	Estimated Annual Coal/Lignite Production by Study Area <sup>2</sup> (million tons)
Study Area 1	3.0 – 12.0	3.0
Study Area 2	5.5 – 13	0.4 – 8.2
Study Area 3	3.5 – 20.0	1.9 – 10.7
Study Area 4	3.9 – 5.0	6.7
Study Area 5	12.0	3.3
Study Area 6	10.5	3.0

<sup>1</sup> Reflects million cubic yards of overburden/interburden moved to recover a million tons of coal/lignite.

<sup>2</sup> Based on current supply obligations of existing coal and lignite mines.

Once an initial box cut (pit) is excavated, overburden and interburden from each subsequent pit would be backfilled into the previous pit and graded to approximate original contour. This surface then would be suitable for completion of reclamation procedures including rough and final grading, placement of growth media or prime farmland soils (as applicable), testing of growth media for suitability, seeding and planting, installation of permanent erosion control structures, and other final reclamation tasks. The sequence of activities would be implemented to achieve post-mining land uses and long-term reclamation goals of landowners and as approved by permitting agencies prior to site construction.

As the active mine pit advances, existing roads would be closed incrementally by the jurisdictional agency in advance of mine operations. Alternate public and landowner access routes would be provided prior to road closures. In some locations, these alternate road alignments would be permanent. In other locations, the roads would be returned to their original alignment as sequential operations and reclamation activities advance. In general, roads that are returned to their original alignment would be reopened approximately 5 to 15 years after being mined through and following approval of the appropriate jurisdictional agency.

Utilities (e.g., natural gas pipelines, transmission lines, etc.) would be rerouted and removed in advance of mining. Utilities may be permanently rerouted at the discretion of the owner in advance of mine operations. Pipelines located within 100 feet of a mine permit area would be maintained in accordance with RCT regulations.

All oil and gas wells within an area of proposed mining would be sealed in accordance with RCT regulations. Oil and gas wells that would be mined through would be plugged in accordance with 16 Texas Administrative Code (TAC) 3.14.

Surface lignite and coal mining in Texas typically occurs on company and privately owned lands. Privately owned lands would be leased or purchased prior to mine development.

An ongoing exploration program typically would be conducted within the overall proposed mine expansion area or satellite mine, but outside of the initial RCT-approved 5-year mine permit area, to further define the coal or lignite deposit as mining plans are developed. Cement plugs would be installed in the exploration drill holes within 2 days of completion. If flowing water, oil and/or gas, or zones of alternating or unusable water quality are encountered, cement plugs would be installed to prevent flow from, or mixing within, the drill hole.

### **2.2.4.1 Typical Construction Phase**

Receipt of all required local, state, and federal permits would be required prior to initiation of mine construction (see Chapter 1.0). Typical construction activities and mine components developed during the construction phase are described below.

#### Surface Water Control Facilities

Surface water control facilities would be constructed in appropriate locations prior to initiation of construction to control runoff from disturbance areas, including the initial mining area and infrastructure areas, and to divert runoff from adjacent undisturbed areas around mine disturbance areas. These facilities would be designed to minimize erosion and to control the quality of surface water discharged from the site. Structures would be designed, constructed, and maintained in accordance with RCT requirements. All surface water runoff from mine disturbance areas would be monitored by the mine operator and discharged through Texas Pollutant Discharge Elimination System (TPDES) regulated outfalls in accordance with TPDES permit criteria as required by TCEQ. Typical surface water control facilities would include the following:

- Temporary sediment control measures (e.g., drop structures, terraces, silt fences, vegetation, check dams) would be installed to minimize erosion, trap sediment, and stabilize reconstructed soils.
- Temporary and permanent fresh water diversions would be constructed to divert runoff from undisturbed areas around the mine disturbance areas.
- Temporary and permanent storm water diversions would be constructed to direct runoff from mine disturbance areas to sediment control ponds prior to discharge.
- Sediment control ponds would be designed and constructed to contain storm water runoff from mine disturbance areas and provide for adequate retention time or treatment (e.g., addition of flocculants or chemical additives) to allow collected runoff to meet TPDES discharge limits.

Following construction, pond embankments and the surrounding area disturbed during construction would be revegetated or otherwise stabilized. A stable vegetative cover would be maintained on all embankments. Each pond would be routinely monitored as required by MSHA and RCT regulations until the structure is removed or converted to a permanent installation.

#### Dewatering and Depressurization Systems

Dewatering of overburden would be necessary where saturated sands or water-bearing lenses occur in proposed mine areas. Dewatering would reduce the amount of groundwater entering the pits and would stabilize the highwall and spoil for safety reasons and to allow efficient operations. Underburden depressurization also would be necessary at some mines to reduce the head pressure and, thereby, prevent pit floor heaving and instability of spoil and highwalls that could result in unsafe work conditions for personnel and equipment. Dewatering and depressurization operations would be accomplished through the incremental installation of dewatering or depressurization wells as mine pits advance. The required number of dewatering and depressurization wells and the associated pumping rates would be dependent on site-specific hydrologic conditions.

Dewatering wells would be decommissioned immediately prior to being mined through and, if shallower than the final depth of mining, would not be plugged. Dewatering wells that extend below the final depth of mining or were constructed adjacent to a mine area, and depressurization wells no longer needed for mining purposes, would be plugged in accordance with RCT and TCEQ regulations or retained for non-mining purposes with approval of TCEQ.

Dewatering and depressurization well water would be used on-site or disposed of in accordance with TCEQ requirements via sediment control ponds in accordance with TPDES criteria or, if the water meets TPDES discharge standards without treatment, discharged directly to the nearest surface water channel. Alternately, the water may be discharged to injection wells in accordance with mine-specific RCT and TCEQ authorization.

#### Clearing and Grubbing

Once surface water controls are in place, vegetation removal would be completed by clearing and grubbing equipment. Clearing operations would be conducted in advance of ancillary facility construction and incrementally in advance of pit excavation. Vegetation removal would be conducted outside of the peak migratory bird breeding season, to the extent possible. Cleared vegetation would be used to construct brush piles and/or windrows for wildlife cover, recycled into mulch, buried in the pit along with overburden material, or burned in accordance with state and local regulations. Where present, merchantable timber typically would be removed by the landowner or a contractor.

#### Prime Farmland and Other Topsoil Handling

Prime farmland as defined by the Natural Resources Conservation Service (NRCS) is land that has the best combination of physical and chemical soil characteristics for crop production. Unless a negative prime farmland determination has been issued by the RCT (determined based on site-specific investigations and the criteria in TAC Section 12.138 [TAC 2013]), topsoil and subsoil salvage operations on prime farmland would be conducted in advance of construction activities and incrementally in advance of pit excavation. Topsoil and subsoil would be salvaged separately to a depth of 4 feet using backhoes and end-dump trucks or scrapers. These materials would be directly placed (subsoil then topsoil) on regraded areas as part of the reclamation sequence to the extent possible, or segregated and stockpiled for future reclamation purposes. Depending on the planned duration of storage, stockpiles may be stabilized through seeding and the installation of erosion controls (i.e., diversion channels or berms) and best management practices (BMPs) (e.g., silt fences or staked straw bales) to control sediment transport. Appropriate signage would be placed at stockpile locations to prevent possible use of the material for purposes other than reclamation.

At sites not designated as prime farmland, topsoil and suitable overburden material would be salvaged separately or together for use as a growth media in accordance with site-specific RCT requirements. Sufficient growth media would be salvaged to provide a suitable cover depth (a minimum of 4 feet) for reclamation purposes. These materials would be directly placed on regraded areas (suitable overburden then topsoil where salvaged separately) as part of the reclamation sequence to the extent possible or stockpiled for future reclamation purposes. Stockpile stabilization and signage would be the same as described above for prime farmland soils.

#### Main Haul Roads and Transportation Corridors

Primary haul roads would be constructed to provide access between the initial mining area and proposed ancillary support facilities. For future proposed mine expansion areas and satellite mines, a transportation and utility corridor typically would be constructed to connect the mine expansion area to the existing mine facilities. The transportation corridor would include a haul road and potentially a conveyor corridor, depending on the mine site. The transportation corridor would facilitate the transfer of mining equipment (e.g., draglines, truck and shovel fleet, etc.) to the mine expansion area, provide access to existing ancillary facilities, and facilitate the transport of coal or lignite (via truck or conveyor) from the mine expansion area to existing coal/lignite stockpiles or handling facilities. Construction typically would include the placement of appropriate fill and road surfacing material, installation of drainage channels and culverts, where needed, and placement of riprap for reinforcement and erosion control. As soon as practical, temporary disturbance areas would be revegetated.

## Ancillary Support Facilities

### *Ancillary Facilities*

Mine expansion areas and satellite mines would utilize the facilities at the existing mine, typically including the mine office, truck shop, truck wash, warehouse facilities, portions of the existing haul road(s), and the coal/lignite storage and handling facilities. New facilities may include temporary coal/lignite storage stockpiles, employee facilities, an equipment repair area, fueling and parking area, a water truck fill station, an overland conveyor with associated coal handling facilities, and non-lignite storage areas. Most or all of these facilities would be constructed for a satellite mine.

### *Electrical Power Supply*

Electrical power supply would be provided by the local power provider typically via a 138-kilovolt (kV) transmission line. For mine expansion areas and satellite mines, the transmission line may be installed in the transportation corridor that would be constructed to connect to the existing mine site (see Main Haul Roads and Transportation Corridor subsection above), or alternately installed to connect to the closest existing transmission line in coordination with the local power provider. Transmission lines for satellite mines would connect to the local grid as determined in coordination with the local power provider. Substations would be installed, as needed. Distribution lines would be installed within the mine area between the 138-kV transmission line and portable substations. The portable substations would be relocated, as needed, as mining operations advance. Trailing cables would be used to convey power from the portable substations to the mine pit to feed the draglines and support the dewatering system. Distribution lines also would be constructed, as needed, to provide power to the mine maintenance and office facilities as well as the stockpile/blending facilities to feed the crusher, stacker, and conveyors.

All power lines and transmission lines would be designed and constructed in accordance with guidelines presented in *Reducing Avian Collisions with Power Lines* (Avian Power Line Interaction Committee [APLIC] 2012) and *Suggested Practices for Avian Protection on Power Lines* (APLIC 2006).

### *Access Roads*

Access roads would be constructed to facilitate construction and maintenance of sediment control ponds and other surface water control facilities (e.g., freshwater diversions), provide access to groundwater pump sites, provide access to surface water and groundwater monitoring sites, and provide access for clearing and grubbing equipment. Drainage channels and culverts would be installed during road construction, as needed, and erosion controls (e.g., rock sediment traps, silt fences, earth berms) would be installed in the roadway ditches to minimize erosion and retain sediment. These roads would remain in place, as needed, following construction to provide access for monitoring and maintenance purposes.

### *Coal Transport and Coal Handling Facilities*

For a typical mine expansion area, trucks would be used to transport coal/ lignite from the mine expansion area to existing coal/lignite stockpiles or handling facilities as discussed above in the Main Haul Roads and Transportation Corridor subsection. Alternately, an overland conveyor may be constructed within the transportation corridor to transport lignite or coal between a typical mine expansion area and existing stockpiles or coal/lignite handling facility. The conveyor would be covered to provide for wind protection/dust control and to minimize additional coal/lignite moisture as a result of precipitation. A conveyor maintenance facility, as well as new coal handling facilities to prepare the run-of-mine coal/lignite for transport by conveyor (including a truck dump and crushing and transfer equipment with dust control equipment), also would be constructed in the mine expansion area.

For a typical satellite mine, coal/lignite storage and handling/blending facilities would include truck dumps; crusher(s); overland, reclaim, and transfer conveyors for transport of coal/ lignite; stockpiles; sampling and analysis systems; and dust control equipment. Coal/lignite transport via rail, if proposed in the future, would require construction of a new rail spur. Prior authorization from the jurisdictional



agencies and agreements with railroad companies, as applicable, would be required prior to construction and operation.

#### *Water Supply*

Water used for dust suppression would be obtained from dewatering/depressurization wells, sediment control ponds, or other sources authorized by TCEQ. Potable water for mine expansion areas and satellite mines typically would be obtained from privately owned groundwater wells at existing mine office complexes or from a local water provider. For satellite mine locations, either a new potable water source (i.e., groundwater well) would be permitted and developed or the water would be obtained from a local provider.

#### *Wastewater*

Collection and handling of wastewater associated with both potable and non-potable water supplies (as would be required for satellite mines) would be conducted in accordance with applicable permits and building codes. Design and construction of an on-site sewage treatment system would be in compliance with all applicable local and state regulations to ensure groundwater protection.

Water associated with facilities and equipment washing would be collected by the surface water control facilities in place within the facilities area. A dedicated sediment pond would be used to recycle this water, where possible. Any oil contained in this water would be removed by oil separation equipment prior to reuse or discharge. Discharge of excess water would be conducted in compliance with TCEQ permit criteria. Solids retained in the sediment pond periodically would be removed and disposed of in the mine pit.

#### *Fuel and Lubricant Storage*

Flammable fluids (e.g., gasoline or diesel fuel) or other materials (e.g., oil, grease, anti-freeze, solvents) classified as toxic or hazardous by TCEQ and other applicable regulatory authorities would be registered, transported, stored, labeled, handled, and disposed of in accordance with applicable regulatory requirements. In addition, a state-required and -approved Spill Prevention, Control, and Countermeasure (SPCC) Plan would be implemented to minimize the potential for, and resulting impacts of, an on-site spill or release of these materials.

For mine expansion areas and satellite mines, fuels and lubricants typically would be stored at the existing mine facilities or, for diesel fuel and gasoline, at a new equipment fueling area that would include above-ground storage tanks installed in accordance with a state-approved SPCC Plan. Typically, there would be no increase in use or consumption of any of these materials as operations transition from the existing mine to the mine expansion area. However, there would be an extended period of transport to, and use at, the mine site. For a satellite mine, required fuel and lubricant storage facilities would be constructed in accordance with applicable regulatory requirements. A temporary increase in the storage, use, and consumption of these materials may occur during construction and the period of operations overlap with the existing mine; there also would be an extended period of transport and use of these materials.

#### *Refuse and Solid Waste Disposal*

During construction and operations, short-term storage areas for non-coal wastes (e.g., combustible refuse, non-combustible refuse, flammable liquids, and chemicals) would be registered with the TCEQ and other applicable agencies as required under federal regulations. Temporary placement and storage of non-coal wastes would be in a controlled manner within the mine plan area to ensure that any leachate and surface runoff would not degrade surface water or groundwater, fires would be prevented, and the area would remain stable and suitable for reclamation and revegetation. Disposal of non-coal wastes would be in accordance with TCEQ's regulations in order to meet all local, state, and federal

requirements. Waste materials would be reclaimed and reused or salvaged whenever practical. Unsalvageable combustible wastes would be disposed of by controlled burning under TCEQ regulations, when possible. As applicable, some non-coal wastes (e.g., crushed galvanized culverts) would be removed from the mine site in accordance with TCEQ regulations.

During construction and operation, some non-coal wastes (i.e., trees, tree by-products, and rocks) would be disposed of in the mine backfill. Wastes would be compacted and covered. Suitable growth media (a minimum of 4 feet) would be placed over the site, slopes stabilized, and the area revegetated. These activities would be conducted in accordance with all local, state, and federal requirements.

#### *Fencing, Site Security, and Fire Management*

During the construction phase, perimeter fencing, gates, earthen berms, and appropriate signage would be installed to control public access. These facilities would be maintained throughout the life of the mine.

During construction and operation, prescribed fires may be used for fire management within the mine boundary, as well as for burning of cleared vegetation in advance of mining. Mobile equipment capable of excavating, burying, or extinguishing fires would be available on site. Prescribed fires would be conducted in accordance with state and local regulations and coordinated with local fire control authorities.

#### *Lighting*

During construction and operations, mobile light plants would be used in the mine pit areas as may be required by MSHA or to address safety and operations practices to provide for night mining activity. Mobile lighting equipment also would be used for the transportation and utility corridor.

#### Initial Mining Area

Prior to mining, ramps and main haul roads would be constructed in the initial mine area in accordance with mine plans that would address MSHA and RCT regulations. Ramps and haul roads incrementally would be constructed over the life of a mine as the mine pits advance. Crushed rock or other RCT-approved surfacing material would be used as a road surfacing material to provide for all-weather travel. Bottom ash also may be used as a road surfacing material with prior approved from TCEQ and RCT. BMPs (e.g., water, approved chemical dust suppressant, periodic road maintenance) would be used to control fugitive dust emissions from road surfaces. In preparation for mining, overburden would be removed from the initial mine area (box cut) using draglines or mobile equipment (e.g., dozers, scrapers, backhoes/excavators, end-dump trucks, and front-end loaders) to expose the upper coal or lignite seam. The overburden would be placed in an adjacent temporary out-of-pit stockpile. Selective handling of overburden, as needed, would be conducted for all mine areas to ensure adequate volume of suitable plant growth media. The remainder of the overburden, as well as the interburden removed from between the coal or lignite seams, would be side-cast into a previously mined-out pit during normal operations. Spoil from the initial pits would be sequenced so the upper portion (a minimum of 4 feet) would meet the criteria of plant growth media. Overburden and interburden from subsequent pits would be graded to tie into the adjacent topography and drainage patterns established by the graded spoils from the initial pit.

#### Utility Relocations and Road Closures

Prior to mining, existing public roads and utilities located within the initial mine development area would be closed or relocated, respectively, as needed and approved.

Ground-truthing of all utility locations would be conducted prior to mining. During construction and operations, removal and relocation of pipelines, transmission lines, and other utilities would be negotiated with the respective owners of the utilities prior to disturbance. This work would be completed by, or under the direction of, the utility owners.

Portions of public roads would be closed or temporarily may be affected by bridge or overpass construction at various times during the life of a typical mine. All required approvals from the jurisdictional agencies and alternate public and landowner access would be provided prior to closure of any public road segment. Unless a variance is obtained from the jurisdictional agency, mining activities would not be conducted within 100 feet of a public road right-of-way (ROW) until the road has been closed by the jurisdictional agency.

#### **2.2.4.2 Typical Operations Phase**

The operations phase would include activities associated with normal, steady-state mining operations up to initiation of closure and reclamation activities. Typical mining, maintenance, and concurrent reclamation activities conducted during the operations phase are described below.

##### Surface Water Control Facilities

BMPs (e.g., silt fences, straw bales, riprap) would be used throughout operations to limit erosion and reduce sediment transport as a result of storm water runoff from the mine disturbance areas. Storm water diversions and sediment control ponds would be installed during the construction phase and incrementally over the life of a mine. These facilities would be used to divert and route storm water and to control sediment in surface water runoff from newly disturbed lands during mine pit advancement. TPDES-regulated outfalls (discharge locations) would be installed, where needed, to facilitate discharge from sediment control ponds. The design, construction, and operation of these facilities would be in accordance with RCT and MSHA requirements. Storm water diversions also would be constructed to divert storm water runoff from undisturbed areas around disturbance areas, where needed.

To facilitate mining, a series of berms, ditches, or sumps would be constructed in and around the mine pits to control surface water and groundwater inflow. These water control features incrementally would be installed in appropriate locations throughout the life of a mine as operations advance. Collected water would be pumped to a sediment control pond prior to discharge.

Berms and ditches would be used in rough graded areas to maintain dry pit conditions, to provide a safety feature and address MSHA requirements along the highwall edge, and to retain sediment within the disturbance areas. These sediment and water control measures would be used in conjunction with sediment control ponds, and installed incrementally where needed as operations advance. No berm or ditch that would increase a pond watershed area would be constructed without prior approval of the RCT.

Following storm events, the water quality of the contained storm water runoff would be monitored on a continuous basis. When the water quality meets TPDES permit criteria, the water typically would be discharged down to the sediment storage level of the pond. Between storm events, the sediment control ponds would be dewatered to an elevation that would provide sufficient storage capacity to retain runoff from a 10-year/24-hour storm event or as required by RCT.

During operations, drainage and sediment control facilities and installed erosion controls would be routinely inspected and maintained. Sediment periodically would be removed from the ponds to maintain adequate containment volume for a 10-year/24-hour storm event or as required by RCT. Grading would be conducted to maintain site drainage patterns.

##### Dewatering

During operations, additional dewatering wells would be installed, where required, in advance of pit excavation to partially dewater overburden and interburden zones. Additional depressurization wells also would be installed at some mines, depending on site-specific hydrologic conditions, to reduce the head pressure below the advancing pit floor. Water pumped from these wells would be used or discharged in

accordance with procedures described in the Dewatering and Depressurization Systems subsection under Section 2.2.4.1, Typical Construction Phase.

Dewatering wells would be decommissioned immediately prior to being mined through. Decommissioning would include removal of electrical cables, pipelines, pumps, and ancillary equipment. Dewatering wells typically would not be plugged as they would be shallower than the final depth of mining. Dewatering wells that would extend below the level of mining or were constructed adjacent to the actual mine area, and depressurization wells no longer needed for mining purposes, would be plugged in accordance with RCT and TCEQ regulations or retained for non-mining purposes.

Seepage and surface runoff collected in the active mine pit would be pumped to nearby sediment control ponds for treatment, as needed, to meet TPDES permit criteria prior to discharge to local drainages. Alternately, the water may be discharged to injection wells in accordance with mine-specific RCT and TCEQ authorizations.

#### Clearing and Grubbing

Clearing and grubbing to remove vegetation would be conducted incrementally in advance of pit excavation. Clearing practices, including minimizing clearing to the extent needed at any given time, timing clearing operations to avoid the peak migratory bird breeding season, to the extent possible, and disposal of cleared vegetation would be conducted as discussed in the Clearing and Grubbing subsection under Section 2.2.4.1, Typical Construction Phase.

#### Prime Farmland and Other Topsoil Salvage and Stockpiling

Salvage of prime farmland soil, where present, and other topsoil would occur incrementally throughout the life of a mine as the mine pit advances. Salvage and handling procedures would be the same as described in the Prime Farmland and Other Topsoil Handling subsection under Section 2.2.4.1, Typical Construction Phase.

#### Haul and Access Road Construction

Haul roads in the active mine area would be extended as mining operations advance, and access roads would be constructed or extended, as needed, to provide access for ongoing maintenance and monitoring purposes. Road surfaces would be maintained on a regular basis by grading, ditch cleaning, and adding additional RCT-approved surfacing material.

Access and haul roads would be constructed and maintained to have adequate drainage control (e.g., ditches, culverts) designed to safely pass peak runoff from a 10-year/6-hour precipitation event or as required by RCT. Erosion control measures (e.g., rock sediment traps, silt fences) would be installed in the roadway ditches to minimize erosion and retain sediment and would be used in conjunction with the sediment control ponds.

Structures for road crossings of perennial or intermittent streams would include bridges and culverts. Bridges and culverts would be designed and constructed to accommodate runoff from a 10-year/6-hour precipitation event or as required by RCT. Final design plans would be approved by RCT prior to construction. Low-water crossings would be designed, constructed, and maintained to prevent erosion of the structure or streambed and additional contributions of suspended solids to stream flow.

If haul road or access road crossings of active pipelines should be necessary, a minimum of 6 feet of compacted material (or as agreed with the pipeline owner) would be placed between the pipeline and the road that crosses over it. No excavation would be allowed within 100 feet or the depth of the cut, whichever is greater, of an active oil or gas pipeline without prior approval by RCT.

Fugitive dust generation from haul roads typically would be controlled by water sprays, approved chemical dust suppressants, and regular maintenance and/or slow-curing liquid asphalt as allowed by TCEQ. Other fugitive dust emission controls would include proper loading of haulage trucks to limit spillage (i.e., not over-loading); prompt removal of coal, rock, or soil from roads; compaction of unpaved roads, as needed; and restriction of travel of unauthorized vehicles on other than established roads.

#### Overburden and Interburden Removal

The size, depth, highwall slopes, and bench heights of active mine pits would vary by mine depending on site-specific conditions (e.g., geologic structure).

During operations, draglines would work from one end of the pit area to the other, with spoil side-cast into a previously mined-out pit (**Figure 2-1**, Typical Mine Sequence). Alternately, mobile equipment would be used for overburden and interburden removal, with the material placed in end-dump trucks for transport to a previously mined-out pit. Per RCT requirements, the backfilled spoil subsequently would be regraded to establish a graded surface at the approximate original contour. Overburden would be selectively handled, as needed, to ensure placement of a minimum cover of suitable growth media (a minimum of 4 feet) on regraded backfill for reclamation purposes. Growth media and prime farmland soils, where present, would be hauled directly to and redistributed on regraded areas to the extent possible, or alternately placed in temporary stockpiles. Sequential overburden and interburden removal, pit backfilling and regrading, and growth media placement would continue throughout the life of a mine. As a result of sequential backfilling of the mine pits and concurrent reclamation, the acreage of mine pit-related disturbance at any given time during operations typically would range from 250 to 650 acres.

Depending on the designated future mine-specific post-mining land use for the final mine pit(s), the pit(s) may be backfilled and reclaimed as described above or allowed to fill with water, resulting in end lakes. Alternately, a series of smaller end lakes may be constructed along drainages in the reclaimed landscape. End lake designs would be submitted to RCT and TCEQ for approval.

#### Lignite Mining and Transport

Lignite seams typically would be mined using backhoes, front-end loaders, or a continuous miner, with the lignite loaded into bottom or end-dump trucks for transport. The loaded trucks would haul the coal or lignite to temporary stockpiles or a truck dump area at a coal/lignite handling or blending facility. Alternately, coal or lignite would be transported to existing mine facilities via overland conveyor or rail as discussed in the Coal Transport and Coal Handling Facilities subsection under Section 2.2.4.1, Typical Construction Phase.

Coal or lignite placed in storage areas, uncovered in the active pits, or located beyond the margins of the active pits would be monitored regularly for burning material. If burning coal or lignite is identified, mining equipment would be available to bury the burning material, or diesel and electric pumps would be available to flood the area, as appropriate, to extinguish the burning material. Unmined coal or lignite beyond the pit margins would be inspected prior to backfilling and covered with overburden (a minimum of 4 feet).

#### Ancillary Support Facilities

Ancillary support facilities, as described in the Ancillary Support Facilities subsection under Section 2.2.4.1, Typical Construction Phase, would be used throughout the life of a typical mine.

#### Utility Relocations and Road Closures

Utilities (pipelines, transmission lines, and other utilities) incrementally would be relocated in advance of operations, as needed. Relocations would be completed in coordination with the controlling company.

Buffers for utilities outside of active mine areas as required by RCT (e.g., 100-foot buffer for pipelines) would be adhered to unless a variance is obtained from RCT.

During operations, general mining or reclamation activities would not be conducted within the 100-foot buffer zone of public roads until the roads have been closed by the jurisdictional authority or a buffer zone waiver and authorization have been obtained from the RCT and jurisdictional authority, respectively. Public roads located within the mine area would be closed or relocated (as approved by the jurisdictional authority) sequentially over the life of the mine in advance of pit development. Temporary road closures for bridge or overpass construction (installed to provide safe separation of mine-related traffic from public traffic) also would occur incrementally, as needed. All required approvals from the jurisdictional agencies and alternate public and landowner access would be provided prior to closure of any public road segment.

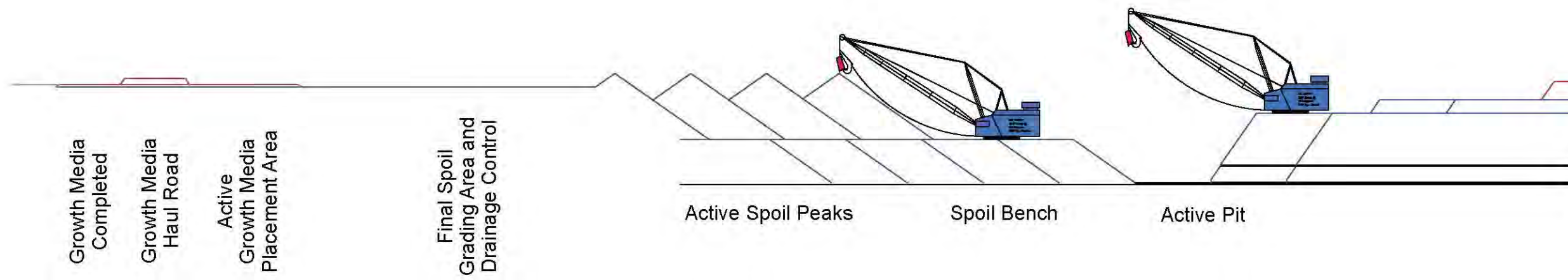
### 2.2.4.3 Typical Closure and Reclamation

Reclamation would be initiated following excavation of the initial mining area and would continue concurrently with mining operations throughout the life of a mine and through final closure. The short-term reclamation goal for a typical mine includes the establishment of a vegetative cover to provide for soil stabilization and erosion control. 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.

Reclamation would be conducted in accordance with the mine-specific reclamation plans that would be developed in support of each mine's required RCT permit, with the following exception. Reclamation of streams and wetlands would be conducted in accordance with USACE Fort Worth District permit criteria and would be incorporated as features within the RCT post-mine land use categories. Specific reclamation and revegetation plans for disturbance areas located outside of waters of the U.S. would **include consideration of individual landowner plans** (i.e., per landowner agreements).

The RCT-required reclamation plans would be developed in accordance with Sections 12.145 through 12.154 of the Texas Coal Mining Regulations. Mine-specific reclamation success programs also would be established and conducted, with revegetation success determined in accordance with RCT's **2014 Procedures and Standards for Determining Revegetation Success on Surface-Mined Lands in Texas** and Sections 12.395 and 12.399 of the Texas Coal Mining Regulations. The RCT guidance document describes procedures and standards for determining revegetation success on reclaimed surface mined lands in Texas, including the vegetation evaluation process, evaluation and measurement methods, and success standards for the nine RCT-designated post-mine land uses (pastureland, cropland, grazing land, forestry, fish and wildlife habitat, residential, industrial/commercial, recreation, and undeveloped). In accordance with these requirements, reclamation plans for a typical mine would include rough and final grading and growth media replacement procedures, drainage reconstruction and sediment control procedures, plant species lists for the various RCT-designated post-mine land uses, seeding and planting techniques, and the monitoring and evaluation criteria that would be used to determine reclamation success.

Waters of the U.S. (including wetlands) impacted by mining and mining-related activities would be reconstructed in locations as stipulated by the USACE Fort Worth District in future mine-specific Section 404 or Section 10 permits. Reconstruction typically would be achieved through creation, restoration, or enhancement techniques as would be outlined in a mine-specific Conceptual Mitigation Plan that would be developed and submitted in accordance with the requirements of the USACE's Section 404 permitting process. The reconstructed, restored, and/or enhanced streams, open water, and wetland resources would need to meet the USACE's criteria for waters of the U.S or other established



Distance from the active pit to growth media placement will vary due to ongoing spoil grading and growth media placement operations.

Figure 2-1 Typical Mine Sequence





performance metrics. Following the release from a mine's Section 404 reclamation performance bond, the reclaimed waters of the U.S., including wetlands, designated as compensatory mitigation would be protected by a long-term site protection instrument (e.g., a conservation easement).

After the coal or lignite has been removed from a mine pit and the pit backfilled with overburden and interburden, the peaks of the backfilled material (spoil) would be leveled and graded to approximate original contour in compliance with RCT coal mining regulations and approved plans. Selective handling and placement of overburden and interburden materials during backfilling, as needed, would provide for redistribution of suitable growth media (a minimum of 4 feet) over the regraded surface. The general sequence of mining and reclamation activities is shown in **Figure 2-1**. The typical lag that would occur between the time mining commences for a given pit and the completion of rough leveling to approximate original contour, placement of suitable growth media, and seeding and planting would be approximately 2 to 5 years. Overall reclamation activities in a given area, including normal husbandry, may continue for approximately 10 to 15 years. The ability of reclaimed land to support the approved post-mining land uses would be evaluated in accordance with the RCT's revegetation success criteria and USACE approved compensatory mitigation success criteria.

#### Rough and Final Grading

Following selective placement, as needed, of overburden and interburden in each pit, rough grading would be completed using mobile equipment to create a land surface with elevations and drainage patterns that would approximate, to the extent practical, the pre-mine topography. The rough-graded site subsequently would be surveyed to identify areas requiring additional grading to meet surface water control, land form, and approximate original contour. Regraded areas would be scarified or otherwise treated to minimize erosion, eliminate surface slippage, and promote root penetration. Depending on the planned post-mining land use in a given area, a suitable plant growth media or salvaged prime farmland soils would be distributed (to a minimum depth of 4 feet). Final grading and installation of erosion control structures subsequently would be completed.

#### Prime Farmland Soil and Growth Media Replacement

Suitable growth media (suitable overburden then topsoil where salvaged separately) or prime farmland soils (subsoil then topsoil) would be spread over graded disturbance areas to a minimum depth of 4 feet as discussed in the Rough and Final Grading subsection above, with the prime farmland soils placed in areas where the post-mining land use is designated as cropland. When impractical to promptly redistribute growth media or prime farmland soils on rough graded areas, the materials would be stockpiled for future use. The stockpiled materials would be stabilized by interim seeding with a rapid-growing annual or perennial cover during the first normal period of favorable planting conditions. Once growth media replacement has been completed, the upper 4 feet of soil would be tested for suitability as outlined in the RCT-required soil testing plan. Suitability would be determined based on a comparison of the test results with RCT-approved post-mine soil performance standards. If suitable plant growth media is present, the area would be permanently revegetated during the next available growing season, with a temporary vegetative cover used in the interim to control erosion, as needed. If the soil does not meet all of the criteria for suitability, topsoil substitutes and amendments would be used to construct a suitable plant growth media, as appropriate. If areas are identified that do not have suitable plant growth media present in the top 4 feet of material, the unsuitable material either would be covered with suitable material or it would be excavated and hauled to an adjacent pit for burial and replaced with suitable material.

#### Post-mining Topography

The post-mining topography would be consistent with mine-specific reclamation goals and post-mining land uses and would approximate the general nature of the pre-mining topography and blend into the surrounding topography.

### *Drainage Reconstruction and Sediment Control*

Drainage patterns would be re-established in the reconstructed landscape prior to placement of suitable growth media. To the extent possible, drainage channels would be constructed to approximate pre-mining conditions and configured to ensure that ephemeral drainages upgradient of the mined area connect with the new drainage system, including re-established waters of the U.S. Temporary erosion controls would be installed to provide surface stabilization and erosion control in the post-mining landscape, until vegetation has been re-established. Permanent erosion control measures (e.g., rock check dams, in-channel grade control structures such as cross-vanes and/or other natural stream channel design methods) also would be installed, as required.

Some of the constructed sediment control ponds may be retained as permanent structures following the completion of mining to achieve post-mining land uses. Sediment control ponds not required to achieve post-mining land uses would be removed once their respective watershed areas have been revegetated, the vegetation requirements have been met, and the surface water drainage meets applicable state and federal water quality criteria. Following removal of an impoundment, the area would be recontoured to provide appropriate drainage and blend with the surrounding topography and subsequently revegetated. Surface water diversions also would be regraded and revegetated when no longer needed.

Additional permanent ponds would be constructed on the reclaimed surface as needed to achieve post-mining land uses. The additional ponds would be constructed incrementally throughout the life of a mine as mining and reclamation operations advance. Pond design plans would be submitted to RCT for approval prior to construction.

Storm water runoff from the reclaimed area would be routed through sediment control ponds and ultimately discharged through final discharge outfalls. Post-mining discharges through these outfalls would be monitored in accordance with mine-specific TPDES permit requirements. When runoff quality meets TPDES requirements without treatment, discharge outfalls would be removed.

### *Revegetation*

#### Seed Mixes and Woody Species Plantings

Species selection for use in revegetation would be based on the reclamation stage, site-specific conditions, and proven success capabilities of the plant species selected, as well as contractual agreements with landowners. The mine-specific species lists, as required by RCT, would be used to develop seed mixes specific to post-mining land uses and would contain a complement of grasses and forbs as applicable to the post-mine land use. Seed application rates would vary based on planting method, species, and region. Tree and shrub seedlings also would be used to achieve specific post-mining land uses. Plant species (herbaceous and woody) proposed for use in locations designated for fish and wildlife habitat and undeveloped land in the post-mine setting typically would be selected in coordination with the NRCS, USACE, USFWS, TPWD, and RCT.

The establishment of a temporary vegetative cover and/or mulching would be used, as needed, for stabilization of disturbance areas when conditions for establishment of permanent vegetation are not favorable or practical. Selection and establishment of a temporary cover would be coordinated with the planned establishment of a permanent cover to ensure compatibility.

#### Seeding and Planting Techniques

Seeding of prepared seed beds would be accomplished using various methods and equipment, depending on topographic features and soil characteristics. A combination of broadcast seeding, drill seeding, hydro-mulching, and/or other conventional means would be used for application of seed mixes, depending on season and site conditions.

Drill seeding equipment with depth control bands would be used for seed application on level to gently sloping areas where coarse fragment content would allow drilling operations. Planting would follow the contour of the land, where possible. A no-till planter equipped with coulters, disc openers, and packer wheels would be used on appropriate sites to plant into standing cover crops. This method may be used to establish permanent cover without conventional seedbed preparation.

Broadcast seeding would be used on steep or rocky areas where drill seeding would not be practical. Broadcast seeding methods that may be used include tractor equipment fitted with seed boxes, hydroseeding, tractor hand seeding, and/or hand cyclone seeders. Where broadcast seeding is used, the seed bed would be prepared by shallow ripping or dozer tracking parallel to slope contours in order to provide microsites for seed germination and to control runoff. Where possible, seeded areas would be chained, harrowed, or cultipacked to cover the seed or, alternately, covered with mulch.

Establishment of grass species that do not produce viable seed normally would be accomplished with a sprig (stolon) planter. Dormant sprigs typically would be covered with up to 3 inches of soil. Green sprigs would not be covered as deeply and normally would be partially exposed.

Tree and shrub seedlings would be planted mechanically or by hand. Bare rootstock, plugs, and containerized seedlings would be used, as appropriate.

A suitable mulch may be used to aid in moisture conservation, promote germination, and/or enhance soil stabilization. Mulching techniques would vary depending on season, slope gradient, soil moisture conditions, and planned permanent vegetation. Mulching techniques would include mechanical incorporation of existing plant residue into the top few inches of soil or application of certified weed-free straw or hay. Where straw or hay is applied, the material would be secured by a mechanical crimper or chemical tackifier, as needed. Alternately, where a temporary cover has been established to minimize exposure of disturbance areas to erosion, perennial species may be directly planted into the area, with the remaining stubble serving as mulch and erosion control until the permanent vegetation becomes established.

#### *Irrigation*

The need for irrigation of revegetated areas would be determined on a mine-specific basis. Irrigation may be used in areas requiring enhanced stabilization or to extend the season for initial vegetation establishment if drought conditions exist.

#### *Seedbed Amendments*

The preparation of a suitable seedbed for temporary or permanent revegetation would include, as needed, the application of fertilizer or soil amendments. Growth media soil samples would be collected and analyzed by standard soil testing procedures to identify fertilizer and soil amendment requirements needed to support the post-mining land uses and attain the required productivity levels.

#### *Pesticide Applications*

Pesticides would be used, as required, to control insect damage and invasion of noxious weed or invasive plant species. 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.

#### Restoration of Waters of the U.S., Including Wetlands

As a special condition of any Section 404 permit approved for future surface coal or lignite mining operations, the USACE Fort Worth District would require successful implementation of mitigation measures for waters of the U.S., including wetlands, in accordance with the District's proposed

regulatory framework (see Section 2.2.1) and current Section 404 mitigation guidelines (see Section 2.1.2). Future project-specific mitigation would be described in the Conceptual Mitigation Plan that would need to be developed and submitted to the USACE Fort Worth District in support of the Section 404 permit application. A Conceptual Mitigation Plan typically would present the proposed direct and compensatory mitigation ratios for reclamation of waters of the U.S., including wetlands. It also typically would outline the conceptual plans for creation, restoration, and enhancement of streams and wetlands; present lists of proposed plant species that would be used in reclamation; outline the success criteria and performance standards; and discuss the monitoring, financial assurances, and site protection (e.g., conservation easement) for the stream and wetland areas reclaimed as compensatory mitigation. In order to fully compensate for unavoidable aquatic functions lost as a result of permitted actions, the USACE typically requires in-kind mitigation for each aquatic resource type. Detailed stream design information would be submitted for USACE Fort Worth District and resource agency review and USACE approval prior to construction of mitigation streams. The information would include but not be limited to plan, profile, and dimension measurements based on appropriate regional hydrographic and geomorphological data **obtained from least disturbed streams and wetlands** and successful as-built streams/systems on and/or near the respective mitigation site.

#### Final Pit Reclamation

As described in the Overburden and Interburden Removal subsection under Section 2.2.4.2, Typical Operations Phase, sequential backfilling and reclamation would be conducted throughout the life of a mine as the pit advances. The backfilled pit areas would be revegetated in accordance with the requirements of the specified post-mining land uses. The final mine pit(s) may be backfilled and reclaimed or allowed to fill with water, depending on the designated post-mining land use. Alternately, a series of smaller end lakes may be constructed along drainages in the reclaimed landscape of the final pit(s).

#### Main Haul Roads and Transportation Corridor Reclamation

Following the completion of mining, the main haul roads and transportation corridor would be reclaimed, except where required for long-term monitoring and management purposes or where retained and modified for public access (based on prior authorizations and agreements). Where main haul roads and transportation corridors are removed, all culverts would be removed and either reused or disposed of off site. If bottom ash is used as a road surfacing material, the material would be salvaged and disposed of in accordance with TCEQ and RCT requirements, including placement in pit backfill areas at a minimum depth of 4 feet or disposal at a Class III waste disposal site. Fill material used to construct the haul road and riprap used for reinforcement to control erosion would be removed and either used in reclamation or sold. The disturbance area subsequently would be reseeded and/or replanted in accordance with the requirements of the specified post-mining land uses.

#### Reclamation of Ancillary Facilities and Disposition of Equipment

Ancillary facilities in areas designated for industrial/commercial post-mining land use may be retained for industrial use, with prior authorization. Closure of all other ancillary facilities and disposition of equipment would be conducted in accordance with applicable federal, state, and local regulations. Ancillary structures (e.g., buildings, conveyors) would be dismantled and removed from the site. Concrete foundations and pads would be broken up, either buried in place or hauled to a pit, and covered with suitable growth media or prime farmland soils (a minimum of 4 feet), as applicable. Revegetation would be completed in accordance with the requirements of the post-mining land uses. All equipment would be transported off site. Transmission lines and substations would be dismantled and removed from the site, rerouted, or retained, as would be determined by the power company.

Following the completion of mining, any remaining coal or lignite in temporary storage areas would be loaded and transported to the truck dump area at the coal/lignite handling facilities. The disturbance

areas subsequently would be ripped to relieve compaction and reclaimed in accordance with the post-mining land uses.

### *Roads*

Haul roads and access roads would be removed, except where required for long-term monitoring and management purposes or where retained and modified, as needed, for public access (based on prior authorizations and agreements). Where roads are removed, the road surfacing material would be salvaged for reuse or buried under a minimum of 4 feet of suitable growth media. If bottom ash is used as a road surfacing material, the material would be salvaged and disposed of in accordance with TCEQ and RCT requirements as discussed in the Main Haul Roads and Transportation Corridor Reclamation subsection above. The road disturbance areas subsequently would be scarified, recontoured to blend with the surrounding topography and the natural drainage patterns, and revegetated in accordance with the requirements of the specified post-mining land use.

### *Fuels and Lubricants*

Following the completion of mining and reclamation, materials not consumed on-site would be returned to the supplier or shipped to a licensed recycler, as appropriate. In addition, all storage tanks for these materials would be removed and disposed of in accordance with all applicable federal, state, and local laws and regulations.

Following the completion of mining and reclamation, any remaining solid waste would be transported to and disposed of at a licensed Class III disposal facility.

### *Fencing and Site Security*

Mining areas undergoing reclamation would be fenced, as necessary, to control public access and/or to facilitate revegetation.

### *Monitoring Wells*

Groundwater wells used for monitoring purposes would be plugged in accordance with TAC 1001, 1002, and 1009 when no longer in use. Wells completed above the mine floor elevation within a mining block would be removed during pit excavation. Wells completed below the mine floor elevation would be plugged with a cement-bentonite grout as regulations require.

### Sediment Control Ponds

Sediment control ponds would be retained in the post-mining landscape to the extent possible, pending final agreements with landowners and final RCT approval. Alternately, the sediment control pond embankments would be removed and appropriate drainage re-established. The disturbance area subsequently would be reseeded and/or replanted in accordance with the requirements of the specified post-mining land uses.

### Monitoring of the Reclaimed Site

A mine-specific reclamation success program would be established and conducted in coordination with appropriate jurisdictional agencies throughout the mine life. Revegetation success would be determined in accordance with RCT's 2014 *Procedures and Standards for Determining Revegetation Success on Surface-Mined Lands in Texas* and Sections 12.395 and 12.399 of the Texas Coal Mining Regulations. Revegetation success would be monitored through evaluation of percent ground cover, tree densities, and productivity, as applicable, in relation to the site-specific post-mining land use. The program then would examine, review, and determine the effectiveness of the reclamation efforts to achieve proposed standards of reclamation success. Based on the results of the evaluation, reclamation techniques would be refined, as needed, to ensure reclamation objectives would be achieved. RCT criteria for

determination of reclamation success by post-mining land use are presented below. Mitigation success criteria, as would be specified in the mine-specific Section 404 permits that may be issued by the USACE Fort Worth District in the future, also are discussed below.

#### *Pastureland and Grazing Land*

Under the RCT regulations for pastureland and grazing land, the success of ground cover establishment of revegetated mine disturbance areas is compared either to the ground cover of an approved reference area or to approved technical standards. When reference areas are used, the ground cover of the revegetated land must be 90 percent of the reference area with a 90 percent statistical confidence. Alternately, ground cover must achieve at least 90 percent of the ground cover technical standards established by the NRCS, which require 95 percent cover for sod-forming grasses and 90 percent cover for bunchgrasses for areas with annual precipitation greater than 26 inches, or 90 percent cover for sod-forming grasses and 80 percent cover for bunchgrasses for areas with annual precipitation less than or equal to 26 inches. Productivity is required to reach or exceed 90 percent of a reference area or 90 percent of site-specific technical standards developed by the NRCS at the request of the applicant. For areas with annual precipitation of greater than 26 inches, ground cover and productivity need to meet or exceed the approved standards any 2 of the first 5 years, with the exception of the first year. For areas with annual precipitation of less than or equal to 26 inches, ground cover and productivity need to meet or exceed the approved standards in at least the last 2 consecutive years of the first 10 years. Production may be measured through a combination of whole-field hay harvest methods and/or grazing use records.

#### *Cropland*

Under the RCT regulations for non-prime farmland soils, sufficient ground cover is to be maintained to control erosion until crop production begins, with the Revised Universal Soil Loss Equation (RUSLE) used to estimate erosion potential. Productivity is required to reach or exceed 90 percent of a reference area or 90 percent of site-specific technical standards developed by the NRCS at the request of the applicant. For areas with annual precipitation of greater than 26 inches, ground cover and productivity need to meet or exceed the approved standards any 2 of the first 5 years, with the exception of the first year. For areas with annual precipitation of less than or equal to 26 inches, ground cover and productivity need to meet or exceed the approved standards in at least the last 2 consecutive years of the first 10 years. Production is to be measured based on whole-field harvest as compared to approve productivity standards specifically developed for a particular crop and growing season.

For prime farmland soils, sufficient ground cover is to be maintained to control erosion until crop production begins, with the RUSLE used to estimate erosion potential. Productivity is required to meet 100 percent of the reference crop yield technical standards developed by the NRCS at the request of the applicant. Measurement of productivity is required to be initiated within 10 years after the completion of soil replacement. For areas with annual precipitation of greater than 26 inches, crop production must meet or exceed the approved standards in any of the first 5 years, with the exception of the first year. For areas with annual precipitation of less than or equal to 26 inches, crop production needs to meet or exceed the approved standards in at least the last 2 consecutive years of the first 10 years. Reference crop yields are compared to average yields for specific prime farmland soil series. Average yields are determined in consultation with the NRCS.

#### *Forestry*

Under the RCT regulations for the forestry land use type, performance standards for both vegetative ground cover and tree stocking rates must be achieved. Ground cover is required to meet or exceed 90 percent of a reference area or 90 percent of the technical standard of 78 percent. Tree species are required to meet or exceed 90 percent of a site-specific technical standard developed by the applicant in coordination with the Texas Forest Service. Ground cover and tree composition measurements also are required, with a minimum of 75 percent of the ground cover to comprise permit-approved species that

support the post-mining land use and up to 25 percent of the ground cover to comprise desirable invader species (i.e., RCT-approved species for the designated post-mining land use that are allowed to naturally recolonize the disturbance area). Ground cover must meet or exceed the success standards during the growing season of the last year of reclamation responsibility. At the end of reclamation responsibility, at least 80 percent of the healthy tree stems are to have been in place for 60 percent of the reclamation period.

#### *Fish and Wildlife Habitat*

Under the RCT regulations for fish and wildlife habitat, ground cover (i.e., herbaceous species) in general wildlife habitat is required to meet or exceed 90 percent of the technical standard of 78 percent. For early successional habitat, including quail grassland, the groundcover is required to meet or exceed 90 percent of the technical standard of 63 percent. In areas where the wildlife habitat type is planned for tree and shrub species restoration, site-specific technical standards are developed by the applicant in consultation with the TPWD. For general wildlife habitat, woody species stocking rates are required to meet or exceed 90 percent of the identified technical standard. For early successional habitat, including quail grassland mottes (i.e., thicket of shrubs or small stand of trees on a prairie), woody species stocking rates are required to meet or exceed the identified technical standards. The RCT regulations relative to herbaceous and woody species composition measurements and end of reclamation responsibility goals are the same as described above for the forestry land use type.

Fish and wildlife habitat also would be provided through mitigation of waters of the U.S., including wetlands, which would be reclaimed in accordance with an applicant's Section 404 Permit requirements. See the Developed Water Resources subsection below relative to aquatic habitat.

#### *Residential Land*

Under the RCT regulations for the residential land use type, sufficient ground cover is to be maintained to control erosion, with RUSLE used to estimate the erosion potential. Woody species are required to meet or exceed 90 percent of a site-specific technical standard developed by the applicant in coordination with the Texas Parks and Wildlife. Woody species composition monitoring, where applicable, and end of reclamation responsibility goals are the same as described above for the forestry land use type.

#### *Industrial/Commercial*

Under the RCT regulations for the industrial/commercial land use type, sufficient ground cover is to be maintained to control erosion, with RUSLE used to estimate the erosion potential. If woody species stocking is to be implemented, these plantings would be required to meet or exceed 90 percent of a site-specific technical standard developed by the applicant in coordination with the Texas Parks and Wildlife. Woody species composition monitoring, where applicable, and end of reclamation responsibility goals are the same as described above for the forestry land use type.

#### *Recreation*

Under the RCT regulations for the recreation land use type, sufficient ground cover is to be maintained to control erosion, with RUSLE used to estimate the erosion potential. If woody species stocking is to be implemented, these plantings would be required to meet or exceed 90 percent of a site-specific technical standard developed by the applicant in coordination with the TPWD. Woody species composition monitoring, where applicable, and end of reclamation responsibility goals are the same as described above for the forestry land use type.

#### *Undeveloped Land*

The undeveloped land category includes those areas for which long-term management goals and uses have not been identified. These areas would be planted with native grasses, shrubs, and trees. Per the

RCT regulations, ground cover must meet or exceed 90 percent of the ground cover technical standards. The technical standards for areas with annual precipitation of greater than 26 inches are 95 percent cover for sod-forming grasses and 90 percent cover for bunchgrasses. For areas with annual precipitation less than or equal to 26 inches, the technical standards are 90 percent cover for sod-forming grasses and 80 percent cover for bunchgrasses. For areas predominately reclaimed with woody species, the technical standard for ground cover is 78 percent. As per the RCT regulations for the fish and wildlife habitat type, woody species stocking rates are required to meet or exceed 90 percent of the identified technical standard developed by the applicant in coordination with the TPWD. The RCT regulations relative to herbaceous and woody species composition measurements and end of reclamation responsibility goals are the same as described above for the forestry land use type.

#### *Developed Water Resources*

An applicant in coordination with the USACE would identify and inventory appropriate waters of the U.S. (including wetlands) reference sites for use in evaluating reclamation success for developed water resources. The reference sites, as well as aquatic resource creation and/or restoration mitigation ratios, would be specific to an applicant's Section 404 permit requirements.

### **2.2.5 Typical Environmental Protection Measures**

Presented below are the typical environmental protection measures implemented by surface coal and lignite mines to minimize potential environmental impacts associated with mine development. These measures include typical permit requirements of the various federal and state agencies with jurisdiction over surface coal and lignite mining operations and additional BMPs implemented by the mines as standard operating procedures.

#### **2.2.5.1 Geology, Paleontology, and Mineral Resources**

- As required by RCT regulations, mine spoils would be regraded to approximate original contours prior to being revegetated.

#### **2.2.5.2 Water Resources (groundwater, surface water, and waters of the U.S., including wetlands)**

- During mining and following completion of reclamation, water supply would be replaced if water supply wells are adversely impacted by mining operations
- 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.
- Temporary and permanent erosion control measures (e.g., check dams, riprap, mulch) would be installed incrementally throughout the life of a mine in advance of ground-disturbing activities and as part of reclamation.
- Surface water control features (e.g., storm water diversions, sediment control ponds, BMPs) would be constructed or installed in advance of ground-disturbing activities.
- Designs for intermittent and perennial stream diversions, where needed, would be approved by RCT prior to installation.
- Water discharged from sediment control ponds would be monitored in accordance with TPDES permit requirements to control the quality of the discharge. Treatment systems (e.g., chemical additives or use of flocculants) would be used, as needed, to ensure compliance with permit requirements.
- To the extent possible, pre-mine stream drainage configurations would be retained, and slopes similar to pre mine conditions would be achieved when practical during reclamation, to facilitate stream-flow regimes consistent with pre-mining rates.



- Potential impacts to water quality **as a result of sediment transport or the spill or release of a hazardous material** would be minimized through implementation of mine-specific state-required Storm Water Pollution Prevention Plan (SWPPP); SPCC Plan; and Emergency Response Plan.
- Waters of the U.S., including wetlands, directly impacted by mining would be reconstructed through creation, restoration, or enhancement as outlined in the mine-specific Conceptual Mitigation Plan, which would be developed in accordance with the requirements of the USACE. Incrementally, as areas become ready for reconstruction of waters of the U.S, specific detailed plans would be reviewed **by the USACE and resource agencies** and approved by the USACE, prior to implementation.

#### **2.2.5.3 Soils**

- Potential impacts to soils would be minimized by limiting the acreage of mining disturbance at any given time and prompt revegetation of disturbance 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).
- Selective materials handling and testing would be implemented to ensure placement of suitable growth media in the upper 4 feet of the reclaimed spoil material.
- Soils in prime farmland areas would be salvaged, stockpiled, if needed, and replaced to a minimum depth of 4 feet.
- Growth media and prime farmland stockpiles to be left in place more than 30 days would be graded and seeded with a temporary crop cover. BMPs (e.g., silt fences, straw bales, berms, ditches), as needed, and signage would be installed.
- Replaced growth media would be tested to ensure no acid- or toxic-forming materials are present in the upper 4 feet of the regraded spoils.
- To minimize erosion, rills and gullies in final graded areas would be filled, graded, or otherwise stabilized as soon as field conditions allow. The area subsequently would be reseeded or replanted during the first favorable planting period.
- Fertilizer and other soil amendments would be used, as needed, to ensure successful re-establishment of vegetation.

#### **2.2.5.4 Vegetation (including threatened and endangered species)**

- Potential impacts to vegetation would be minimized by limiting the acreage of mining disturbance at any given time and prompt revegetation of disturbance 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).
- Permanent revegetation would be initiated during the first favorable planting period. During periods unfavorable for re-establishment of permanent vegetation, a temporary crop cover would be established.
- Permanent ponds, where included in the reclaimed landscape, would be designed to promote propagation of aquatic and wetland vegetation.

#### **2.2.5.5 Fish and Wildlife Resources (including threatened and endangered species)**

- Potential impacts to fish and wildlife species would be minimized by limiting the acreage of mining disturbance at any given time, limiting disturbance (to the extent possible) within high-value habitat, and prompt revegetation of disturbance 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).

- A Fish and Wildlife Plan (as required by RCT) would be developed and implemented to minimize impacts to fish and wildlife species and aquatic communities, including special status species. A typical plan would provide for the restoration, enhancement, and maintenance of natural riparian habitats associated with streams, lakes, and other wetland areas. In addition, protection measures for special status species and species of special concern would be included, as applicable.
- Permanent ponds, where included in the reclaimed landscape, would be designed to promote propagation of aquatic and wetland habitats.
- To minimize potential power line- or transmission line-related impacts to raptor species (i.e., collision and electrocution), these facilities would be designed and constructed in accordance with guidelines presented in Reducing Avian Collisions with Power Lines (Avian Power Line Interaction Committee [APLIC] 2012) and Suggested Practices for Avian Protection on Power Lines (APLIC 2006).
- Potential impacts to breeding and nesting migratory bird species would be minimized through the avoidance of rookeries and raptor nest sites during the breeding season, to the extent possible. Also, to the extent possible, clearing operations would be conducted during non-breeding periods to avoid the peak migratory bird breeding season.
- To minimize impacts to threatened and endangered species, employee awareness training would be conducted, as applicable.

#### **2.2.5.6 Cultural Resources**

- Cultural resource surveys, report preparation, and review of reports by regulatory agencies (including THC) would be completed in advance of ground-disturbing activities to provide time for implementation of THC-approved mitigation or avoidance measures for any identified National Register of Historic Places (NRHP)-eligible sites prior to disturbance.
- No cultural resource sites would be disturbed unless and until written authorization to proceed has been obtained from the THC, USACE, and RCT.
- If previously unknown archaeological sites or potential human remains are discovered during construction, construction activities in the vicinity would cease, THC would be notified, and the site would be protected until THC could evaluate the nature of the discovery and issued a notice to proceed.

#### **2.2.5.7 Air Quality**

- Fugitive dust emissions from haul roads would be controlled by the application of water sprays, chemical dust suppressants, and routine maintenance and/or slow-curing liquid asphalt as allowed by TCEQ. Other controls would include proper loading of haul trucks (i.e., not overloading) to prevent spillage, prompt removal of coal/lignite, rock, or soil from roads; compaction of unpaved roads, as needed; and restriction of travel of unauthorized vehicles on other than established roads.
- 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 regraded lands, and restricting fugitive dust causing activities during periods of air stagnation as required by the jurisdictional agencies.

- Particulate emissions related to potential coal/lignite combustion would be minimized by promptly extinguishing areas of burning or smoldering coal/lignite and conducting periodic inspections for burning areas whenever the potential for spontaneous combustion is high.

#### **2.2.5.8 Land Use and Recreation**

- Land uses would be reclaimed to the pre-mine land use, except when an alternative land use is approved by the RCT.
- Lands would be reclaimed to the proper level of management, as applicable for the land use.
- Landowners' plans would be considered and landowners consulted should alternative post-mine land uses be included in the reclamation plan under the RCT permit.

#### **2.2.5.9 Social and Economic Values**

- No typical measures.

#### **2.2.5.10 Transportation**

- Alternate public and landowner access would be provided prior to closure of a road.

#### **2.2.5.11 Noise and Visual Resources**

- No typical measures.

#### **2.2.5.12 Hazardous Materials**

- Flammable fluids (e.g., gasoline or diesel fuel) or other materials (e.g., oil, grease, anti-freeze, solvents) classified as toxic or hazardous by TCEQ and other applicable regulatory authorities would be registered, transported, stored, labeled, handled, and disposed of in accordance with applicable regulatory requirements.
- Potential impacts in the event of a spill would be minimized through implementation of the mine-specific state required SPCC Plan and Emergency Response Plan.

#### **2.2.5.13 Public Health**

- No typical measures.

#### **2.2.5.14 Environmental Justice**

- No typical measures.

### **2.3 No Action Alternative**

Under the No Action Alternative, the USACE Fort Worth District's proposed regulatory framework as discussed in Section 2.2.1, Proposed USACE Fort Worth District Regulatory Framework for Surface Coal and Lignite Mines in Texas, would not be implemented. Alternately, the existing regulatory framework described in Section 2.1.1, Evolution of Current USACE Fort Worth District Regulatory Framework, would continue to be used in responding to potential future requests for authorization of surface coal/lignite mine expansion areas or satellite mines in Texas. The existing USACE Fort Worth District Section 404 mitigation guidelines as discussed in Section 2.1.2, Evolution of Current USACE Fort Worth District Section 404 Mitigation Guidelines, would continue to be implemented under the No Action Alternative (same as under the Proposed Action).

Categories for future NEPA tiering or supplementation (as described in Section 2.2.2) would not be established under the No Action Alternative. However, as part of the permit evaluation process associated with potential Section 404/10 permit authorizations for future surface coal/lignite mines, the USACE Fort Worth District would be required to comply with the regulatory requirements of NEPA in evaluating the potential impacts of an action. In accordance with the CEQ Regulations for Implementing the Procedural Provisions of NEPA (40 CFR 1500-1508), the NEPA analyses for future surface coal/lignite mines that may be proposed within the study areas would be able to tier from this REIS analysis, as appropriate.

The development of a typical surface coal or lignite mine under the No Action Alternative would be the same as described in Section 2.2.4, Description of a Typical Surface Coal and Lignite Mine, with the following exception. The USACE Fort Worth District would require any future surface coal or lignite mine for which a Section 404/10 permit may be approved to commit to successful implementation of mitigation measures for waters of the U.S., including wetlands, in accordance with the District's current regulatory framework and Section 404 mitigation guidelines as discussed in Sections 2.1.1 and 2.1.2, respectively.

## **2.4 Past, Present, and Reasonably Foreseeable Future Actions**

Cumulative impacts are the combination of the individual effects of multiple actions over time in a defined area or region. The individual effects may be minor when considered separately, but may be major or significant when considered in combination. Resource-specific cumulative effects analyses are required under NEPA to disclose a proposed project's contribution to cumulative impacts resulting from other past, present, and reasonably foreseeable future actions (RFFAs). To support the cumulative effects analyses, any past and present actions and RFFAs that may affect the same resources and overlap temporally and spatially with the anticipated impacts of a proposed project need to be identified and a brief description of each action incorporated into the NEPA document, where possible. Descriptions may include the type of project, location, and extent of surface disturbance. This information is used in conjunction with the results of the environmental consequences analyses for analyzing the potential cumulative impacts within defined resource-specific cumulative effects study areas (CESAs).

The actions that are relevant to the cumulative effects analyses for this REIS are those that resulted or would result in surface disturbance in the CESAs, because those actions affected or would affect resources in a manner similar to those activities analyzed under the Proposed Action and No Action alternatives. In addition to surface coal or lignite mines, these actions may include residential, commercial, and industrial structures and facilities associated with cities and towns, roads, oil and gas development, power plants, reservoirs, renewable energy projects, and water supply projects. While the types and extent of actions and land uses within each CESA vary, there also are similarities in that they all include lignite mining, power generation facilities, USACE-permitted Section 404 activities, public water supplies and reservoirs, and oil and gas operations.

For purposes of this REIS, resource-specific CESA boundaries were delineated for each of the six study areas. The acreage of each of the resource-specific CESAs and the rationale used in delineating their boundaries are presented in the cumulative effects analyses discussions in Chapter 3.0. An overall summary of the identified past and present actions and RFFAs and the associated acreage of disturbance within the maximum extent of the CESAs is presented below.

### **2.4.1 Past and Present Actions**

Past and present actions contribute to the current resource conditions within each CESA. **Figure 2-2** displays the maximum extent of the combined resource CESAs delineated for each study area. The maximum CESA boundary encompasses a total of approximately 24,811,170 acres, of which approximately 1,456,940 acres were identified as having surface disturbance resulting from past and present actions. Existing surface disturbance within the combined CESA was identified using selected categories from the spatial data prepared for the Texas Ecological Systems Classification Project

(TPWD 2014e), actions for which USACE Section 404 permits have been issued, as well as the boundaries of existing mines, reservoirs, and landfills. The selected categories used to identify existing disturbance from the TPWD dataset include federal and state highway ROWs and urban areas. The location and general distribution of past and present surface disturbance within the maximum extent of each study area-specific CESA are shown on **Figures 2-3** through **2-8**.

**Table 2-8** includes information about past and present surface coal and lignite mines within each **CESA**. The table includes the information that is relevant to consider when analyzing cumulative effects, including the extent of **authorized** surface disturbance, end date for the life-of-mine, and number of employees. **The authorized surface disturbance acreage reflects the past and present permits; however, not all of the authorized disturbance may be currently disturbed.**

The types of known surface-disturbing projects that have contributed to the total acreage of past and present surface disturbance within each CESA are identified in **Table 2-9**. The surface disturbance associated with each project type is presented as a percentage of the total area of each CESA in order to enable a relative comparison of the types of activities that have contributed to the existing surface disturbance in each CESA. For example, while there are landfills in each CESA, CESA 4 has the most landfill-related disturbance and CESA 6 has the least; all CESAs have some oil and gas development, but CESA 2 has the most oil and gas-related disturbance.

#### 2.4.2 Reasonably Foreseeable Future Actions

Reasonably foreseeable future actions are those actions that have formal plans or for which permitting is in progress at the time this REIS was developed. It is assumed that current activities, such as livestock grazing, agriculture, dispersed recreation, and other existing land uses, would continue into the foreseeable future. The only other known RFFAs include some highway improvements planned by TxDOT, new water supply developments, and the projections of new surface disturbance for potential future surface coal or lignite mine expansion areas or satellite mines shown in **Table 2-3**.

Within the next 10 to 15 years, the following surface-disturbing actions are projected:

- CESA 1—111 miles of state highway construction; 11 public water supply projects; up to 13,500 acres of disturbance for future surface coal or lignite mine expansion areas or satellite mines
- CESA 2—98 miles of state highway construction; 8 public water supply projects; up to 50,200 acres of disturbance for future surface coal or lignite mine expansion areas or satellite mines
- CESA 3—117 miles of state highway construction; 16 public water supply projects; up to 50,600 acres of disturbance for future surface coal or lignite mine expansion areas or satellite mines
- CESA 4—470 miles of state highway construction; 28 public water supply projects; up to 9,800 acres of disturbance for future surface coal or lignite mine expansion areas or satellite mines
- CESA 5—10 miles of state highway construction; up to 9,500 acres of disturbance for future surface coal or lignite mine expansion areas or satellite mines
- CESA 6—46 miles of state highway construction; 7 public water supply projects; up to **25,000** acres of disturbance for future surface coal or lignite mine expansion areas or satellite mines.

## 2.5 Comparison Analysis of Alternatives

**Table 2-10** provides a summary of the key direct and indirect impacts for each resource analyzed as well as additional recommended monitoring and mitigation identified as a result of the impact analysis. Detailed descriptions of impacts are presented for each alternative under each resource in Chapter 3.0. The summarized impacts assume the implementation of typical environmental protection measures as identified in Section 2.2.5 and the environmental protection measures associated with applicable state and federal permits. However, it is not assumed that the recommended mitigation measures would be implemented. Implementation of the recommended mitigation measures identified in Chapter 3.0 potentially would reduce impacts beyond that described in this table. Impacts are referred to as “short-term” if they would occur during typical mine construction, operations, and closure/final reclamation or “long-term” if they would persist beyond closure/final reclamation.

The construction, operation, and closure/final reclamation activities and mine components of a typical surface coal or lignite mine expansion area or satellite mine were used to facilitate the impact analysis for this REIS. The need for additional mitigation may be identified during the project-specific NEPA review that would be conducted at the time future mine expansion areas or satellite mines are proposed.

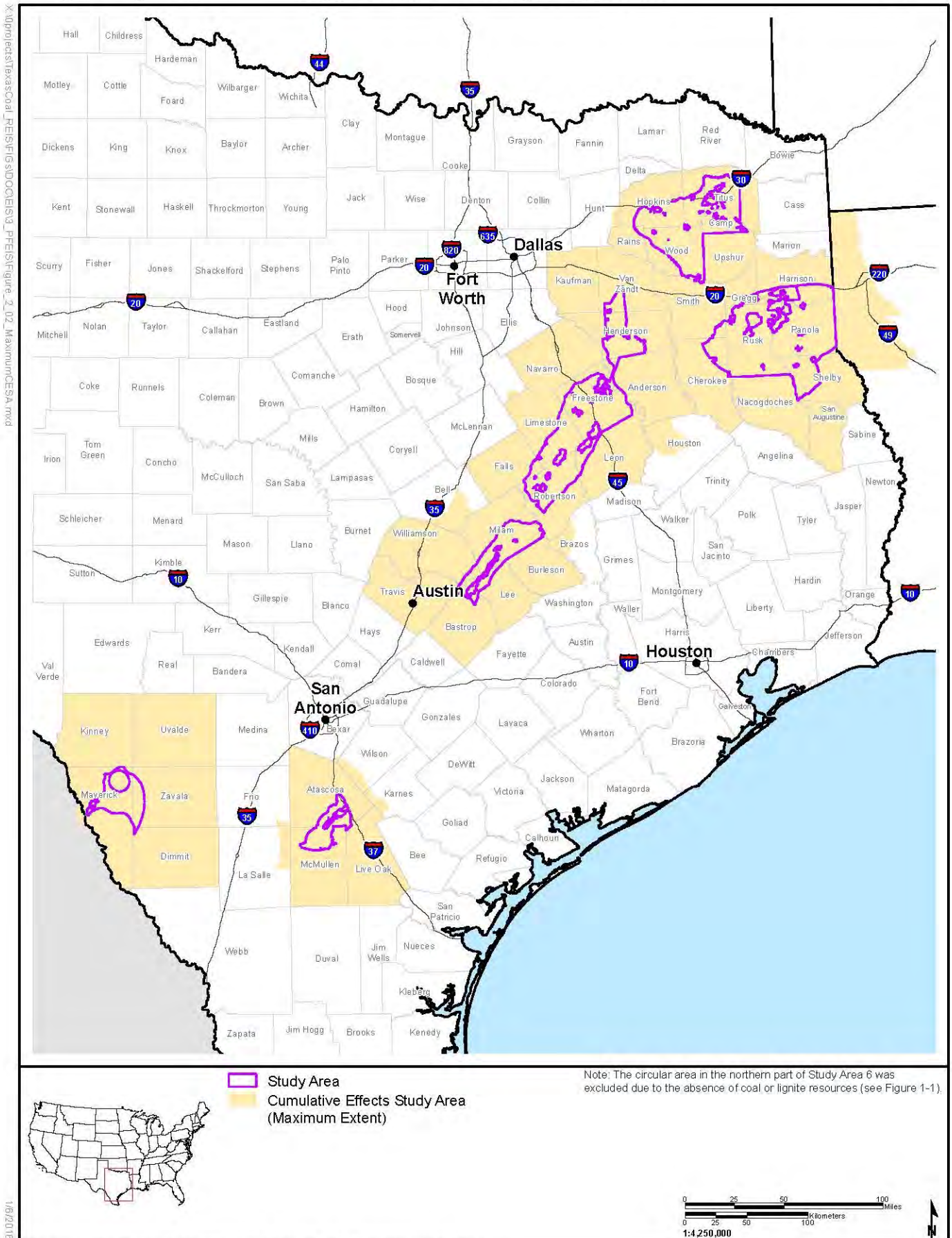


Figure 2-2 Overall Maximum Extent of Combined CESAs

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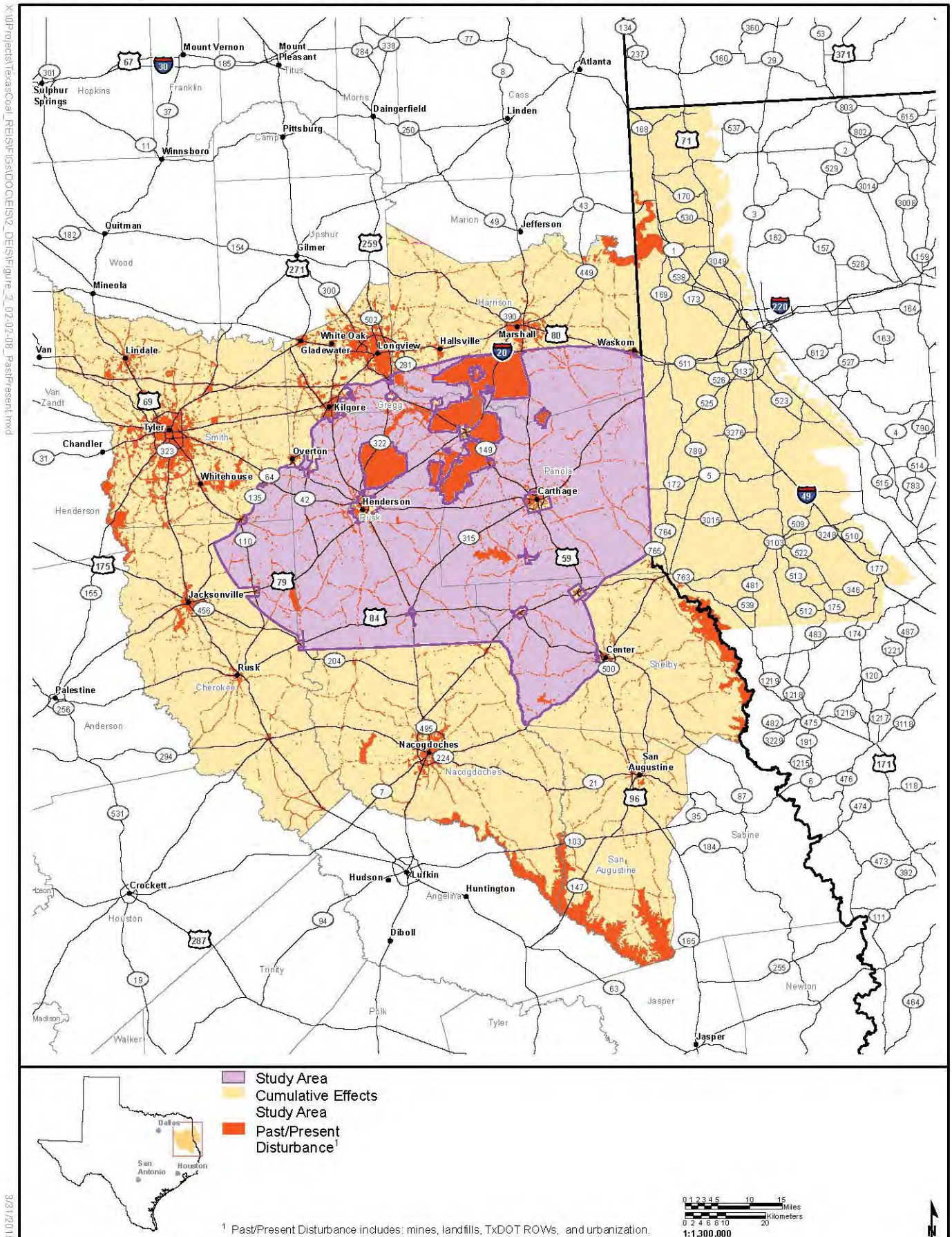


Figure 2-4 Maximum Extent of Study Area 2 CESA

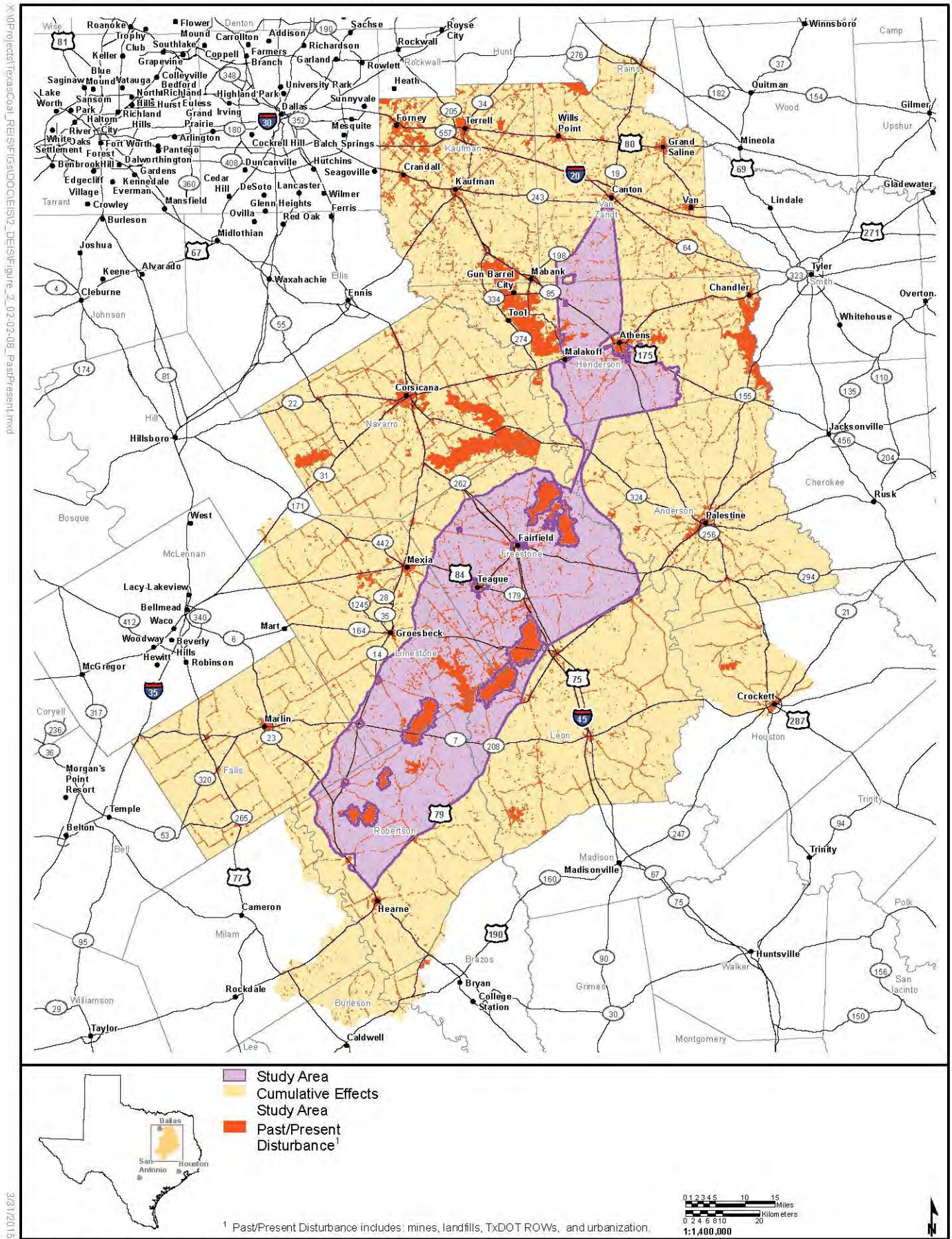


Figure 2-5 Maximum Extent of Study Area 3 CESA

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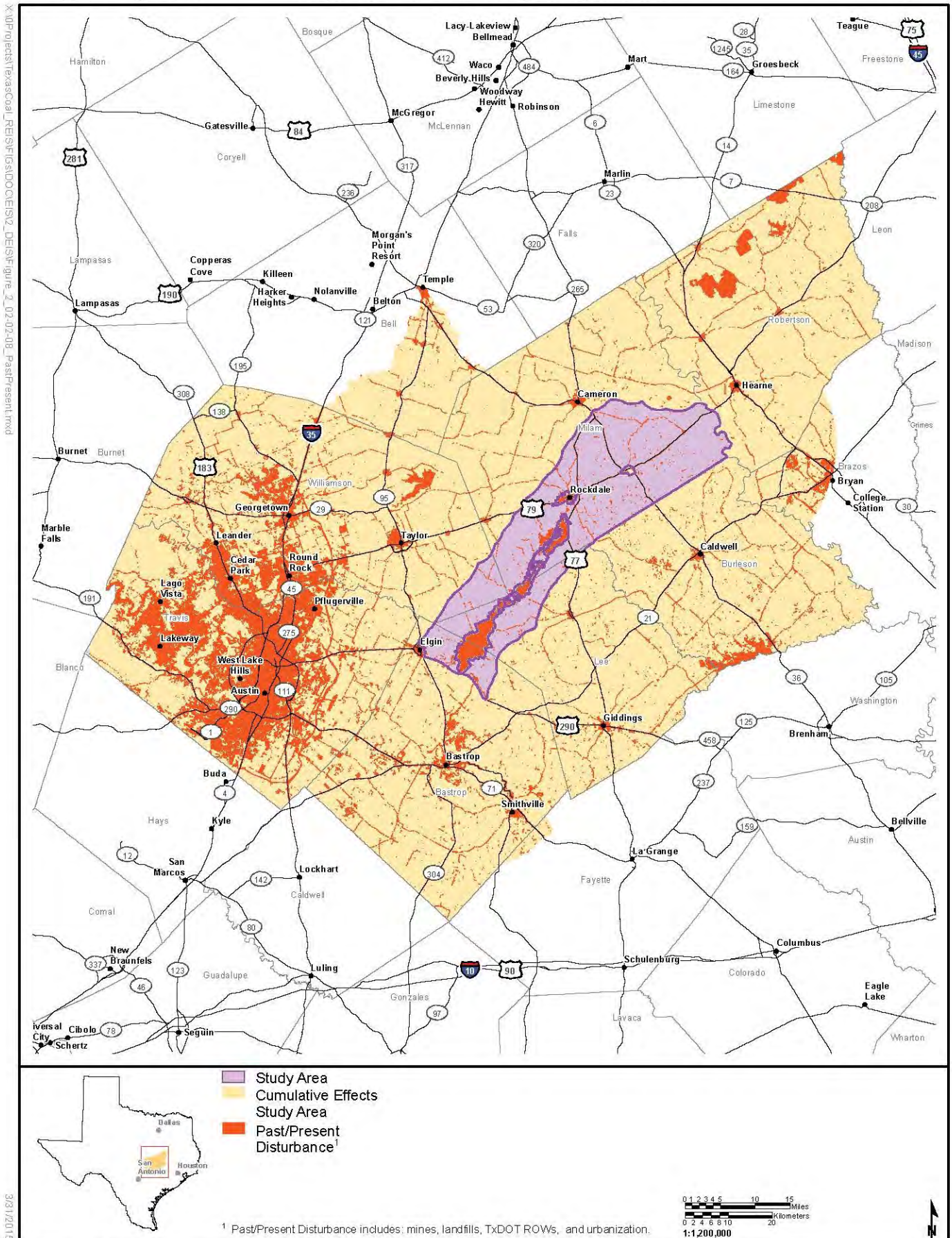
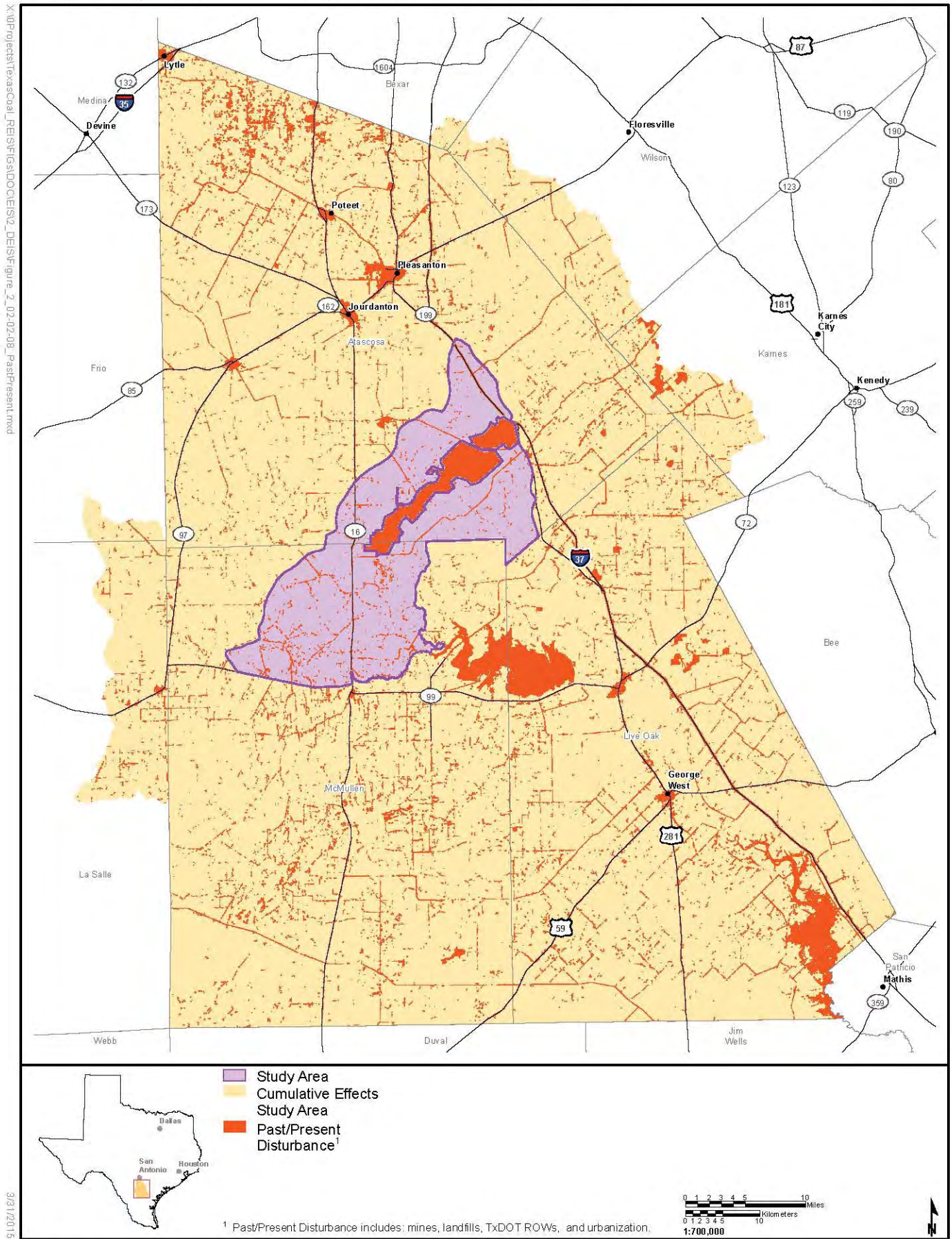


Figure 2-6 Maximum Extent of Study Area 4 CESA



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Figure 2-7 Maximum Extent of Study Area 5 CESA

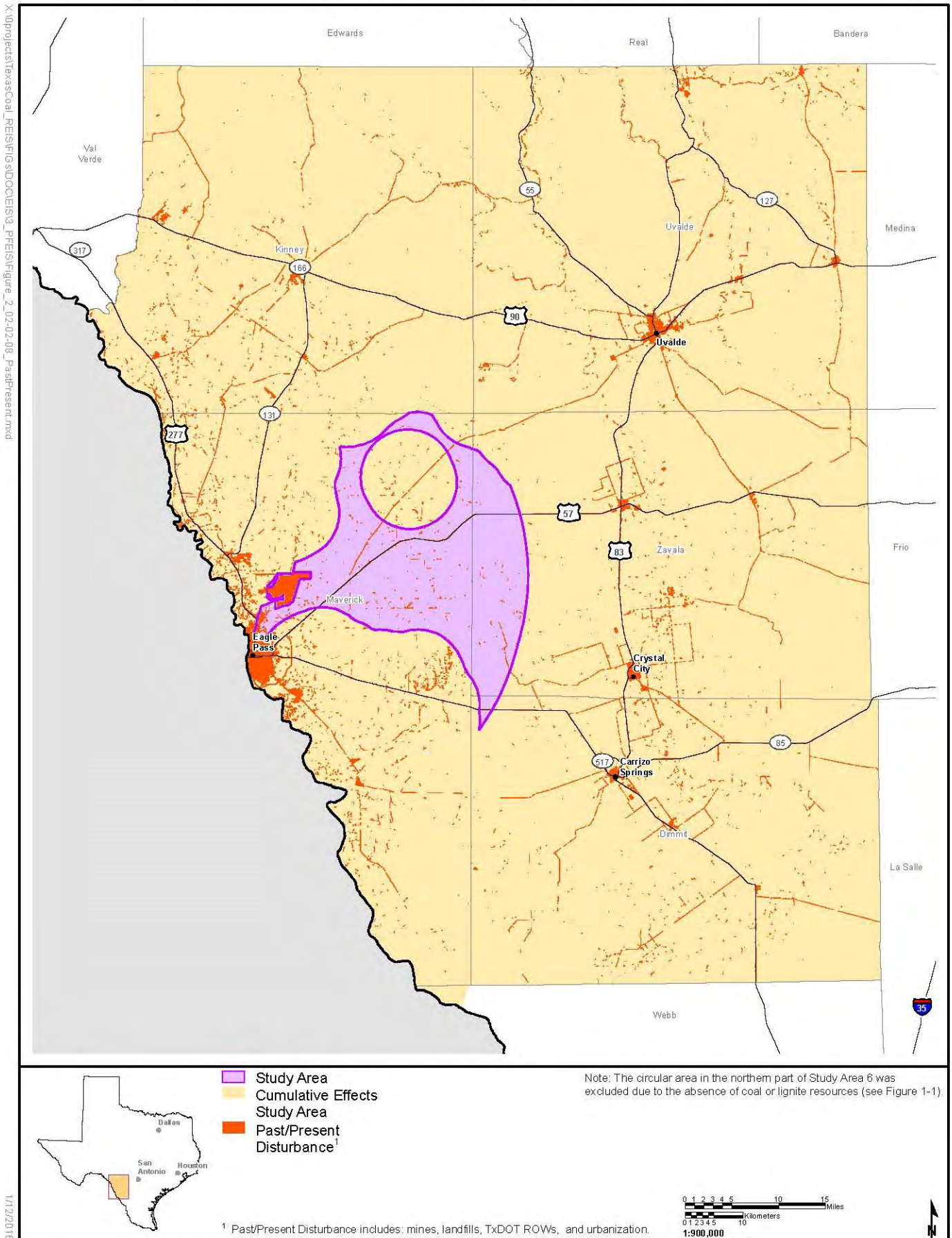


Figure 2-8 Maximum Extent of Study Area 6 CESA

**Table 2-8 Past and Present Surface Coal and Lignite Mines by CESA**

<b>CESA</b>	<b>Mine Name<sup>1</sup></b>	<b>RCT Permit #</b>	<b>Company</b>	<b>Authorized Disturbance (acres)</b>	<b>Life-of-mine<sup>2</sup> (end date)</b>	<b>Number of Employees</b>
1	Monticello Thermo Mine	5F	Luminant Mining Company, LLC	4,508	2020	22
	Thermo A1	56	Luminant Mining Company, LLC	286	2020	Part of Monticello Thermo (5F) complex
	Monticello Winfield Mine	34E	Luminant Mining Company, LLC	26,337	2020	136
	Leesburg Mine	51	Luminant Mining Company, LLC	4,517	Not open: 15-year life span	—
2	Martin Lake Mine (Includes Beckville and Tatum)	4K	Luminant Mining Company, LLC	30,907	2025	359
	Martin Lake AIV South	53	Luminant Mining Company, LLC	2,310	2017	Part of Martin Lake (4K) complex
	Darco Mine [T]	29C	Norit Americas, Inc.	510	2014 <sup>3</sup>	0
	South Hallsville No. 1 Mine	33H	Sabine Mining Company	44,408	2027	0
	Oak Hill Mine	46C	Luminant Mining Company, LLC	26,016	2030	289
	Rusk Mine	55	Sabine Mining Company	20,380	2041	273
	Marshall Mine	57	Marshall Mining Company	132	2043	40
2	Marshall Mine Expansion	59	Marshall Mining Company	2,500	2043	40
	Martin Lake Liberty Mine	58	Luminant Mining Company, LLC	3,866	2025	Part of Martin Lake (4K) complex
3	Big Brown Mine	3E	Luminant Mining Company, LLC	12,908	2017	214
	Gibbons Creek Mine [R]	26D	Texas Municipal Power Agency	11,001	NA <sup>4</sup>	0
	Gibbons Creek IV Mine	38D	Texas Municipal Power Agency	3,900	NA <sup>4</sup>	0
	Calvert Mine	27G	Walnut Creek Mining Company	8,670	2031	103
	Jewett Mine	32F	Texas Westmoreland Coal Company	21,531	2026	319
	Jewett Area E/F	47A	Texas Westmoreland Coal Company	9,343	2027	Part of Jewett Mine (32F)

**Table 2-8 Past and Present Surface Coal and Lignite Mines by CESA**

CESA	Mine Name <sup>1</sup>	RCT Permit #	Company	Authorized Disturbance (acres)	Life-of-mine <sup>2</sup> (end date)	Number of Employees
	Bremond Mine	49A	Luminant Mining Company, LLC	3,371	Not open: 10-year life span	—
	Kosse Mine	50A	Luminant Mining Company, LLC	15,043	2025	330
	Turlington Mine (continuation of Big Brown)	54	Luminant Mining Company, LLC	10,395	2025	Part of Big Brown Mine (3E)
4	Sadow Mine [R]	1F	Alcoa, Inc.	10,730	2007	0
	Three Oaks Mine	48C	Luminant Mining Company, LLC	15,811	2035	294
5	San Miguel Mine	11F	San Miguel Electric Cooperative, Inc.	16,004	2026	174
	San Miguel Mine Area C	52A	San Miguel Electric Cooperative, Inc.	4,444	2023	Part of San Miguel (11F) complex
6	Eagle Pass Mine	42B	Dos Rep�ublicas Coal Partnership	<b>6,346</b>	2021	16

<sup>1</sup> [R] = In final reclamation; [T] = RCT permit terminated.

<sup>2</sup> Based on current assumptions. Life-of-mine is the period of operations.

<sup>3</sup> RCT permit terminated April 22, 2014.

<sup>4</sup> Final reclamation completed.

**Table 2-9 Types of Projects Contributing to Past and Present Surface Disturbance by CESA**

Project Type	Percent of Maximum CESA Boundary Disturbed by Project Type					
	CESA 1	CESA 2	CESA 3	CESA 4	CESA 5	CESA 6
Landfill	17	32	9	40	2	<1
Mine	12	43	27	27	8	1
Pipeline	9	39	26	26	12	8
Petroleum Refinery or Terminal	27	33	13	33	13	0
Public Water Supply	10	8	46	46	2	12
Reservoir	22	35	31	31	8	<1
Wells (Oil/Gas)	11	39	22	11	14	9
<b>Section 404 Permits (USACE)</b>						
Energy Generation	3	81	13	2	3	<1
Mitigation	27	40	13	40	0	0
Other	7	83	5	7	<1	<1
Structure and Development	4	58	8	32	1	<1
Transportation	39	53	14	12	1	1

**Table 2-9 Types of Projects Contributing to Past and Present Surface Disturbance by CESA**

Project Type	Percent of Maximum CESA Boundary Disturbed by Project Type					
	CESA 1	CESA 2	CESA 3	CESA 4	CESA 5	CESA 6
<b>Power Generation Facilities</b>						
Biomass	0	33	0	67	0	0
Coal	17	33	33	33	8	0
Hydro	0	0	0	67	0	33
Natural Gas	5	36	18	45	0	0
Solar	0	0	0	9	0	0
Wind	0	0	0	50	0	50
Wood	0	5	0	0	0	0

Notes: Percentages were calculated based on the total number, acreage, or length of each project type within the CESA compared to the total acreage for the combined CESAs. For this reason, the percentages for each project type may total more than 100 percent when each column is summed due to overlapping CESA boundaries. Where a project type is located within an overlapping area, it is counted more than once. This enables a comparable summary for each CESA.



**Table 2-10 Summary of Direct and Indirect Impacts by Resource or Impact Issue and Recommended Monitoring and Mitigation**

Resource/Impact Issue	Proposed Action Alternative	No Action Alternative	Recommended Monitoring and Mitigation Measures
<b>Geology/Minerals/Paleontology</b>			
Modification of topography	Topography would be altered by the removal of overburden and coal or lignite on approximately 158,600 acres. Effects would be minimized through regrading to approximate original contour.	Same as the Proposed Action.	<ul style="list-style-type: none"> <li>No monitoring or mitigation is recommended for geology, paleontological, or mineral resources.</li> </ul>
Removal of coal and lignite resources making it unavailable in the future	Permanent removal of an estimated 35 million tons of coal or lignite annually.	Same as the Proposed Action.	
Access to oil and gas resources	Access to oil and gas resources would be precluded or limited during active mining unless horizontal drilling were implemented.	Same as the Proposed Action.	
Damage to fossils	Mining may directly damage or destroy common fossils; however, the potential for impact to significant fossils is low.	Same as the Proposed Action.	
<b>Water Resources</b>			
<b>Groundwater</b>			
Drawdown of aquifers	Maximum extent of projected mine-related 5-foot groundwater drawdown contour as a result of dewatering and depressurization would vary across the study areas, ranging from a high of 15 miles in Study Area 4 to zero in Study Area 6. 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.	Same as the Proposed Action.	<ul style="list-style-type: none"> <li>No monitoring or mitigation measures are recommended.</li> </ul>

**Table 2-10 Summary of Direct and Indirect Impacts by Resource or Impact Issue and Recommended Monitoring and Mitigation**

Resource/Impact Issue	Proposed Action Alternative	No Action Alternative	Recommended Monitoring and Mitigation Measures
Groundwater quantity	The effects on other groundwater uses would vary depending on the extent of required mine depressurization and dewatering. Impacts 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.	Same as the Proposed Action.	
Groundwater quality	Groundwater quality in mine pit backfill areas may have elevated levels of salinity; however, impacts to groundwater due to increased salinity would be minimal in all study areas.	Same as the Proposed Action.	
<b>Surface Water</b>			
Removal of surface water features <sup>1</sup>	Direct effects to surface water features from mining would vary by study area. It is estimated that the occurrence of streams within future mining areas would range from a high of approximately 56 miles of perennial streams and 187 miles of intermittent streams potentially in Study Area 2 to a low of approximately 0.3 mile of perennial streams and 81 miles of intermittent streams in Study Area 6. A currently unquantifiable portion of these 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.	Same as the Proposed Action.	<ul style="list-style-type: none"> <li>• No <b>additional</b> monitoring or <b>mitigation</b> beyond that <b>currently</b> required by <b>the USACE Fort Worth District and other</b> jurisdictional agencies is recommended for surface water.</li> </ul>

**Table 2-10 Summary of Direct and Indirect Impacts by Resource or Impact Issue and Recommended Monitoring and Mitigation**

Resource/Impact Issue	Proposed Action Alternative	No Action Alternative	Recommended Monitoring and Mitigation Measures
Flow effects from watershed modifications	Changes to flow patterns and increased storm water runoff from bare ground may alter stream flows. Compliance with federal and state regulations would minimize flow increases from disturbed areas.	Same as the Proposed Action.	
Surface water quality	<p>Surface water runoff from disturbed areas would contain increased turbidity and possibly higher concentrations of salinity and other contaminants. These adverse impacts to would be largely confined to the future mine permit areas. Impacts would be minimized through compliance with RCT and USACE Fort Worth District permit requirements.</p> <p>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 analysis of overburden and underburden through appropriate acid-base accounting or other assessments. Selective handling plans and follow-up testing would be developed and implemented to ensure that acid- or toxic-forming material are not placed in the upper 4 feet of the backfill profile.</p>	Generally similar to the Proposed Action. Restrictions on impacts would not be applied for smaller mine expansion areas and satellite mines (0.5 to 10 acres), which could allow greater surface water-related impacts in some areas. The resource benefits from concentrating regulatory efforts and specific mitigation on future mine expansion areas or satellite mines with greater potential for surface water impacts would not occur.	
<b>Waters of the U.S., including wetlands</b>			
Impacts to waters of the U.S., including wetlands <sup>2</sup>	Assuming that the acreage of waters of the U.S., including wetlands, projected to be impacted by future mining would be proportional to the size of the study area and the projected acreage that would be mined in each area, most of the wetlands projected to be impacted would be palustrine because this type covers the largest acreage within the study areas. It is estimated that the acreage of wetlands projected to be impacted would range from approximately 3,655 acres in Study Area 2 to 110 acres in Study Area 5.	Same as the Proposed Action.	<ul style="list-style-type: none"> <li>No additional monitoring or mitigation beyond that currently required by the USACE Fort Worth District is recommended.</li> </ul>

**Table 2-10 Summary of Direct and Indirect Impacts by Resource or Impact Issue and Recommended Monitoring and Mitigation**

Resource/Impact Issue	Proposed Action Alternative	No Action Alternative	Recommended Monitoring and Mitigation Measures
<b>Soils and Reclamation</b>			
Impacts to soil resources	Direct incremental disturbance of soil resources may cause associated increased erosion, alteration of soil structure, and reduction in soil productivity. Implementation of erosion control measures, soil and suitable growth media salvage, and a mine-specific reclamation plan would minimize the impacts. The projected acreage of soils anticipated to be affected equates to the amount of surface disturbance projected in each study area (see <b>Table 2-3</b> ).	Same as the Proposed Action.	<ul style="list-style-type: none"> <li>• Rough and final grading should occur when the soils are dry to minimize soil compaction during reclamation.</li> <li>• Compacted surface or subsurface soils should be treated for compaction by deep ripping or subsoiling, prior to revegetation efforts.</li> </ul>
<b>Vegetation (including special status species)</b>			
Impacts to vegetation	Up to 158,600 acres of vegetation or approximately 3.6 percent of the 4,376,100 acres within all study areas is projected to be disturbed by future mining, ranging from 1.5 percent of the acreage in Study Area 1 to 10.0 percent in Study Area 6. There would be a long-term loss of woody species and short-term loss of herbaceous species following reclamation. Implementation of compensatory mitigation plans would minimize impacts to vegetation in each study area.	Same as the Proposed Action.	<ul style="list-style-type: none"> <li>• Conduct special status plant species surveys in areas of potentially suitable habitat prior to ground-disturbing activities is recommended.</li> <li>• Development of appropriate mitigation and monitoring in coordination with USFWS and TPWD, as applicable, to minimize impacts to identified special status plant species is recommended.</li> </ul>
Establishment of noxious weeds or invasive plants	Surface disturbance from future mining would increase the potential for the spread and establishment of noxious weeds or invasive plant species,	Same as the Proposed Action.	<ul style="list-style-type: none"> <li>• Where possible, surface disturbance should be at least 100 feet from any non-jurisdictional wetland or riparian area, with a vegetation buffer maintained.</li> </ul>
Impacts to special status plant species (i.e., species afforded protection under federal and state laws)	Surface disturbance in Study Areas 2, 3, 4, and 6 may affect populations or habitat for the six federal or state listed plant species, but adverse impacts would be minimized through consultation with USFWS under the ESA and compliance with state laws and regulations.	Same as the Proposed Action.	<ul style="list-style-type: none"> <li>• Prior to ground disturbance, select plant species (e.g., pitcher-plant) may be relocated to suitable habitat in coordination with the appropriate jurisdictional agency.</li> </ul>

**Table 2-10 Summary of Direct and Indirect Impacts by Resource or Impact Issue and Recommended Monitoring and Mitigation**

Resource/Impact Issue	Proposed Action Alternative	No Action Alternative	Recommended Monitoring and Mitigation Measures
<b>Fish and Wildlife Resources (including special status species)</b>			
<b>Terrestrial Wildlife</b>			
Loss or alteration of terrestrial habitats	Direct impacts would include habitat loss and alteration, habitat fragmentation, wildlife displacement, and wildlife mortality. Indirect impacts would include effects related to increased noise, light, and human presence. Long-term impacts would 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 habitats would be altered for a long time period, particularly woody-species dominated habitats. Larger species displaced during mining would return following reclamation as long as suitable habitat is re-established. The regional carrying capacity for birds may be reduced by the incremental loss of available nest and roost sites depending on the species affected and the site-specific conditions.	Same as the Proposed Action.	<ul style="list-style-type: none"> <li>• 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.</li> <li>• 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.</li> <li>• 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.</li> <li>• For the protection of wildlife and special status species, dark-sky lighting should be installed that is fully shielded.</li> </ul>
Changes in wetland and riparian habitat	Resident and migratory bird species and reptiles would be affected by an incremental reduction in available habitat where directly removed or where impacted by mine-related groundwater drawdown. Mine discharges to surface water channels may increase flows downstream and could support additional riparian areas or wetlands that could be used by terrestrial species during active mining operations.	Same as the Proposed Action.	
Effects on special status wildlife species populations and habitat (i.e., species afforded protection under federal and state laws)	Potential impacts to special status species including 14 bird species, 4 mammal species, and 7 reptile species are anticipated to be minor as long as field surveys and mitigation or avoidance measures are completed in advance of ground-disturbing activities. Potential types of impacts would parallel those described above for general wildlife species.	Same as the Proposed Action.	

**Table 2-10 Summary of Direct and Indirect Impacts by Resource or Impact Issue and Recommended Monitoring and Mitigation**

Resource/Impact Issue	Proposed Action Alternative	No Action Alternative	Recommended Monitoring and Mitigation Measures
<b>Fisheries and Other Aquatic Biological Resources</b>			
Loss or alteration of aquatic habitat	<p>Surface disturbance of streams that are ecologically important to fisheries and aquatic habitat is expected to occur during mine-related activities. Compliance with state and federal permit requirements would minimize long-term impacts, but disturbance of habitat would occur where streams cannot be avoided by surface mining operations. The impacts would vary by study area, based on the projected maximum acreage of surface disturbance and the amount of perennial streams.</p> <p>Flow reductions resulting from mine-related groundwater drawdown and stream flow increases due to mine water discharge may alter aquatic habitat near active mines.</p>	Same as the Proposed Action.	<ul style="list-style-type: none"> <li>• If direct disturbance occurs in a waterbody with invasive aquatic species, all vehicles and equipment would be cleaned and dried prior to working in adjacent drainages.</li> <li>• Avoid important spawning or nursery areas for special status fish species.</li> <li>• Where there is potential habitat, conduct special status mussel species surveys within the proposed disturbance areas. Relocate to similar habitat if disturbance cannot be avoided.</li> </ul>
Effects of water quality changes	<p>Surface water quality may be affected due to surface disturbance within or near waterbodies that may increase sedimentation and turbidity. Off site impacts on aquatic habitat from mining operations would be minimized through compliance with federal and state permit requirements, such as erosion controls and storm water management.</p>	Same as the Proposed Action.	<ul style="list-style-type: none"> <li>• Avoid mining-related construction and operations in designated critical habitat for Houston toad in Study Area 4.</li> </ul>
Effects on special status aquatic species and habitat (i.e., species afforded protection under federal and state laws)	<p>Changes in water flow and quality and the disturbance of perennial streams, contributing drainages, and upstream watersheds may result in adverse impacts to habitat important to listed species. Impacts would vary depending on the location of future mine expansion areas or satellite mines in relation to the rivers and perennial streams containing habitat for federal and state listed species.</p>	Same as the Proposed Action.	

**Table 2-10 Summary of Direct and Indirect Impacts by Resource or Impact Issue and Recommended Monitoring and Mitigation**

Resource/Impact Issue	Proposed Action Alternative	No Action Alternative	Recommended Monitoring and Mitigation Measures
<b>Cultural Resources</b>			
Direct impacts to cultural resources	Historic properties representing numerous cultures, both historic and prehistoric, occur in each study area. Mining-related disturbance would alter archaeological stratigraphy that provides context for buried historic properties, if present. Surface disturbance may modify cultural landscapes, and historic structures and buried archaeological sites may be adversely affected by earth-moving and vibrations from mining activities. Adverse impacts to NRHP-eligible sites would be minimized through survey and documentation in advance of surface disturbance and avoidance or mitigation as determined by the USACE Fort Worth District and THC.	Same as the Proposed Action.	<ul style="list-style-type: none"> <li>• Monitoring of mine-related construction activities (i.e., new surface disturbance) conducted by knowledgeable professionals to avoid recorded NRHP-eligible or state protected cultural resources and minimize damage to previously unknown sites.</li> <li>• Each mining company would educate on site mine personnel as to the sensitive and confidential nature of cultural resources and implement a strict policy against illegal collection.</li> </ul>
Potential impacts to previously undiscovered significant sites	Previously unidentified sites could be discovered during construction and operations. Implementation of committed measures to protect a site until it can be evaluated by the THC potentially would minimize impacts.	Same as the Proposed Action.	
Potential indirect impacts to cultural resources	Potential indirect impacts to NRHP-eligible sites within and outside a mine area may result from increased runoff or water discharge. Implementation of surface water controls and erosion control measures would minimize these effects. Other possible indirect adverse impacts would include illegal collection, inadvertent damage, and vandalism associated with increased access and human presence.	Same as the Proposed Action.	

**Table 2-10 Summary of Direct and Indirect Impacts by Resource or Impact Issue and Recommended Monitoring and Mitigation**

Resource/Impact Issue	Proposed Action Alternative	No Action Alternative	Recommended Monitoring and Mitigation Measures
<b>Air Quality</b>			
Potential exceedence of ambient air quality standards	There would be temporary air quality impacts due to increases in local fugitive dust levels. Concentrations of criteria pollutants generated from mining-related activities would not exceed National Ambient Air Quality Standards (NAAQS).	Same as the Proposed Action.	<ul style="list-style-type: none"> <li>No additional monitoring or mitigation measures are recommended.</li> </ul>
Greenhouse gas emissions	Potential contribution to manmade global climate effects would be immeasurably small.	Same as the Proposed Action.	
<b>Land Use and Recreation</b>			
Impacts to urban growth	Development of future mine expansion areas or satellite mines could delay adjacent urban growth until areas are mined and successfully reclaimed, depending on the proposed location of a future mine area in relation to urban areas.	Same as the Proposed Action.	<ul style="list-style-type: none"> <li>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.</li> </ul>
Impacts to agricultural uses	Agricultural uses would not be available in mine-related disturbance areas until reclamation is completed.	Same as the Proposed Action.	
Impacts to industrial uses	The primary industrial land use in the study areas is oil and gas development. Access to new oil and gas resources may be restricted during active mining. Gathering lines, access roads, and other facilities and associated infrastructure may need to be relocated to allow for mining operations.	Same as the Proposed Action.	



**Table 2-10 Summary of Direct and Indirect Impacts by Resource or Impact Issue and Recommended Monitoring and Mitigation**

Resource/Impact Issue	Proposed Action Alternative	No Action Alternative	Recommended Monitoring and Mitigation Measures
Impacts to availability of dispersed recreational uses	Potential future mining locations temporarily would be inaccessible while mining operations progress through an area and reclamation is completed. Mine construction and operation could disturb recreationists on lands outside of the mine area. Potential impacts would be related to mine-related noise and ground vibrations, fugitive dust emissions, increased human presence, and the visual intrusion of mine equipment and components where solitude and remote experiences are desired. Mining operations may cause game and aquatic species to relocate, changing the experience for hunters and fishers in some areas.	Same as the Proposed Action.	
<b>Social and Economic Values</b>			
Population and housing changes	No measureable effects to population are anticipated.	Same as the Proposed Action.	No monitoring or mitigation measures are recommended.
Employment and income change	No substantial changes to employment or income patterns are anticipated, with the possible exception of a beneficial impact on the high unemployment rate in Study Area 6. There may be a minor shift in income and employment from one county to another within each study area depending on future mine locations. There would be a temporary increase of contract construction workers at the start of mine development.	Same as the Proposed Action.	
Changes to local public finances	Little or no change in public finance is anticipated. Future mine expansion areas and satellite mines would extend the taxable revenue for a longer time period and may move into and out of taxing jurisdictions.	Same as the Proposed Action.	
Impacts on public education	Little or no change in tax payments to schools would result.	Same as the Proposed Action.	

**Table 2-10 Summary of Direct and Indirect Impacts by Resource or Impact Issue and Recommended Monitoring and Mitigation**

Resource/Impact Issue	Proposed Action Alternative	No Action Alternative	Recommended Monitoring and Mitigation Measures
Impacts on residences	Potential future surface coal and lignite mine expansion areas and satellite mines may result in resident displacement, depending on the location of mining operations. Displacement would continue for the life of the disturbance and reclamation.	Same as the Proposed Action.	
<b>Transportation</b>			
Changes to roadways	Limited to no increase in traffic would be anticipated, with the possible exception of temporary increases during mine construction. Mine-related traffic may use different public roadways depending on the location of future mine expansion areas or satellite mines in relation to existing operations. No change in level of service (LOS) on affected roadways is anticipated.	Same as the Proposed Action.	No monitoring or mitigation measures are recommended.
Road closures	Short-term delays may occur where roads are temporarily affected by bridge or overpass construction to accommodate mining. County and local roads within future mine disturbance areas would be closed incrementally by the jurisdictional agency in advance of mine operations; alternate public and landowner access routes would be provided prior to road closures.	Same as the Proposed Action.	
Changes to railroads	Effects on rail transportation would be expected to be minimal.	Same as the Proposed Action.	

**Table 2-10 Summary of Direct and Indirect Impacts by Resource or Impact Issue and Recommended Monitoring and Mitigation**

Resource/Impact Issue	Proposed Action Alternative	No Action Alternative	Recommended Monitoring and Mitigation Measures
<b>Noise</b>			
Change in ambient noise levels	Mining-related noise levels would be temporary and transitory. Impacts at any specific location would depend on the distance between mining activities and sensitive receptors, the intervening terrain, and the in-pit operating depth of the equipment.	Same as the Proposed Action.	<ul style="list-style-type: none"> <li>• Noise generation in the vicinity of sensitive receptors should be minimized by restricting the simultaneous operation of noise producing equipment.</li> <li>• All motorized equipment should be fitted with properly functioning mufflers.</li> <li>• Mine planning should include berms and other noise barriers when operating at or near the surface in the vicinity of sensitive receptors.</li> </ul>
<b>Visual Resources</b>			
Effects to visual landscape	<p>Existing landscape character would be changed from the time of initial clearing until reclamation is successfully completed. The extent of the impact would vary depending on how visible the mining operations are, as determined by the terrain, height and type of vegetation, and location of sensitive viewers.</p> <p>Although 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.</p>	Same as the Proposed Action.	<ul style="list-style-type: none"> <li>• Visual screening should be employed near the permit boundary where there are nearby potentially sensitive public viewpoints. Existing vegetation should be preserved and augmented and groves of trees should be retained where possible to provide visual buffers.</li> </ul>

**Table 2-10 Summary of Direct and Indirect Impacts by Resource or Impact Issue and Recommended Monitoring and Mitigation**

Resource/Impact Issue	Proposed Action Alternative	No Action Alternative	Recommended Monitoring and Mitigation Measures
<b>Hazardous Materials and Solid Waste</b>			
Hazardous materials transport and usage	No general increase in hazardous materials transport or usage; duration of hazardous materials transport would be extended up to 30 years, based on the typical life of mine.	Same as the Proposed Action.	<ul style="list-style-type: none"> <li>Develop a protocol for handling contaminated sites to ensure protection of workers and to minimize potential environmental impacts.</li> </ul>
Spill of hazardous materials during transport	Small probability of a spill or release during the life of a mine. The greatest potential impacts would occur if a spill occurred in proximity to a major river. Implementation of SPCC Plan and Emergency Response Plan would minimize potential impacts of an on site spill or release.	Same as the Proposed Action.	
Generation of hazardous and solid wastes	Hazardous and solid wastes would be stored, used, and disposed of in accordance with current regulations.	Same as the Proposed Action.	
<b>Public Health</b>			
Impact to health of local populations	No adverse public health impacts are anticipated due to water quality, air quality, noise, or lighting effects.	Same as the Proposed Action.	No monitoring or mitigation measures are recommended.
<b>Environmental Justice</b>			
Potential disproportionate effects to low-income or minority populations	No disproportionate effects to low income or minority populations are anticipated.	Same as the Proposed Action.	No monitoring or mitigation measures are recommended.

<sup>1</sup> National Hydrography Dataset (NHD) data lump ephemeral streams with intermittent streams.

<sup>2</sup> For purposes of the regional analysis, potential impacts to waters of the U.S. are assumed to be similar to the impacts described above for surface water. Delineations of waters of the U.S. as required for mine-specific Section 404/10 permit applications will be taken into consideration in future mine-specific NEPA analyses at the time they are proposed.

### **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 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).

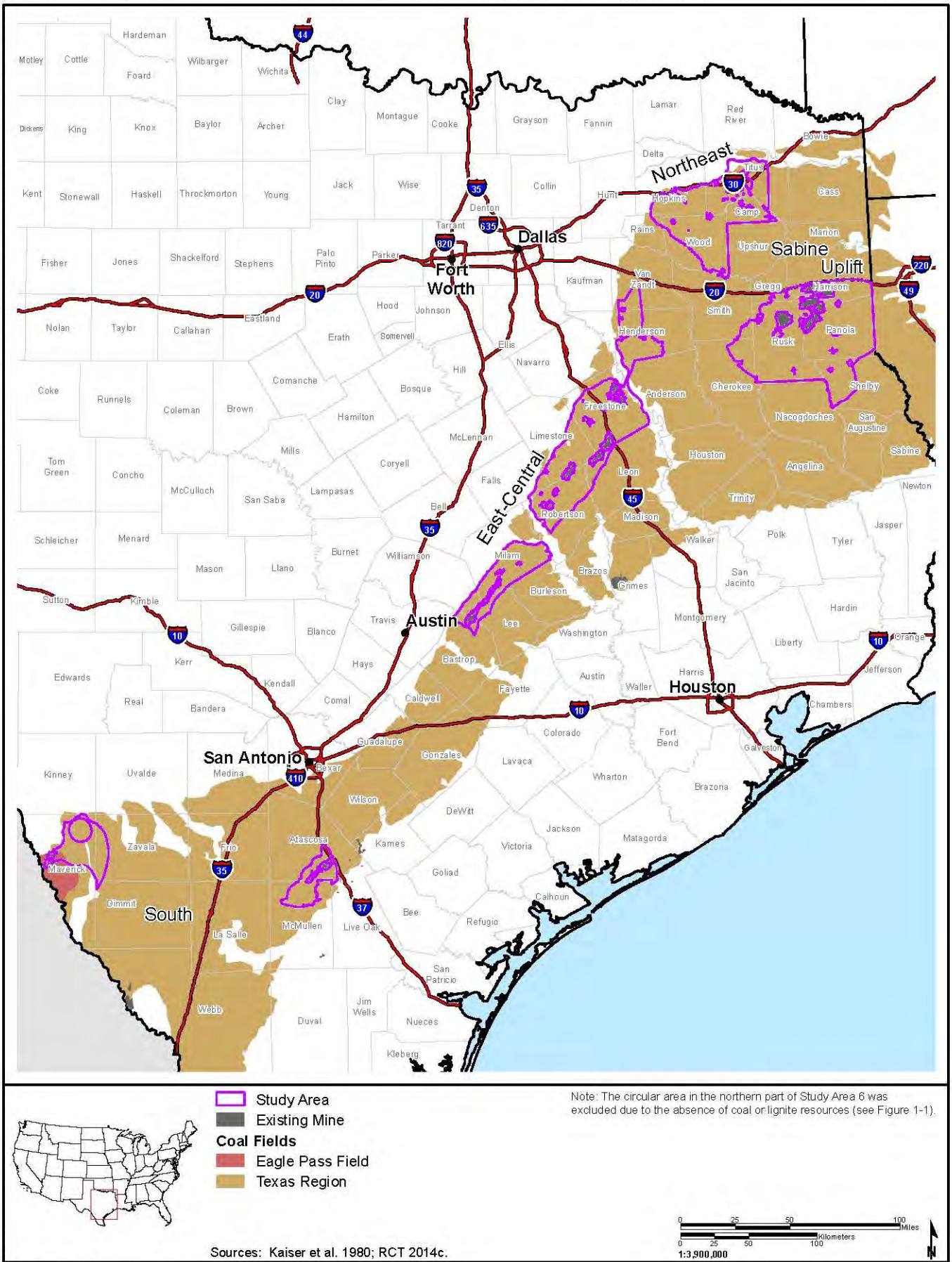
###### Geology

###### *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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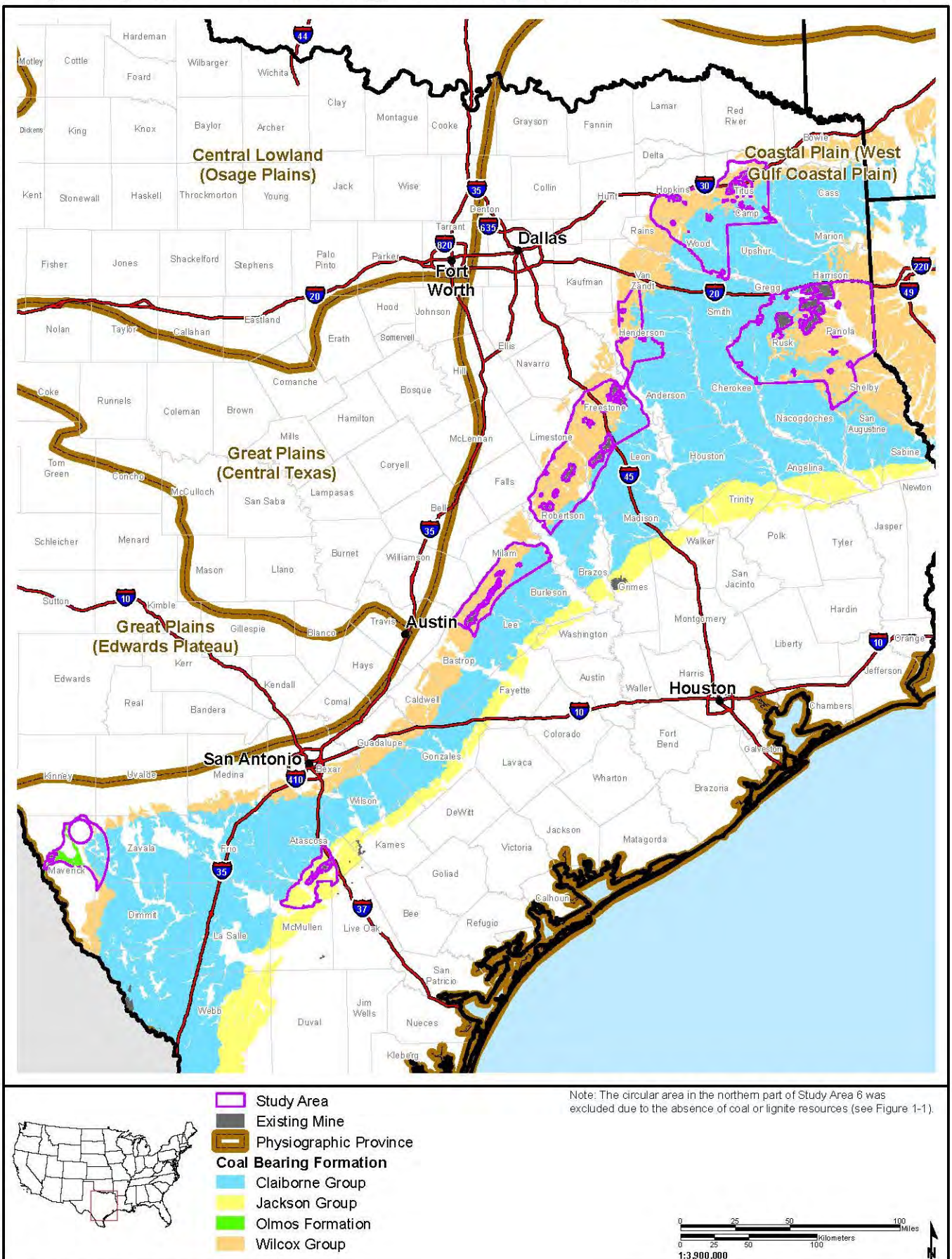


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Figure 3.1-1 Gulf Coast Province in Texas



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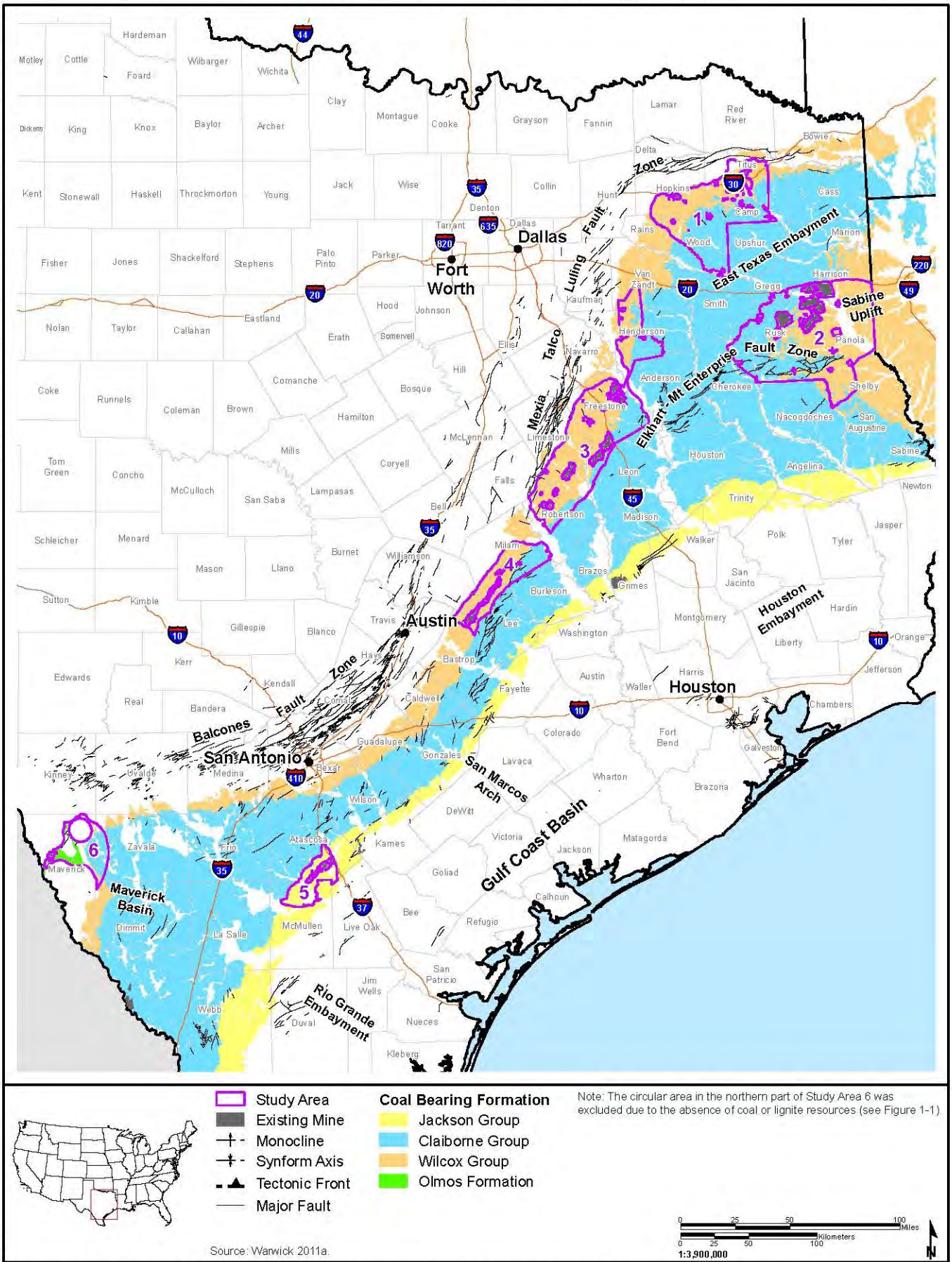
Figure 3.1-2 Physiographic Area

Period	Epoch	Group	Formation
Lower Tertiary	Eocene	Jackson Group	Whitset
			Manning
			Wellborn
			Caddell
		Claiborne Group	Yegua
			Cook Mountain
			Sparta Sand
			Yegua
			Weches
			Queen City
	Paleocene	Wilcox Group	Reklaw
			Carrizo Sand
			Upper Wilcox
	Upper Cretaceous	Midway Group	Navarro Group
Lower Wilcox			
Escondido Formation			
Olmos Formation			

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

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

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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.

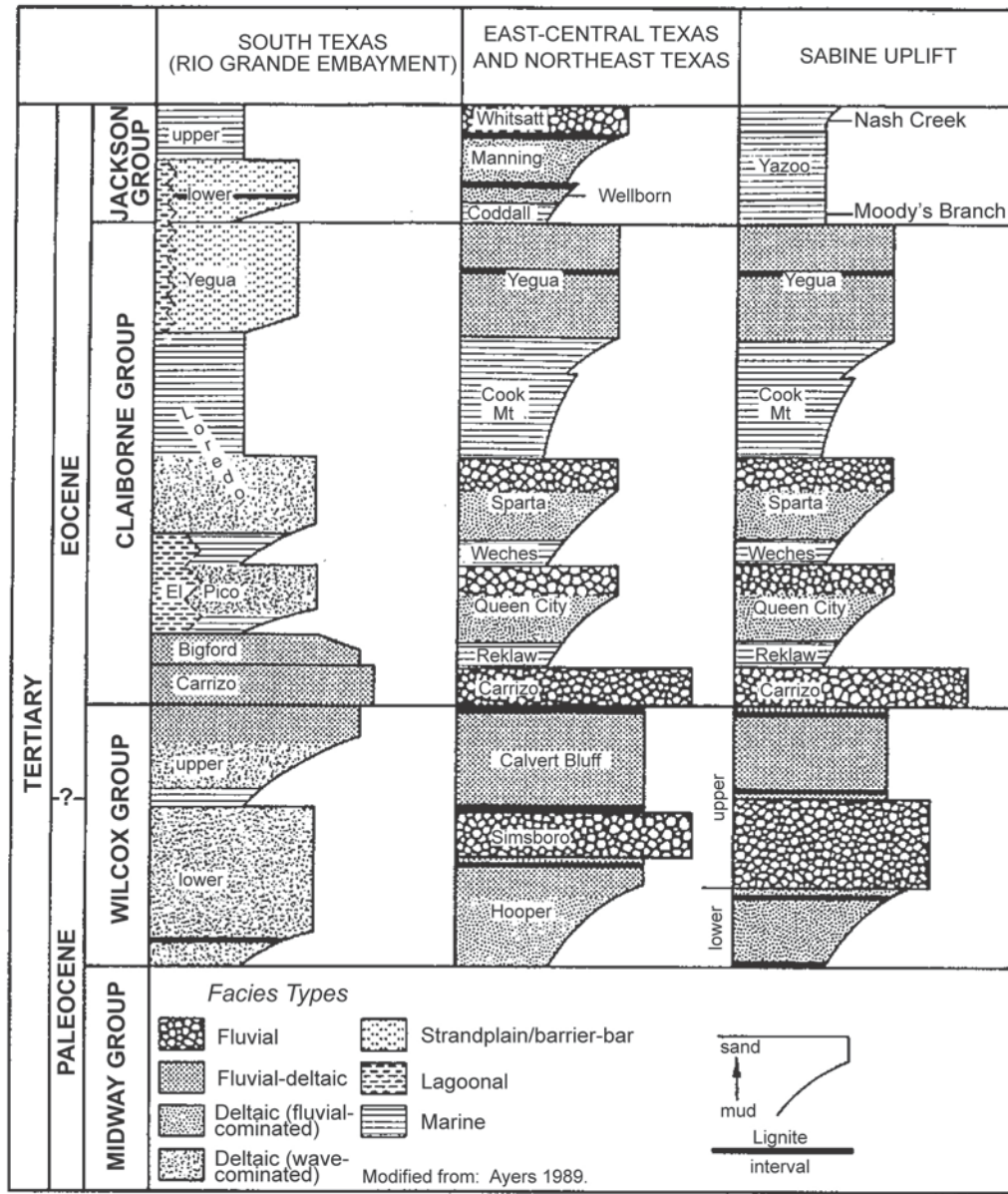
### *Geological Hazards*

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.

### Seismicity

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).



Note: The Wilcox Group formation designations for Central Texas (Calvert Bluff, Simsboro, and Hooper) do not apply to Northeast Texas.

Figure 3.1-5 Texas Coastal Plain Lower Tertiary Outcrop

### Landslides and Subsidence

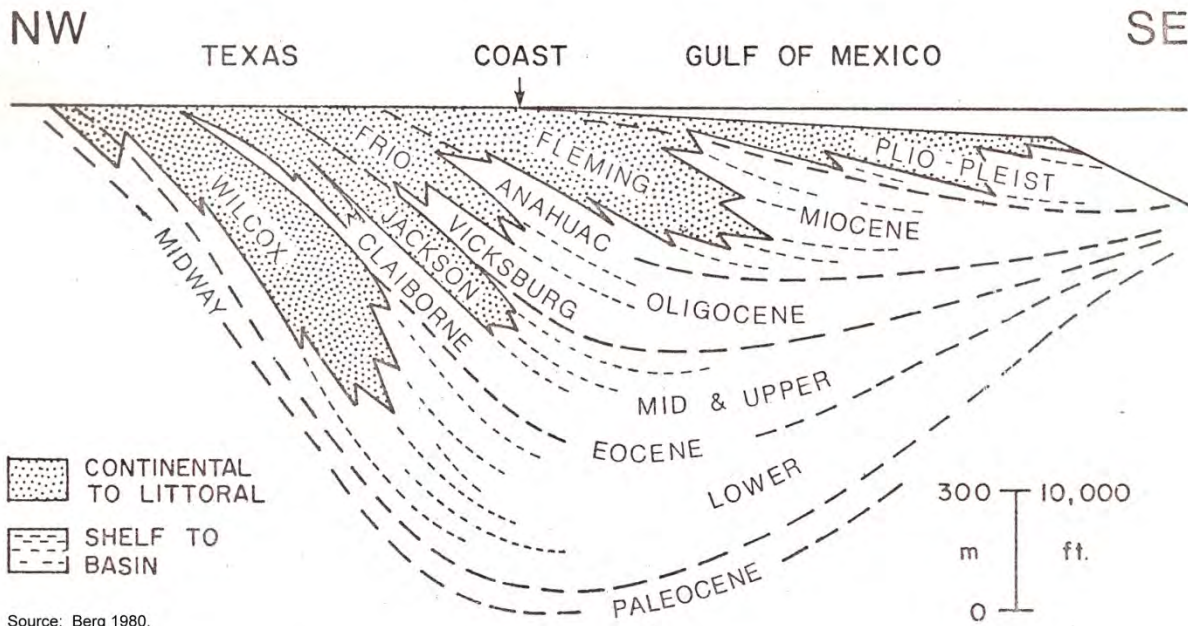
There is a low susceptibility and low potential for landslides in the analysis area based on recent information (National Atlas 2014). Pseudokarst features have been identified in East Texas and occur primarily in the Claiborne Group sediments (Stafford et al. 2013). Pseudokarst occurs when karst features (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 (U.S. Energy Information Administration [EIA] 2014a).

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 2014a). 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.

#### Paleontological Resources

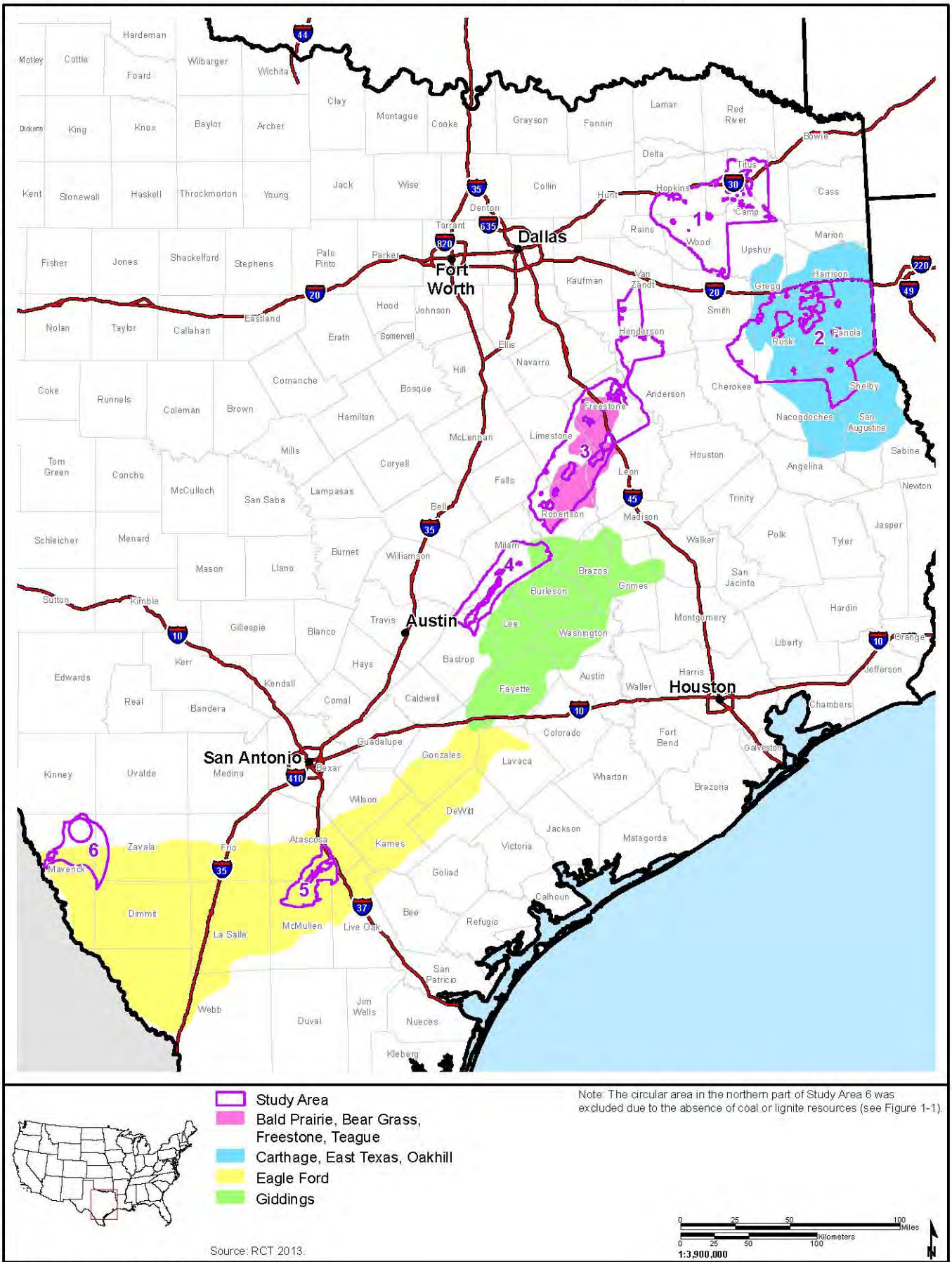
The geologic units in the Texas coal region which are discussed above under the Geology subheading have the potential to contain fossils to varying degrees. There is no regulatory fossil evaluation system for assessing fossil potential in Texas. On federal lands, the Potential Fossil Yield Classification (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.



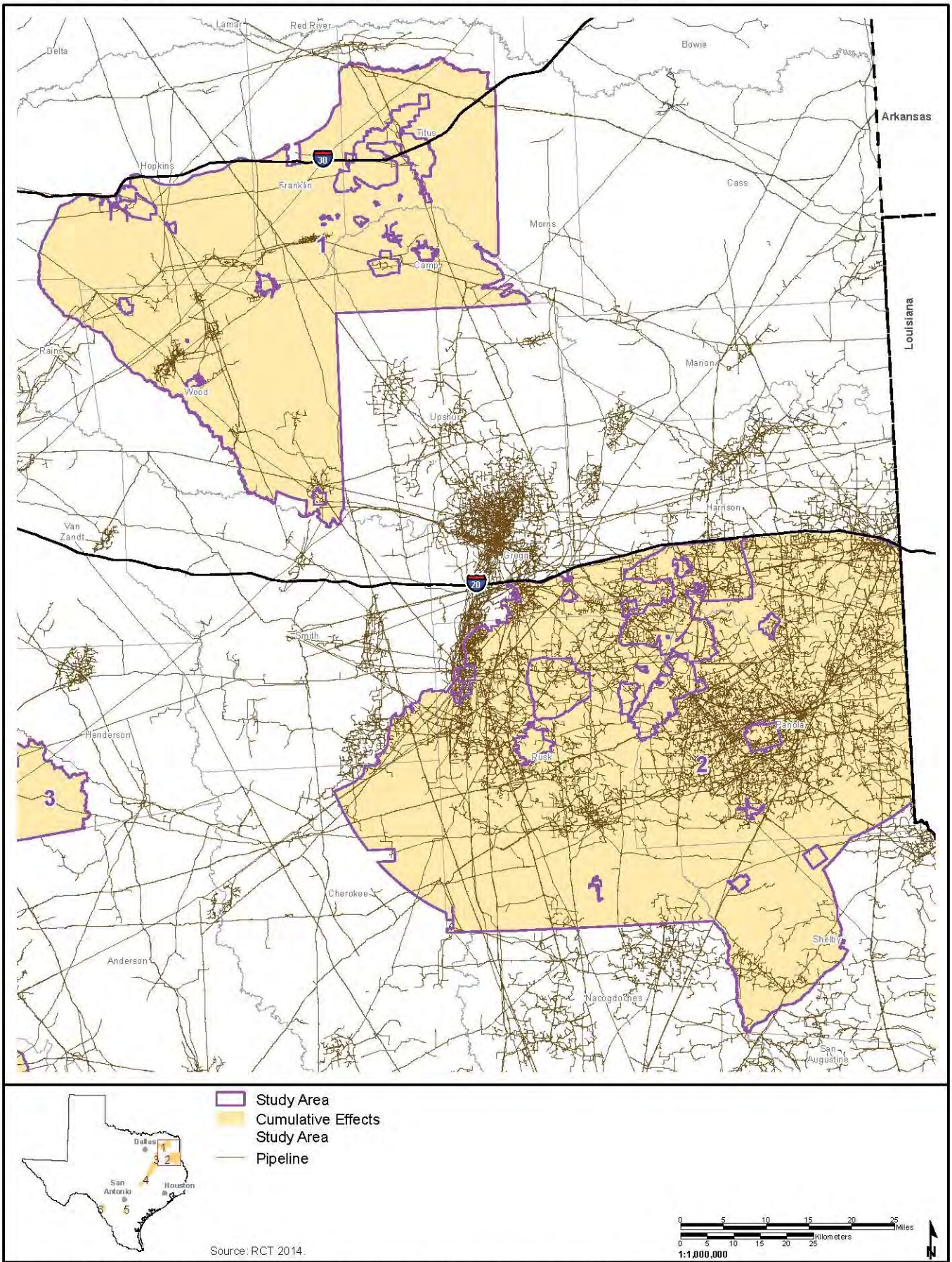
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Figure 3.1-7 Major Oil and Gas Fields

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Source: RCT 2014.

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

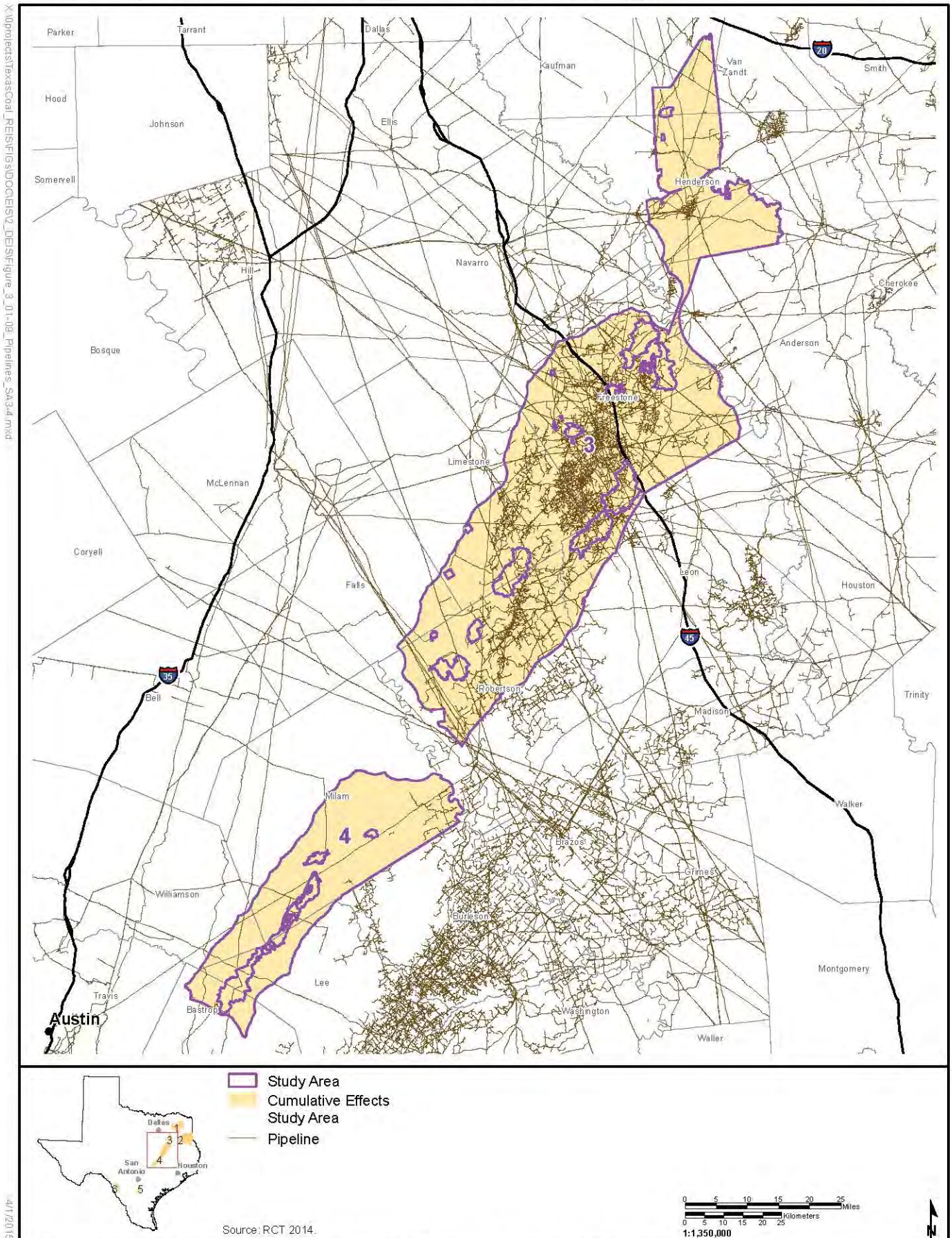


Figure 3.1-9 Oil and Gas Transmission Pipelines in Study Areas 3 and 4

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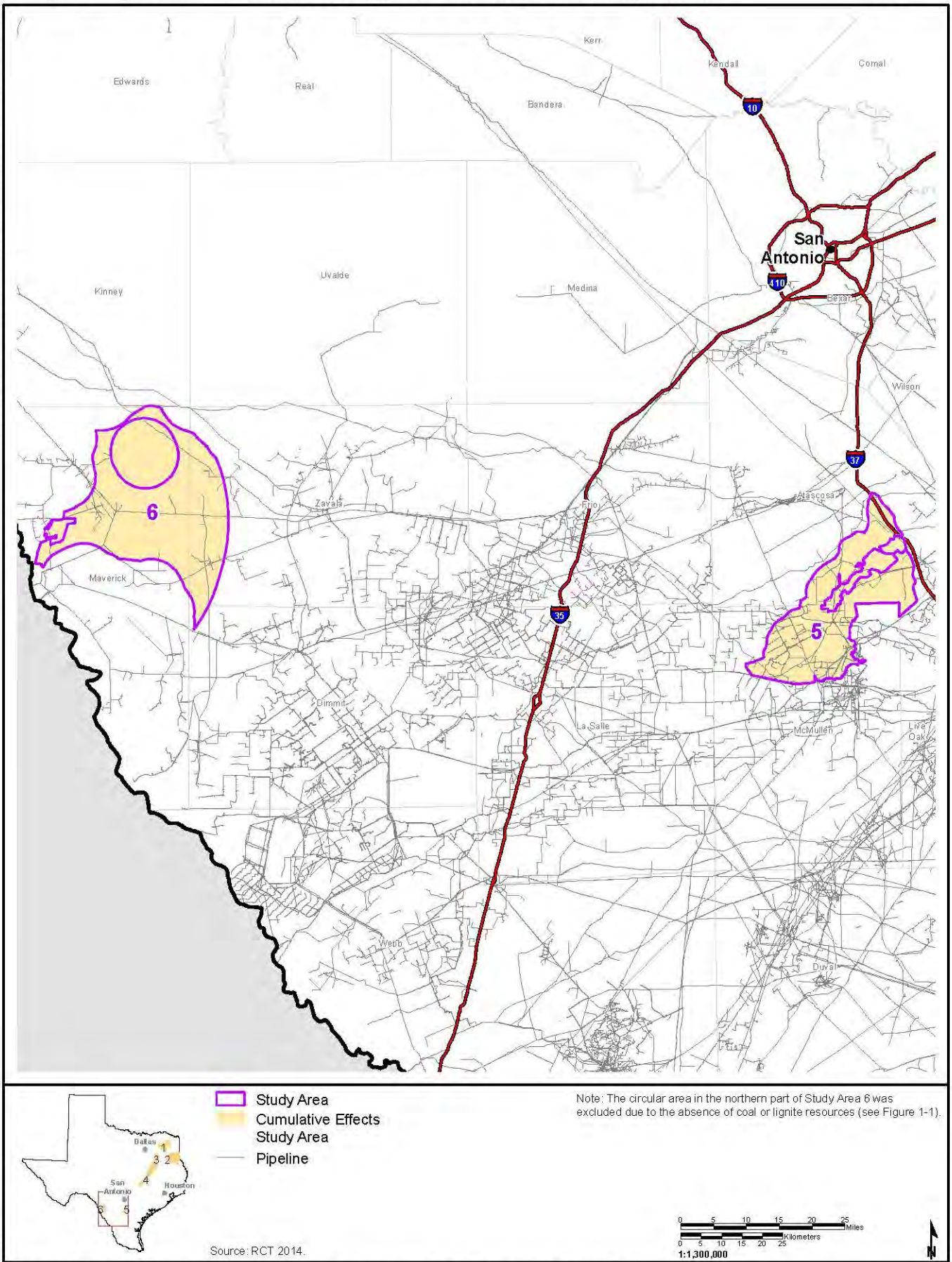


Figure 3.1-10 Oil and Gas Transmission Pipelines in Study Areas 5 and 6

## 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 (Sandeem 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 20<sup>th</sup> 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 2014a).

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 2014a; 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.

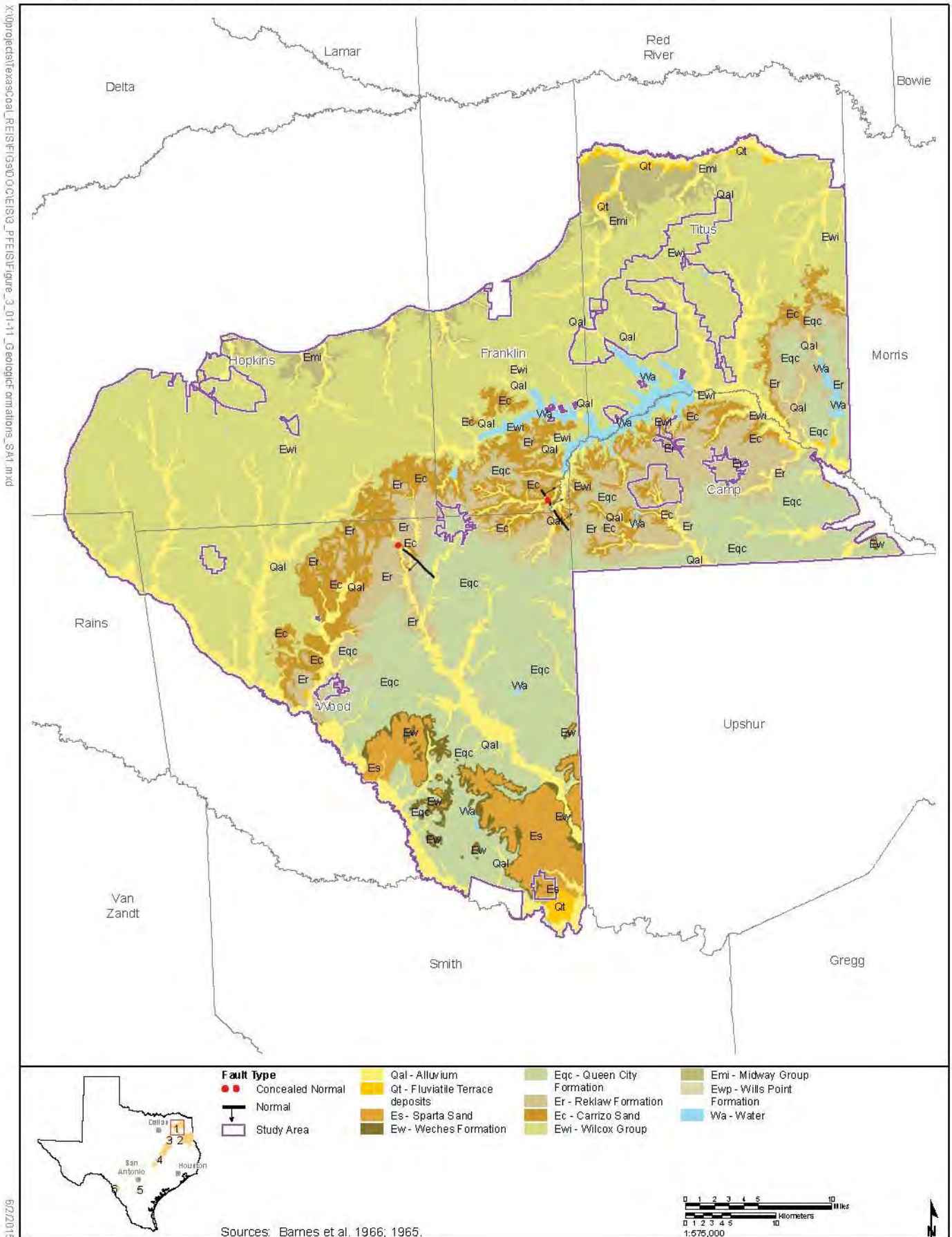


Figure 3.1-11 Surface Geology of Study Area 1

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### *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 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.

### Sabine Uplift Coal Zone—Study Area 2

#### *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*

##### Coal

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 2014a).

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.

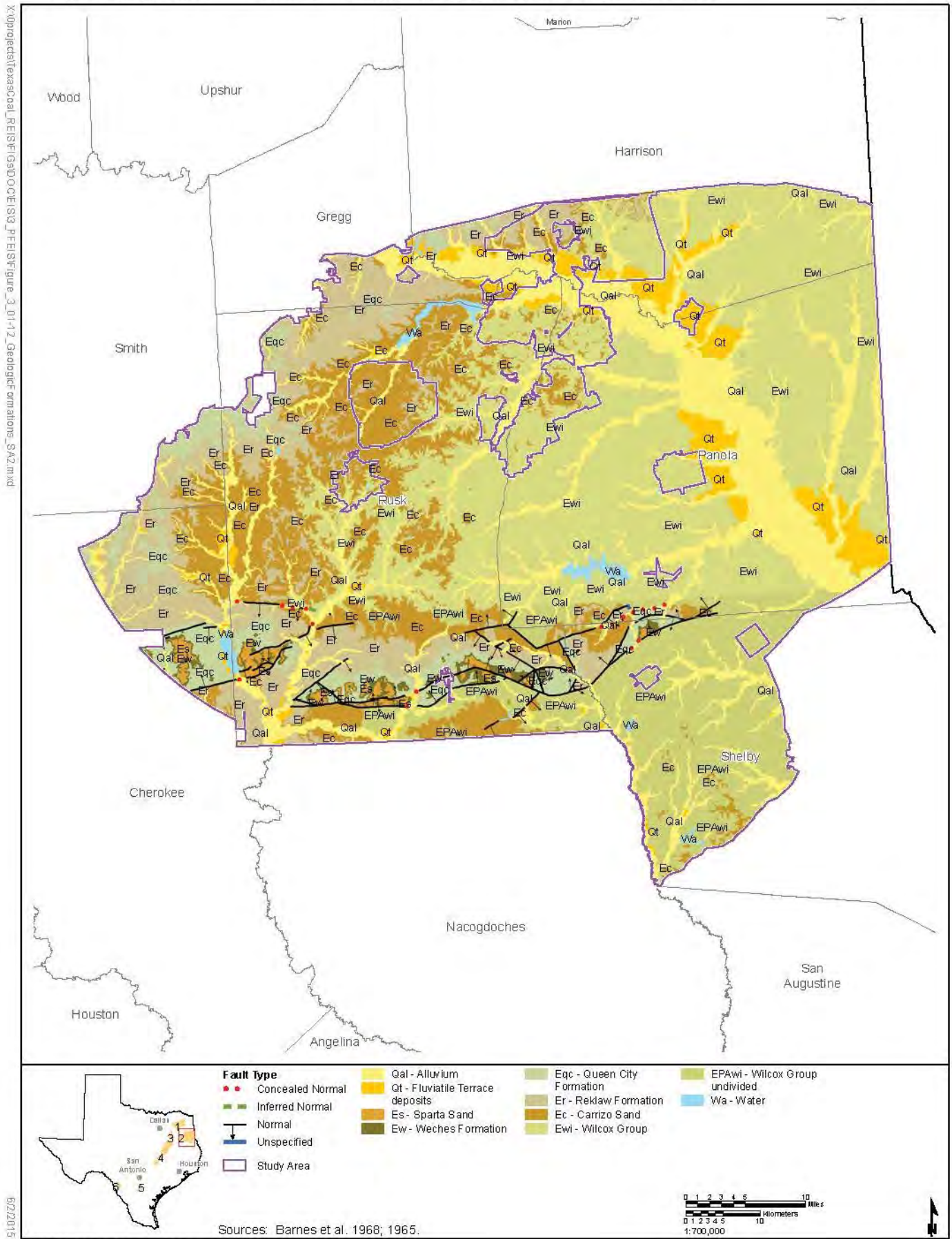


Figure 3.1-12 Surface Geology of Study Area 2

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### 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 2014a). 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 2014a). 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 east central Texas, six of which produced 24.5 million tons in 2012 (EIA 2014a).

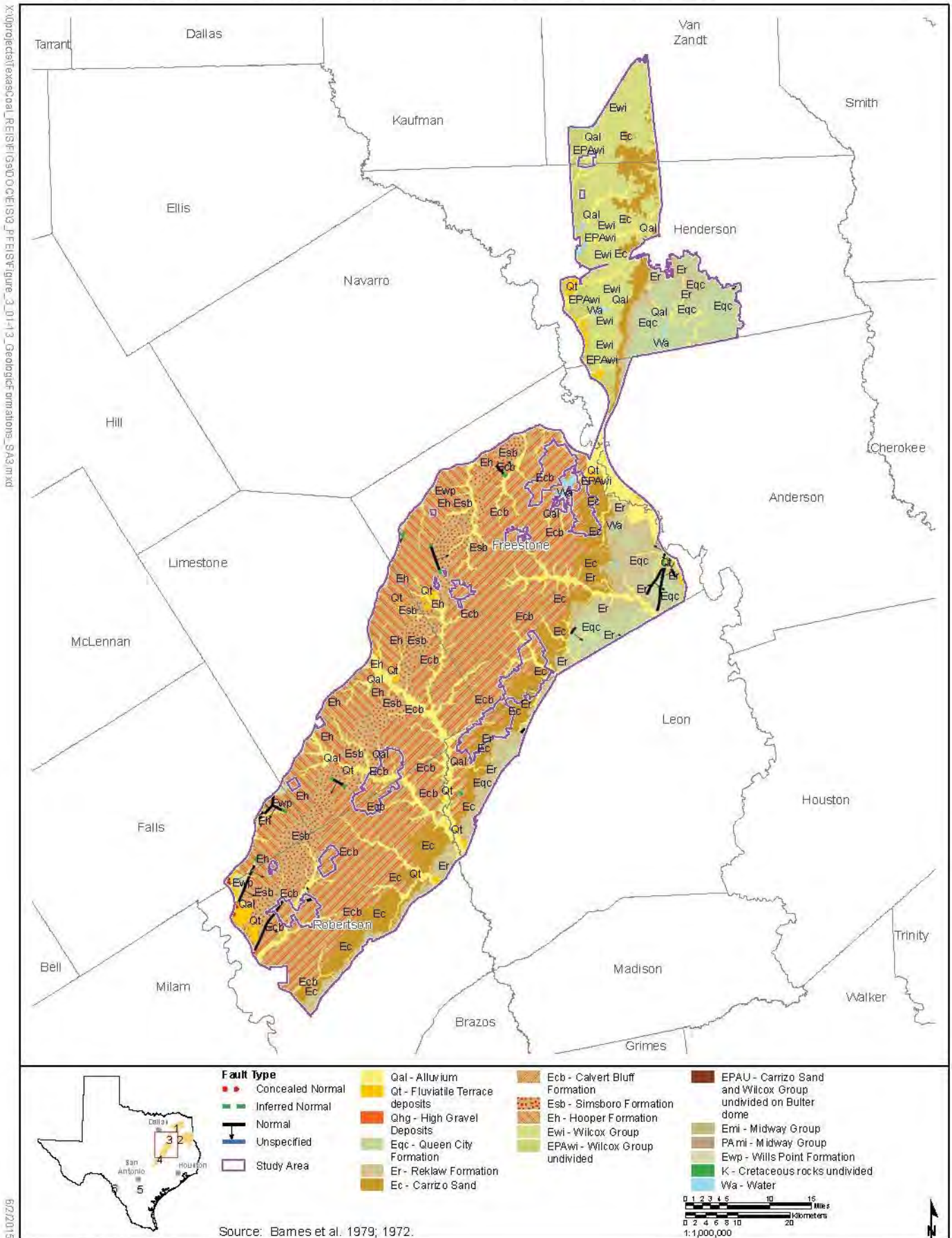


Figure 3.1-13 Surface Geology of Study Area 3

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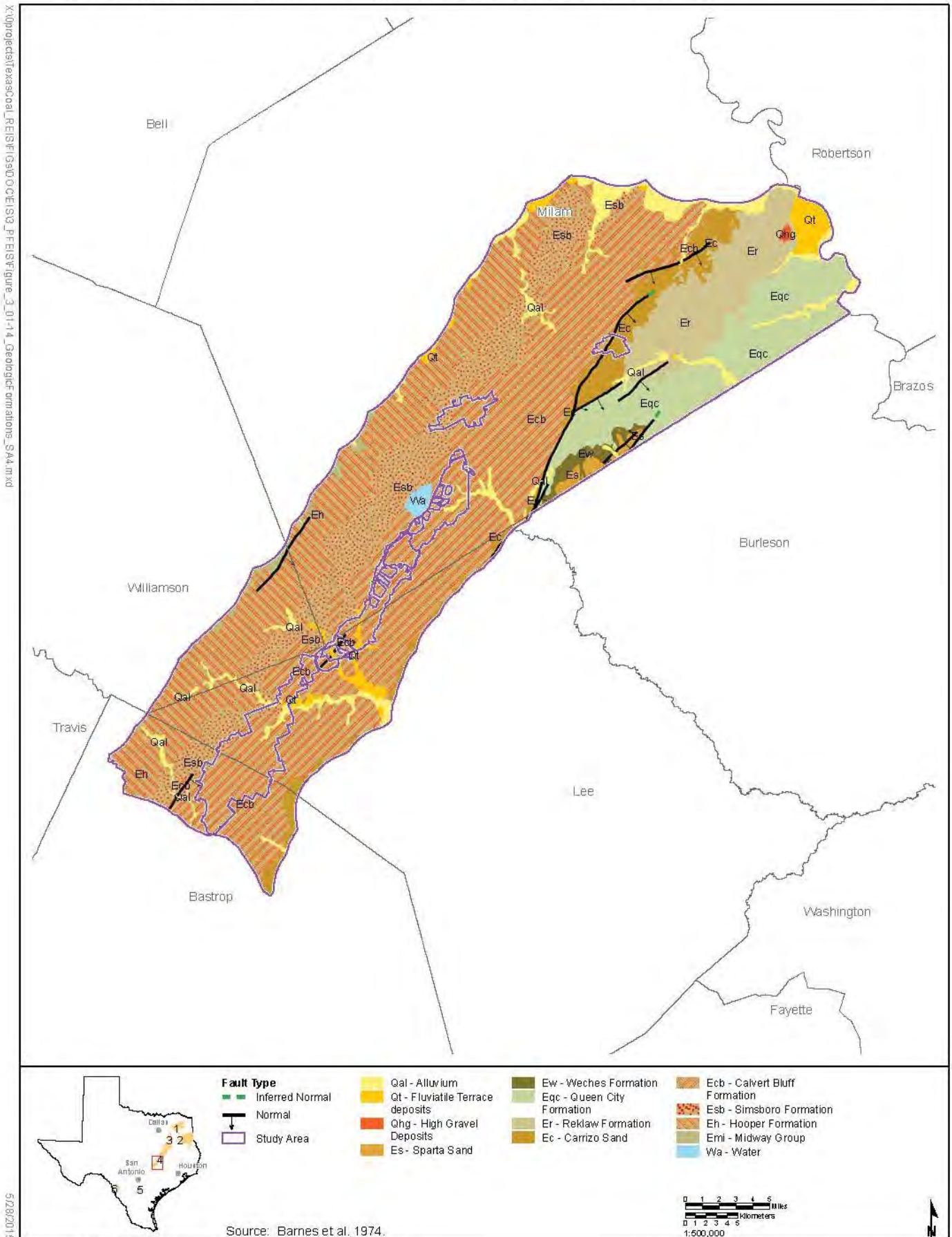


Figure 3.1-14 Surface Geology of Study Area 4

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*

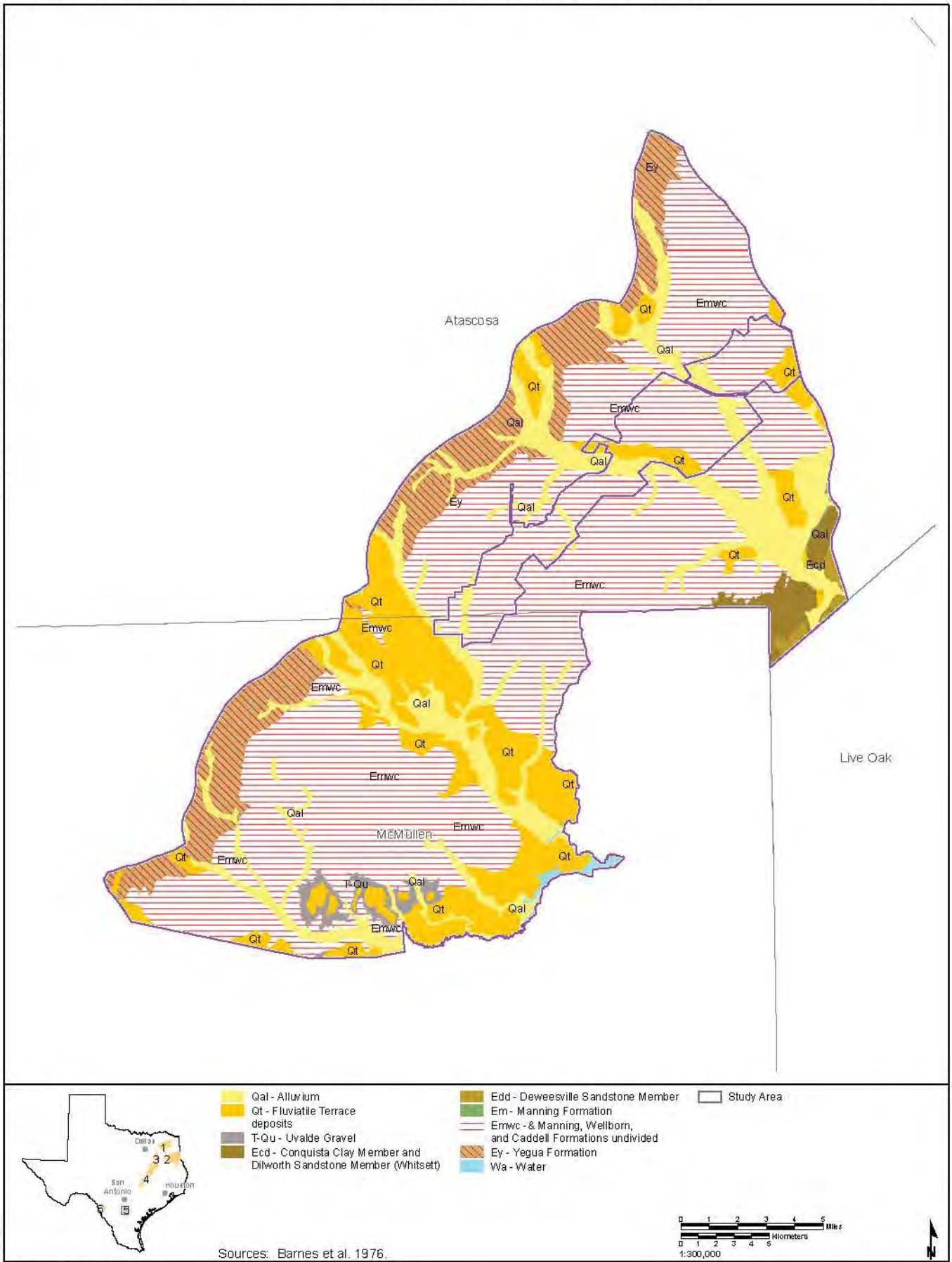
The geologic units of interest for this analysis are the formations in the Jackson Group. These are late Eocene sediments that were deposited in depositional environments interpreted to be shoreline and marginal marine that were derived from fluvial-deltaic, barrier bar, lagoon, and coastal muds (Ayers 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 Whitsett 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<sup>th</sup> 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 2014a).

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Sources: Barnes et al. 1976.

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 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 1,300 feet down-dip from the outcrop. The Olmos Formation has not been studied extensively in the

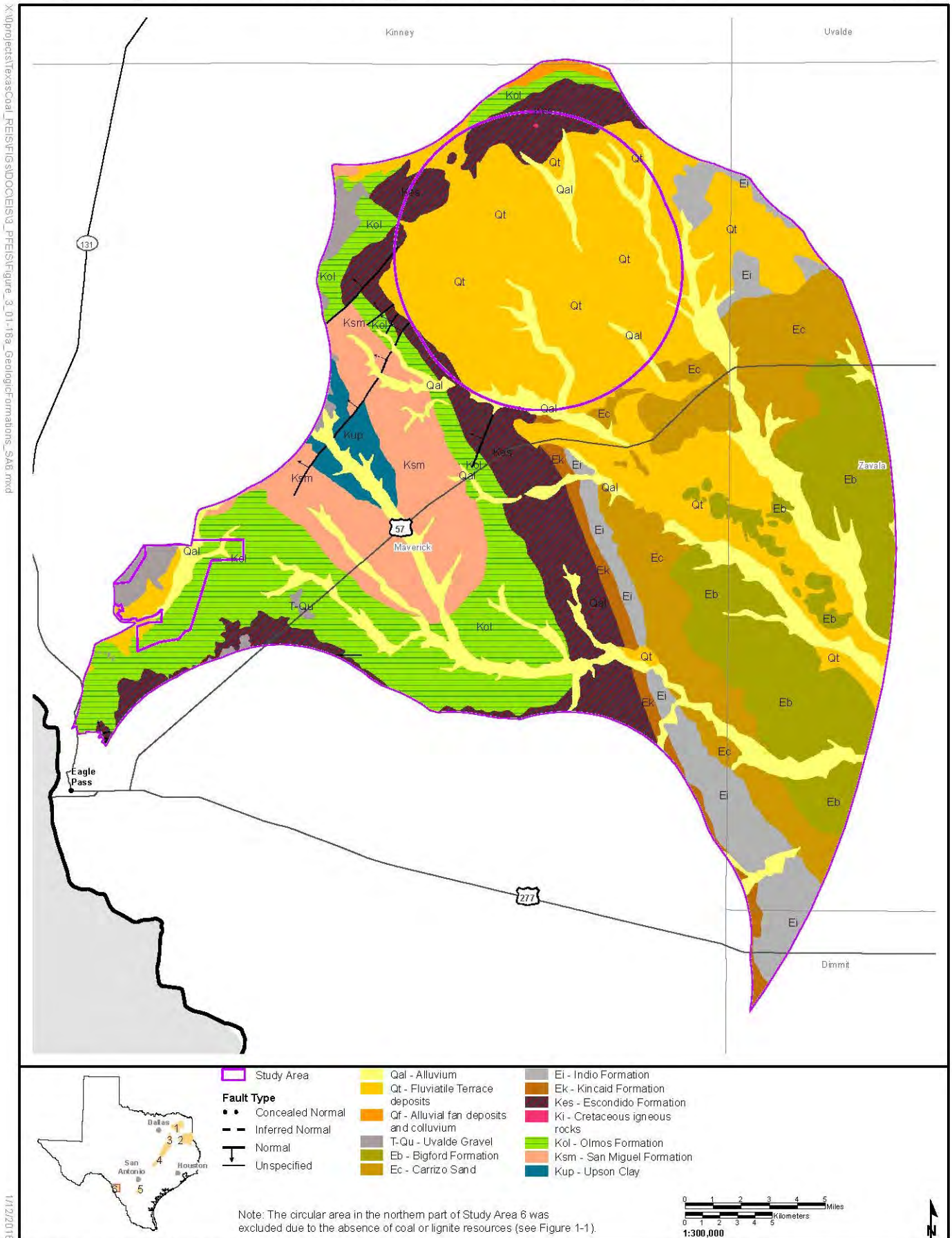


Figure 3.1-16 Surface Geology of Study Area 6

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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

Subbituminous 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. **Although a permit to mine was issued in 2000**, surface mining at the Eagle Pass mine **did not commence until 2015**, 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 (Porrás-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 not known 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 are shown in **Table 3.1-1**.

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

<b>Study Area</b>	<b>Disturbed Inside Study Area (acres)</b>	<b>Disturbed Outside Study Area/Inside CESA (acres)</b>	<b>Total CESA Disturbed (acres)</b>
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 **for groundwater** include:

- **Texas Water Code, Chapter 26, groundwater protection and cleanup, administered by TCEQ;**
- **TCEQ programs including Texas Groundwater Protection;**
- **RCT regulations pertaining to protection of groundwater (16 TAC 12.128, 12.146, 12.346, 12.348, and 12.350); and**
- **TWDB TAC 31, Part 10, Chapter 356.**

**Regulations and agency programs to protect surface water 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.

**Because Texas surface water quality standards are integral to the TCEQ Section 401 and TPDES programs, the following clarifications are warranted. Revisions to the “Texas Surface Water Quality Standards” (“Standards”), as codified by rule in the TAC, Title 30, Chapter 307, were adopted by TCEQ Commissioners in mid-February of 2014. The 2014 Standards became effective as a state rule in early March 2014. However, USEPA approval of the 2014 Standards is required for them to be used for federal permitting programs and other CWA purposes. The 2014 Standards revisions and associated documentation were submitted to USEPA for review and approval in late April 2014.**

**As of the end of 2015, the USEPA was still considering major sections in the 2014 Standards revisions and associated documentation. The sections under review include the addition of site-specific standards for evaluating if the Primary Contact Recreation 2 (PCR2) designated use is supported, revisions to §307.4 and §307.7 concerning contact recreation, some revised site-specific criteria in Standards Appendices A and D, and several site-specific recreational uses and criteria for unclassified water bodies in Standards Appendix G. While the USEPA review of the 2014 Standards is underway, the 1997, 2000, and 2010 Standards will continue to be applied by the state in permitting programs (such as the TPDES program) and other TCEQ activities.**

**Because the REIS is proceeding parallel to, but independently of, ongoing TCEQ/USEPA interactions, it is assumed for purposes of this regional analysis that federally-approved Texas Surface Water Quality Standards will eventually apply as submitted to USEPA in 2014, or in a form closely resembling that submittal.**

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

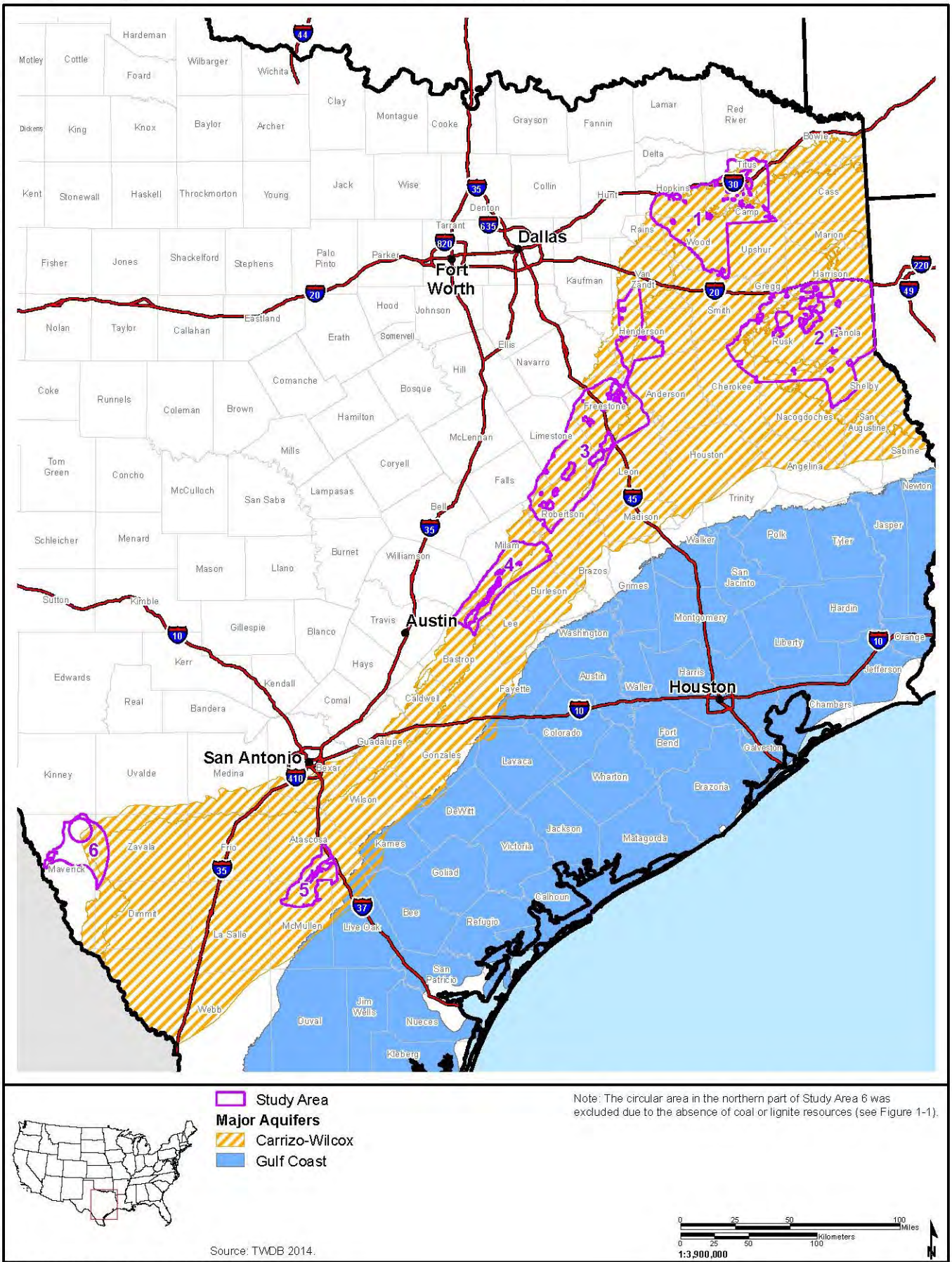
The Texas Water Development Board (TWDB) has defined 9 major and 21 minor aquifers in the State of Texas (George et al. 2011). In the Texas Coal Region, there is one major aquifer (Carrizo-Wilcox aquifer system) and four minor aquifers (Yegua-Jackson, Queen City, Sparta, and Brazos River alluvial aquifer). 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).

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Figure 3.2-1 Carrizo-Wilcox Aquifer

**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).

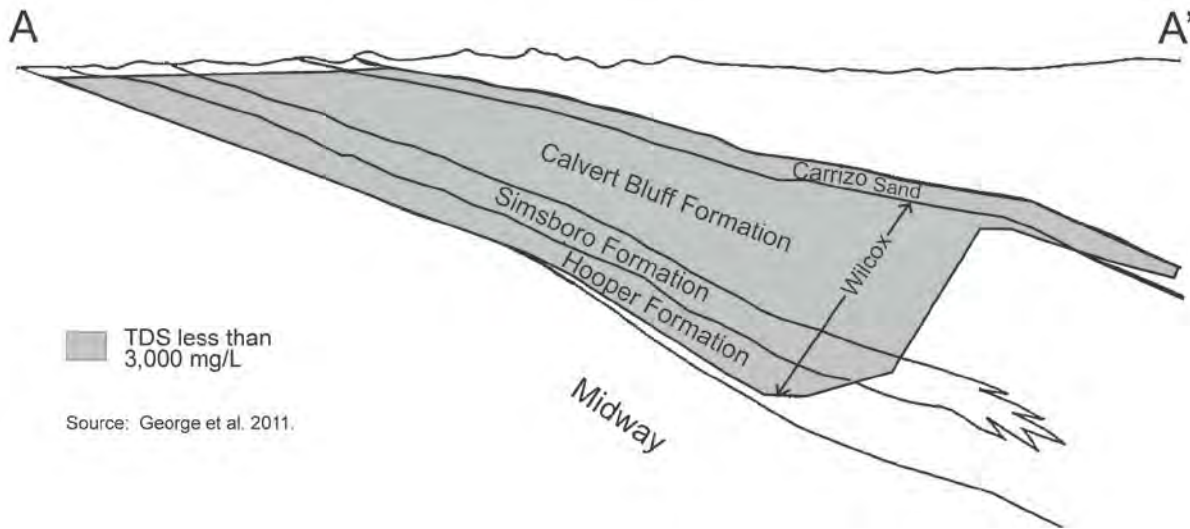
**Figure 3.2-3** shows the relationship between the stratigraphy of the Wilcox and Claiborne Groups and hydrologic units. Recharge occurs at the outcrop and from leakage of groundwater from the Queen City aquifer through the leaky confining Reklaw Formation confining layer (Dutton 1985). Confining layers 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).

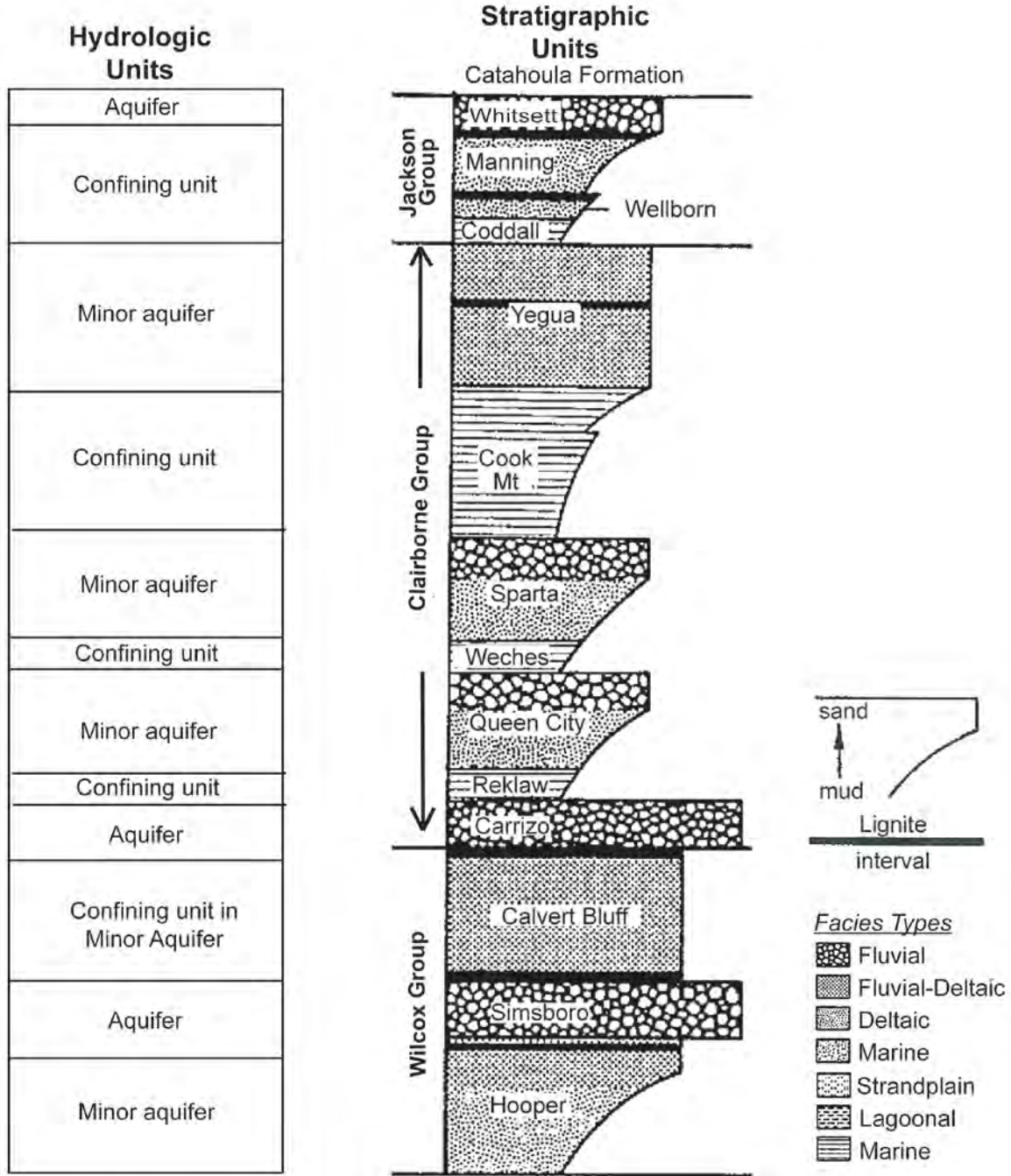
Groundwater quality is also affected by hardness (concentration of calcium carbonate) in up-dip areas of the aquifer and widespread high iron content that contributes to corrosion problems (Ashworth and Hopkins 1995). In the down-dip areas, hydrogen sulfide and methane gas have been reported. Groundwater 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.





**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**

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.

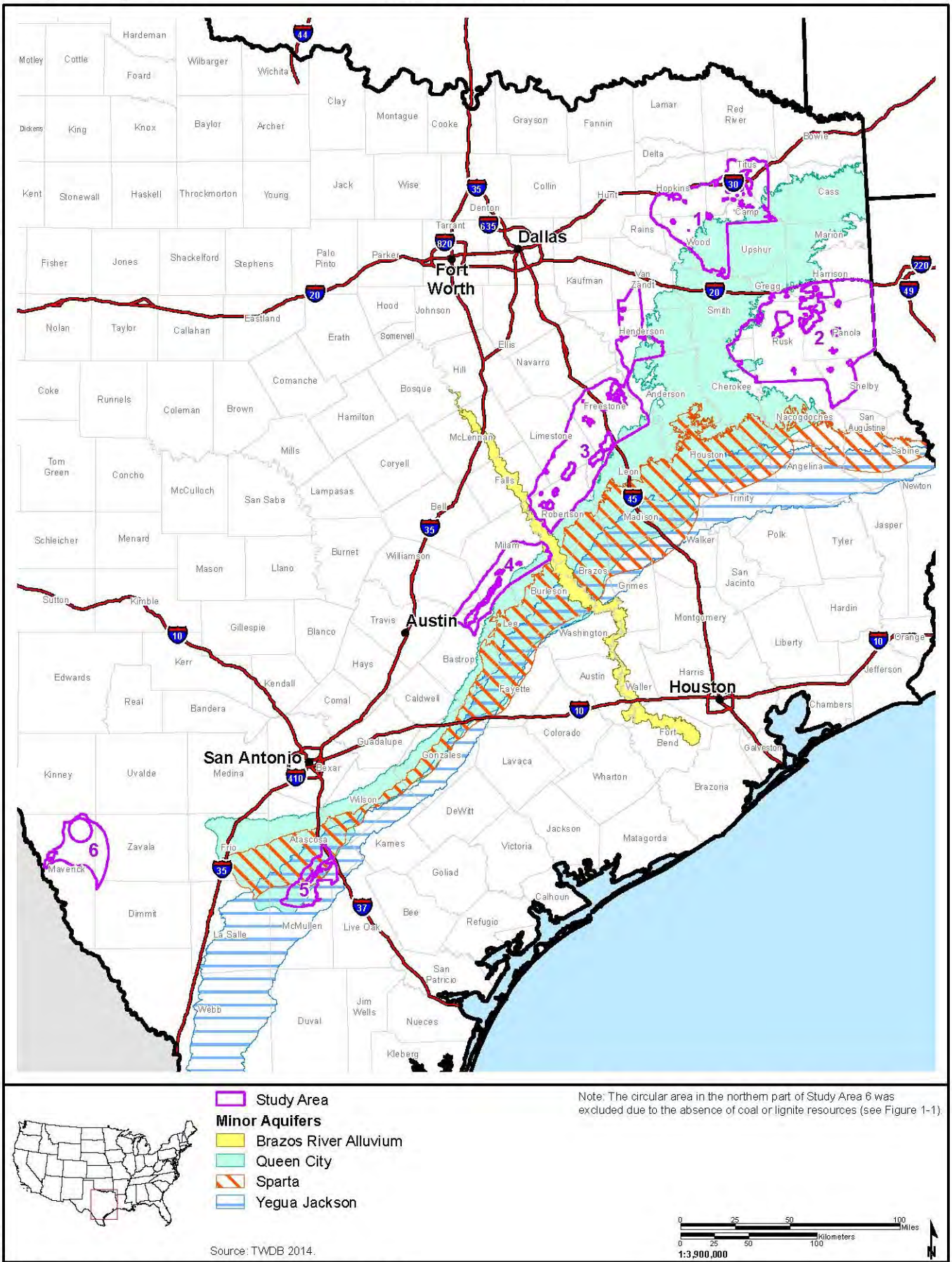
#### Queen City Aquifer

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.

#### 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.

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Figure 3.2-4 Minor Aquifers in the Analysis Area

### 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 <sup>1</sup>
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
	Paleocene	Wilcox <sup>2</sup> 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
			Lower Wilcox			
		Midway Group	900	Calcareous clay and limestone, sandy and silty in part	Does not yield groundwater to wells; not an aquifer	

<sup>1</sup> Small: less than 100 gpm; moderate: 100 to 1,000 gpm; large: more than 1,000 gpm.

<sup>2</sup> 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 <sup>1</sup>
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 <sup>1</sup>
			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 <sup>2</sup>	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
			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
	Paleocene	Midway Group		900	Calcareous clay and limestone, sandy and silty in part	Does not yield water to wells; not an aquifer

<sup>1</sup> Small: less than 100 gpm; moderate: 100 to 1,000 gpm; large: more than 1,000 gpm.

<sup>2</sup> 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 Carrizo-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 <sup>1</sup>
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 known 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
	Paleocene	Wilcox Group <sup>2</sup>		400-1,800	Lenticular sand bodies within clay and shale, non-continuous lignites	Small to moderate quantities of fresh groundwater
		Midway Group		450	Sandy clay	Not known as an aquifer in this area

<sup>1</sup> Small: less than 100 gpm; moderate: 100 to 1,000 gpm; large: more than 1,000 gpm.

<sup>2</sup> 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 <sup>1</sup>
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
	Paleocene	Wilcox Group	Upper	150-2,300	Sand, silt, clay, and thin lignite seams	Small to moderate quantities of fresh to very saline groundwater
			Lower			
			Midway Group		250-550	Shale and clay
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
			Upton Clay	750+	Clay, marl, limestone	Small quantities of very saline water

<sup>1</sup> 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 approximately 15 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.

**Another potential groundwater quality concern is the presence of pyrite in the coal seams and overburden. After pyrite is exposed to an oxidizing environment, the oxidation process may result in the acidification of surface water 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, to handle such materials in a manner that reduces the acid generating potential, and to conduct post-mine acid/base soil monitoring to ensure that selective handling measures have been successful with respect to managing acid-forming constituents. Contributing to the mitigation of acid generating potential is the low to medium sulfur content of coals in all of the study areas (less than 1 percent up to 2 percent by weight) (Fisher 1963; Hook et al. 2011d; Schweinfurth 2009). High sulfur coal has greater than 3 percent sulfur by weight. In addition, RCT regulation 16 TAC 12.339 states that if related practices are insufficient to meet corresponding regulatory requirements, then the person conducting surface mining activities**

**shall operate and maintain the necessary water treatment facilities for as long as treatment is required under the RCT Permanent Program performance standards.**

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.

### Proposed Action

#### *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 (Pollock 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 down dip. 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.

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 1.1 miles (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. **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 Study Area 2 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 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 2011b, 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 2011b, 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 2011b, 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). **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 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/depressurization 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 <sup>1</sup> )	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
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

<sup>1</sup> 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).

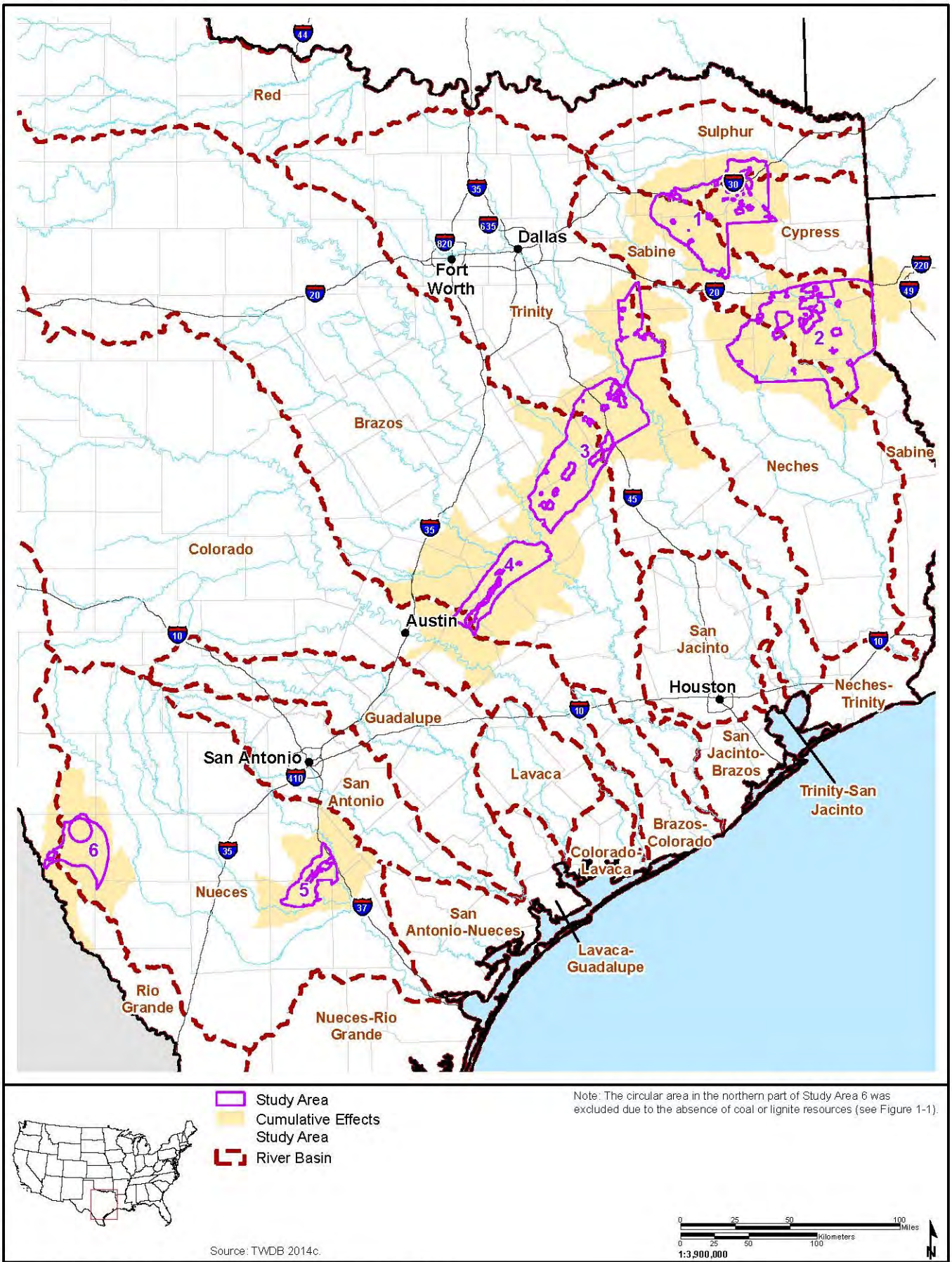
Surface water quality standards are assigned according to beneficial uses, whether existing, designated, presumed, or attainable uses (TCEQ 2014a). Designated uses are those formally assigned to specific waterbodies and typically include Domestic Water Supply, Aquatic Life categories, Recreation categories, 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 **Limited** 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).

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3/27/2016

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.

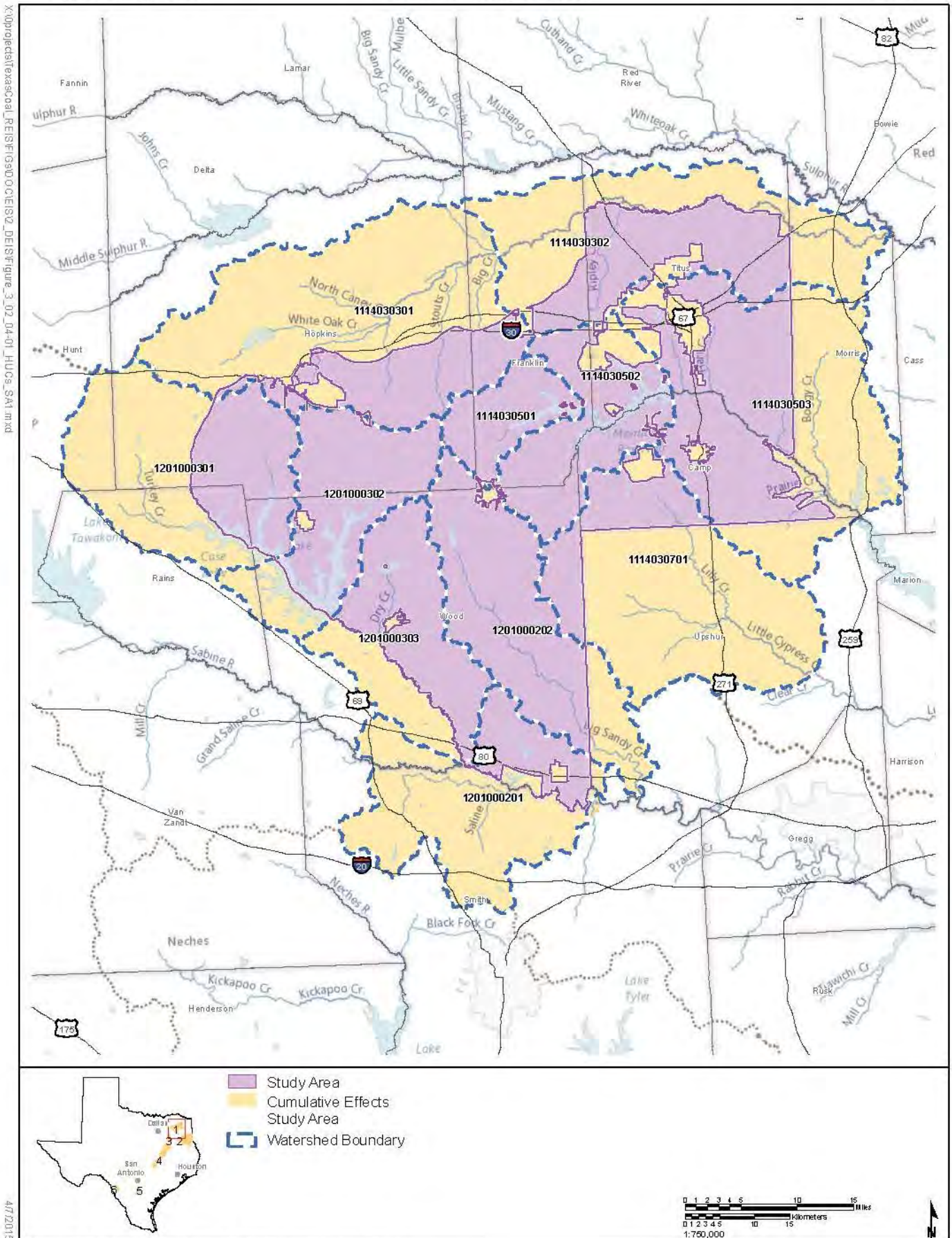


Figure 3.2-6 Study Area 1 Surface Water Features

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**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
<b>Totals</b>		<b>912,497</b>	<b>1,011,214</b>	<b>1,923,711</b>

**Table 3.2-7 General Monthly Flow Characteristics for Select Streams in Study Area 1 <sup>1</sup>**

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<sup>1</sup>**

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)

<sup>1</sup> 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.

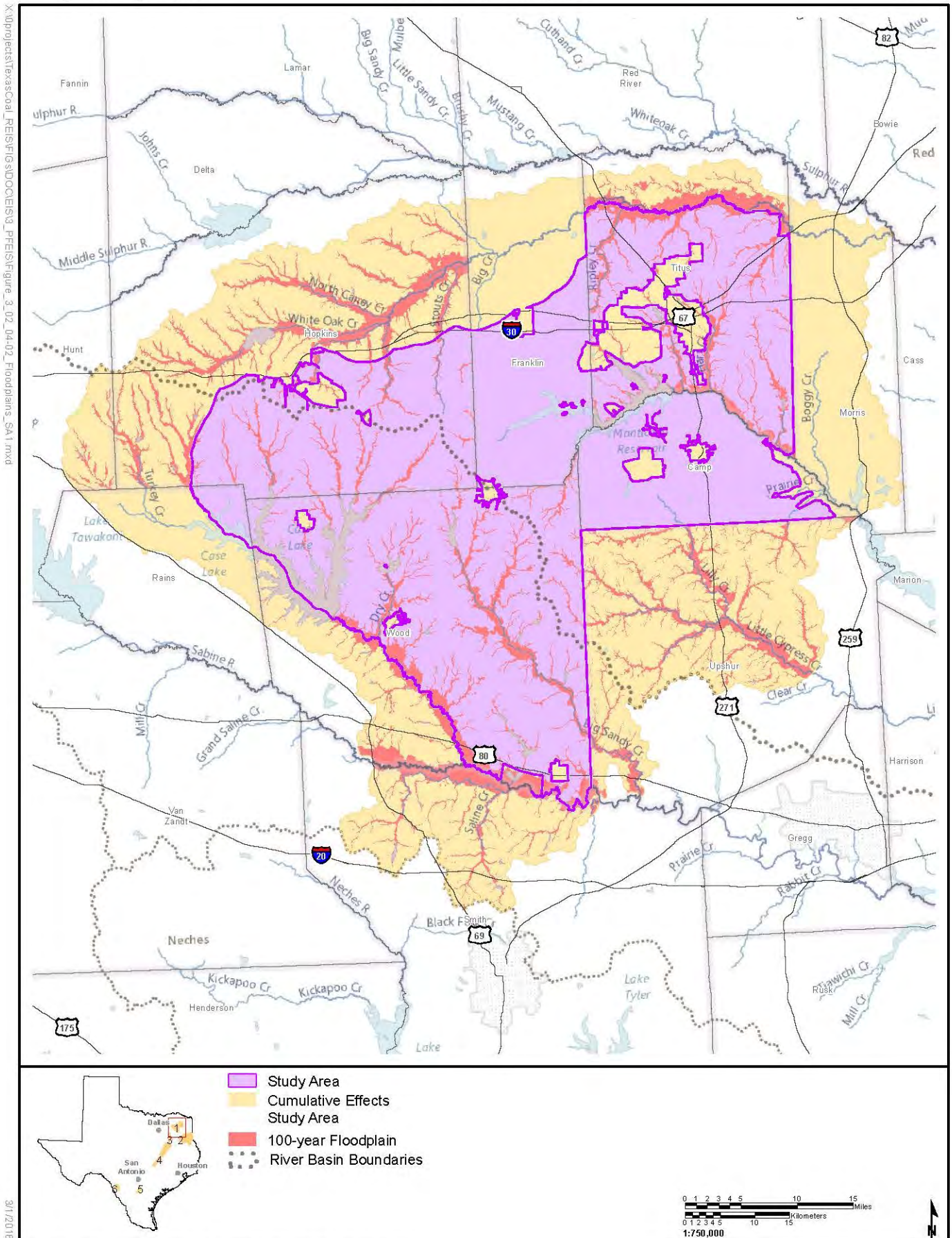


Figure 3.2-7 100-year Floodplains – Study Area 1

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**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 <sup>1</sup>	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

<sup>1</sup> 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.



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 chlorophyll-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*

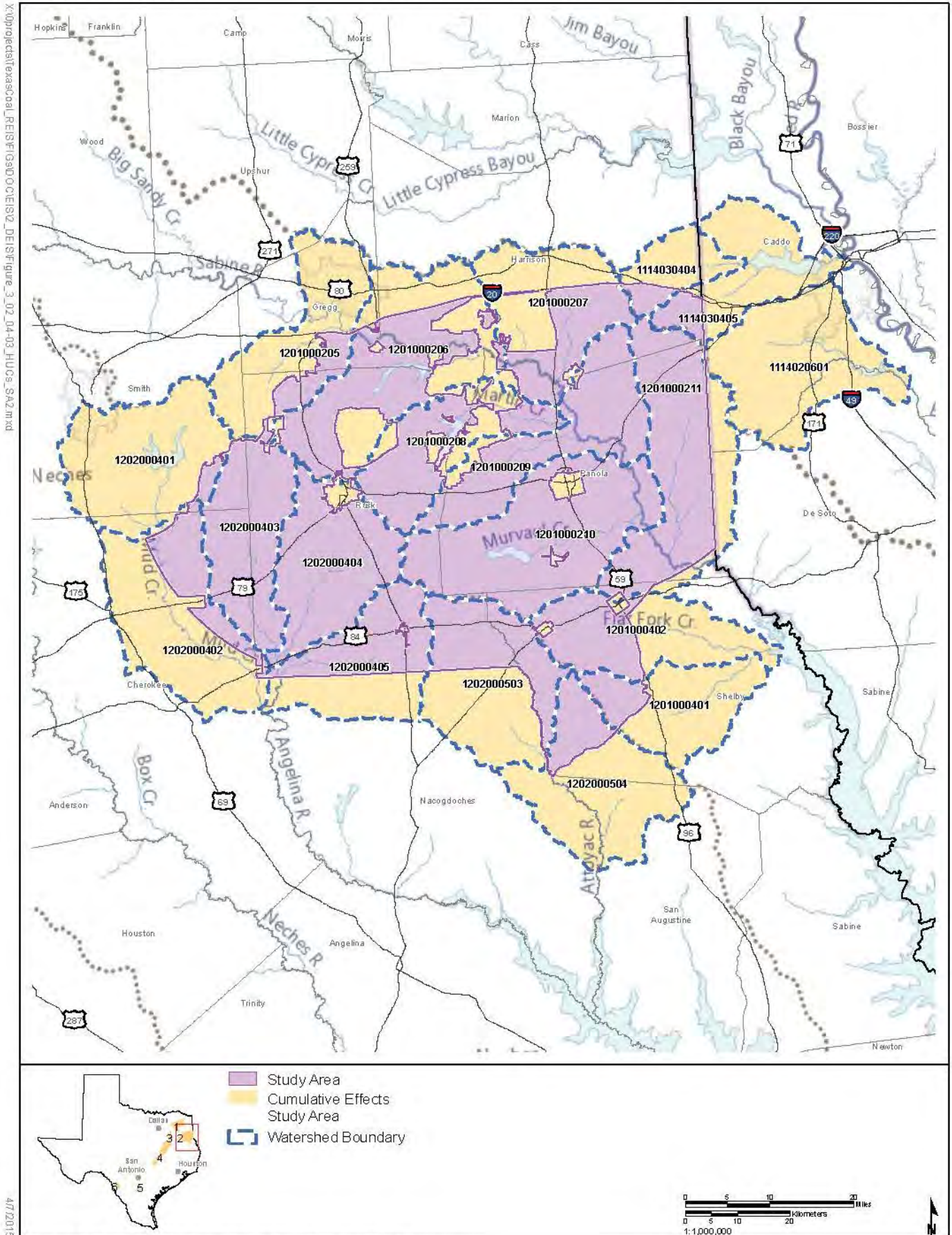
Study Area 2 is mainly located in the Sabine River Basin, with smaller portions in the Angelina, Red-Saline, and Big Cypress-Sulphur river basins. Major flow systems include the mainstem of the Sabine River; its eastward-flowing tributaries Martin Creek, Murvaul Creek, and Flat Fork Creek; the Angelina 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**.



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Figure 3.2-8 Study Area 2 Surface Water Features

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

<b>HUC 10 Watershed Identifier</b>	<b>Watershed Name</b>	<b>Watershed Area within Study Area (acres)</b>	<b>Watershed Area in CESA Outside of Study Area (acres)</b>	<b>Total Watershed Area within Analysis Area (acres)</b>
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
<b>Totals</b>		<b>1,449,322</b>	<b>1,463,106</b>	<b>2,912,428</b>



**Table 3.2-11 General Monthly Flow Characteristics for Select Streams in Study Area 2 <sup>1</sup>**

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)

<sup>1</sup> 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)

**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 <sup>1</sup>	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	No Data	13 to 54	5 to 200	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

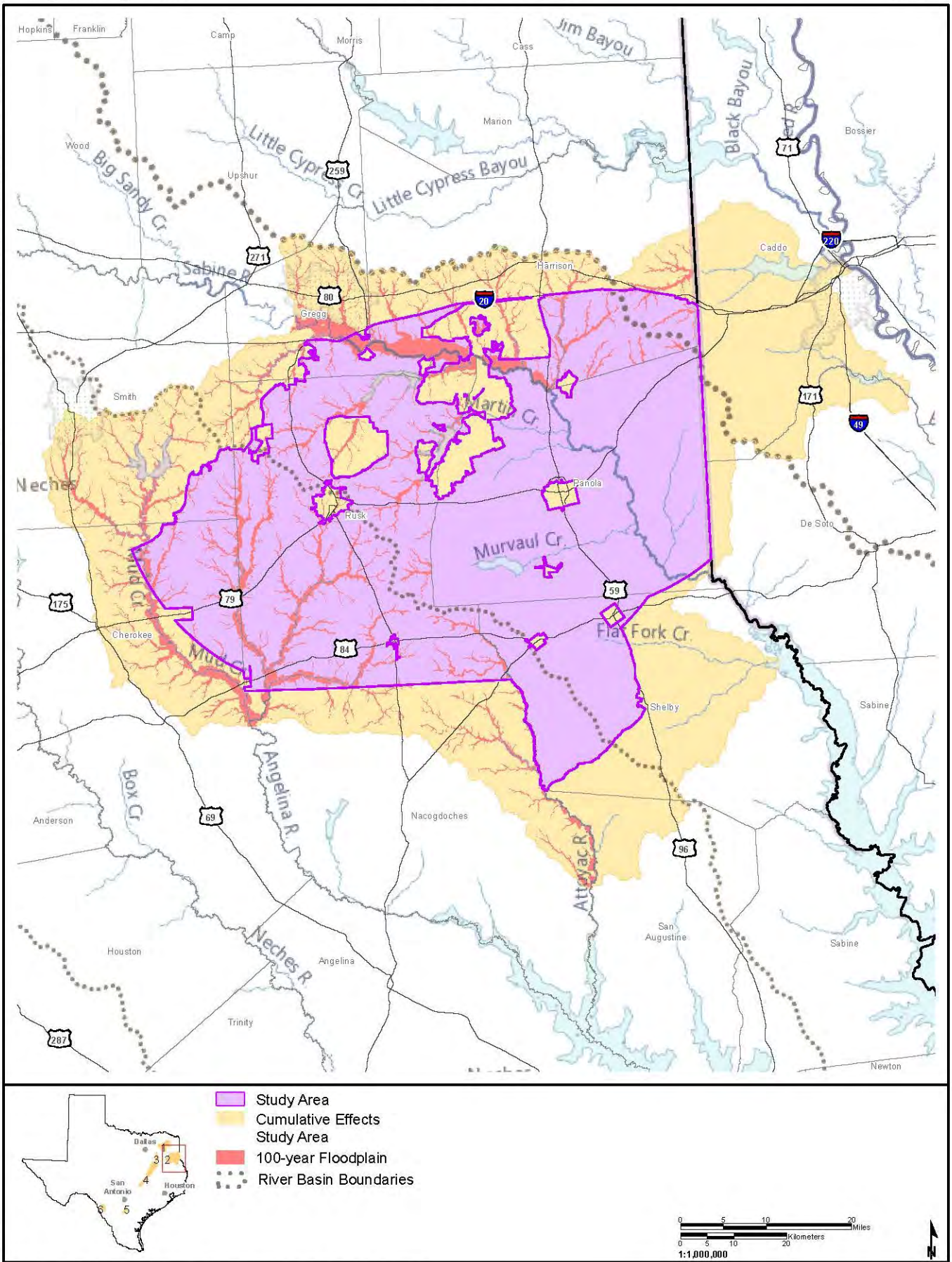
<sup>1</sup> Values reflect concentration (mg/L) and percent saturation, where available. No saturation data for Irons Bayou.

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.



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

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 (Murvault 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) – **Limited**
- Mason Creek (east of Longview) – **Limited**
- 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 Murvault 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) – **Limited**
- 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) – **Limited**

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**

<b>HUC 10 Watershed Identifier</b>	<b>Watershed Name</b>	<b>Watershed Area within Study Area (acres)</b>	<b>Watershed Area in CESA Outside of Study Area (acres)</b>	<b>Total Watershed Area within Analysis Area (acres)</b>
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	Cattfish 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
<b>Totals</b>		<b>1,219,146</b>	<b>2,455,335</b>	<b>3,674,481</b>

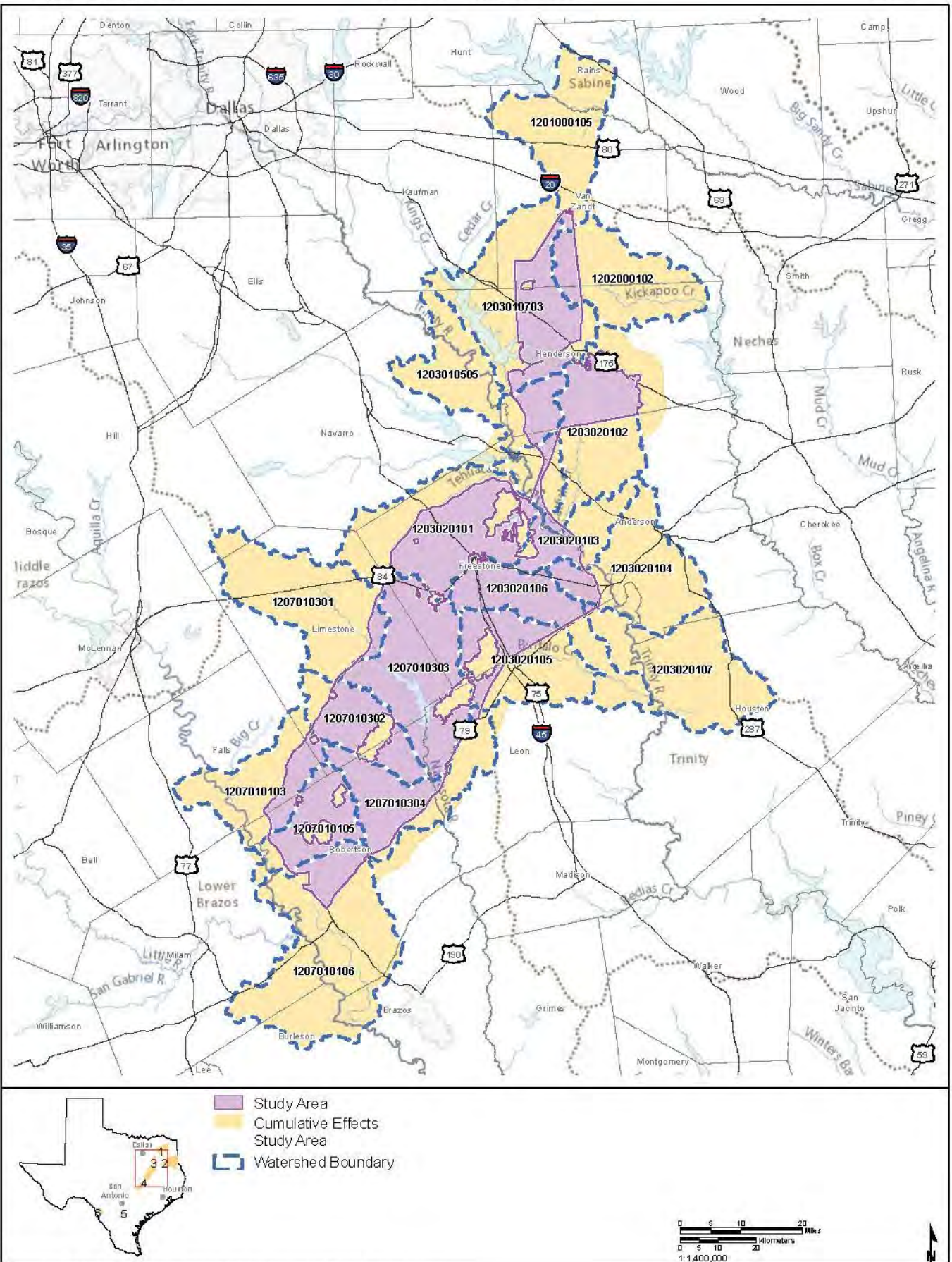
**Table 3.2-15 General Monthly Flow Characteristics for Select Streams in Study Area 3 <sup>1</sup>**

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)

<sup>1</sup> 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)

**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 <sup>1</sup>	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

<sup>1</sup> 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.



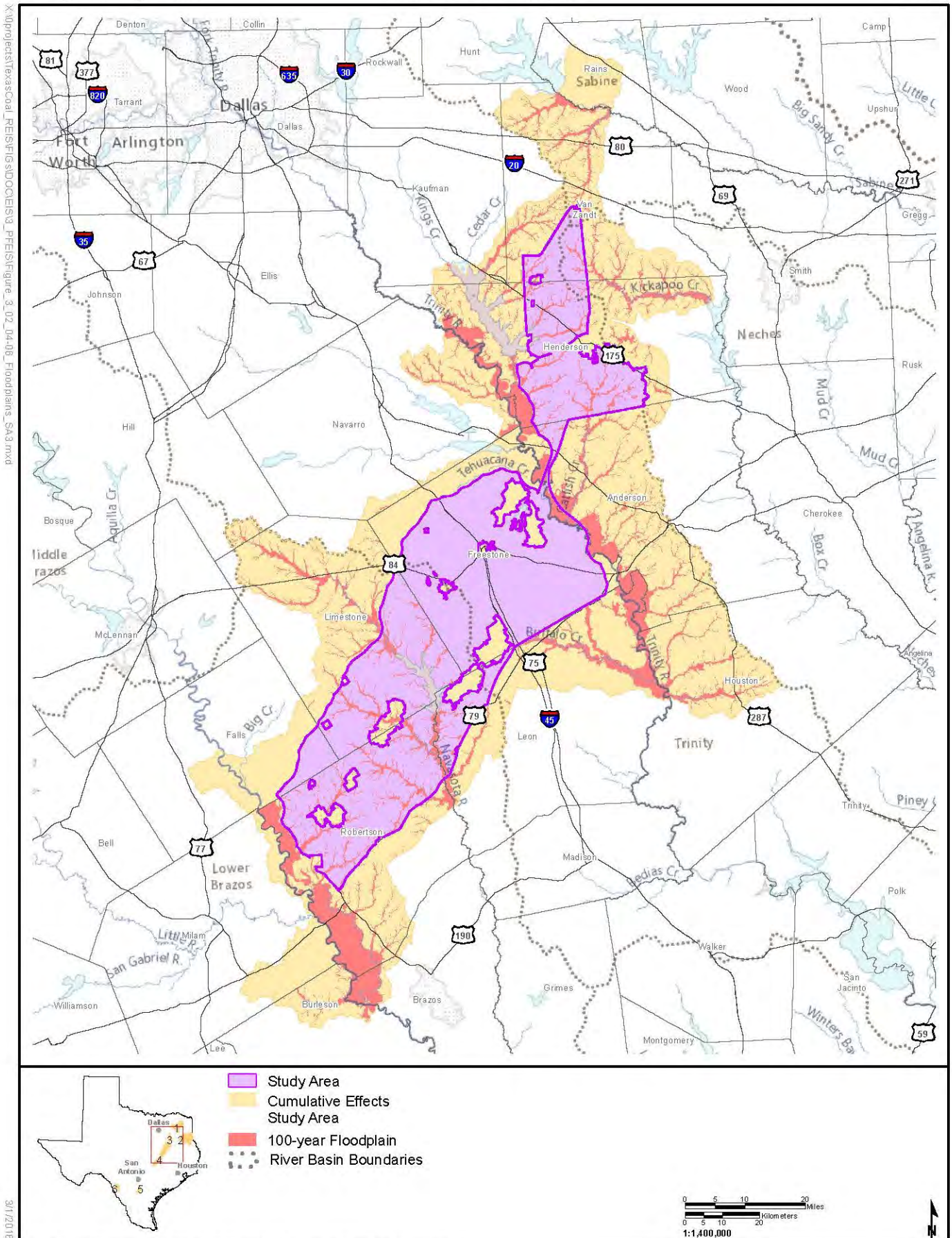


Figure 3.2-11 100-year Floodplains – Study Area 3

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- 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) – **Limited** (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

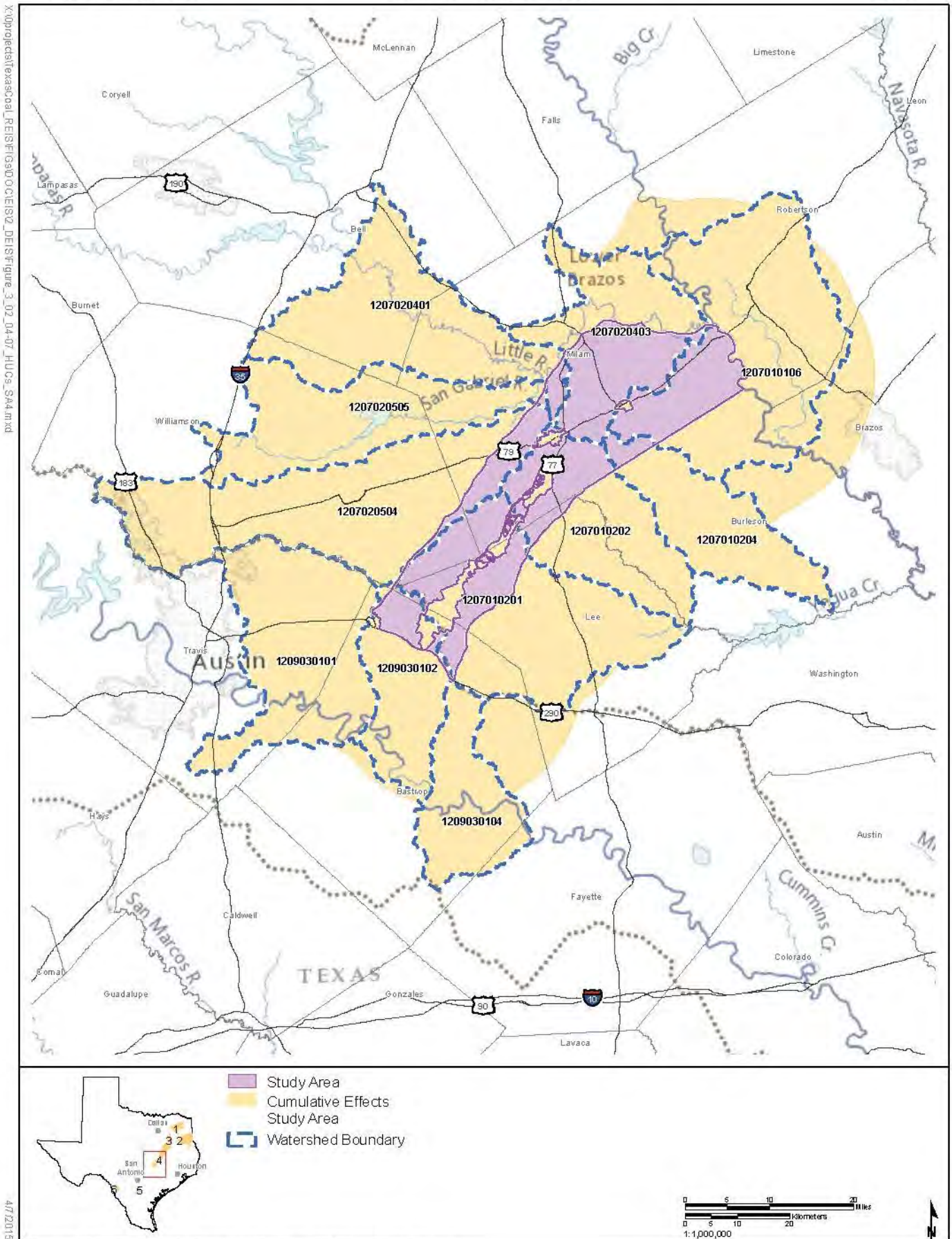
##### *Surface Water Features and Flows*

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.



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Figure 3.2-12 Study Area 4 Surface Water Features

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

<b>HUC 10 Watershed Identifier</b>	<b>Watershed Name</b>	<b>Watershed Area within Study Area (acres)</b>	<b>Watershed Area in CESA Outside of Study Area (acres)</b>	<b>Total Watershed Area within Analysis Area (acres)</b>
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
<b>Totals</b>		<b>365,348</b>	<b>2,267,430</b>	<b>2,632,777</b>

**Table 3.2-19 General Monthly Flow Characteristics for Select Streams in Study Area 4 <sup>1</sup>**

<b>Waterbody</b>	<b>Monitoring Site</b>	<b>General Location</b>	<b>Drainage Area (square miles)</b>	<b>Period of Record</b>	<b>Average High Flow (cfs)</b>	<b>Average Low Flow (cfs)</b>
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)

<sup>1</sup> 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)**

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

Source: Hershfield 1961.

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).

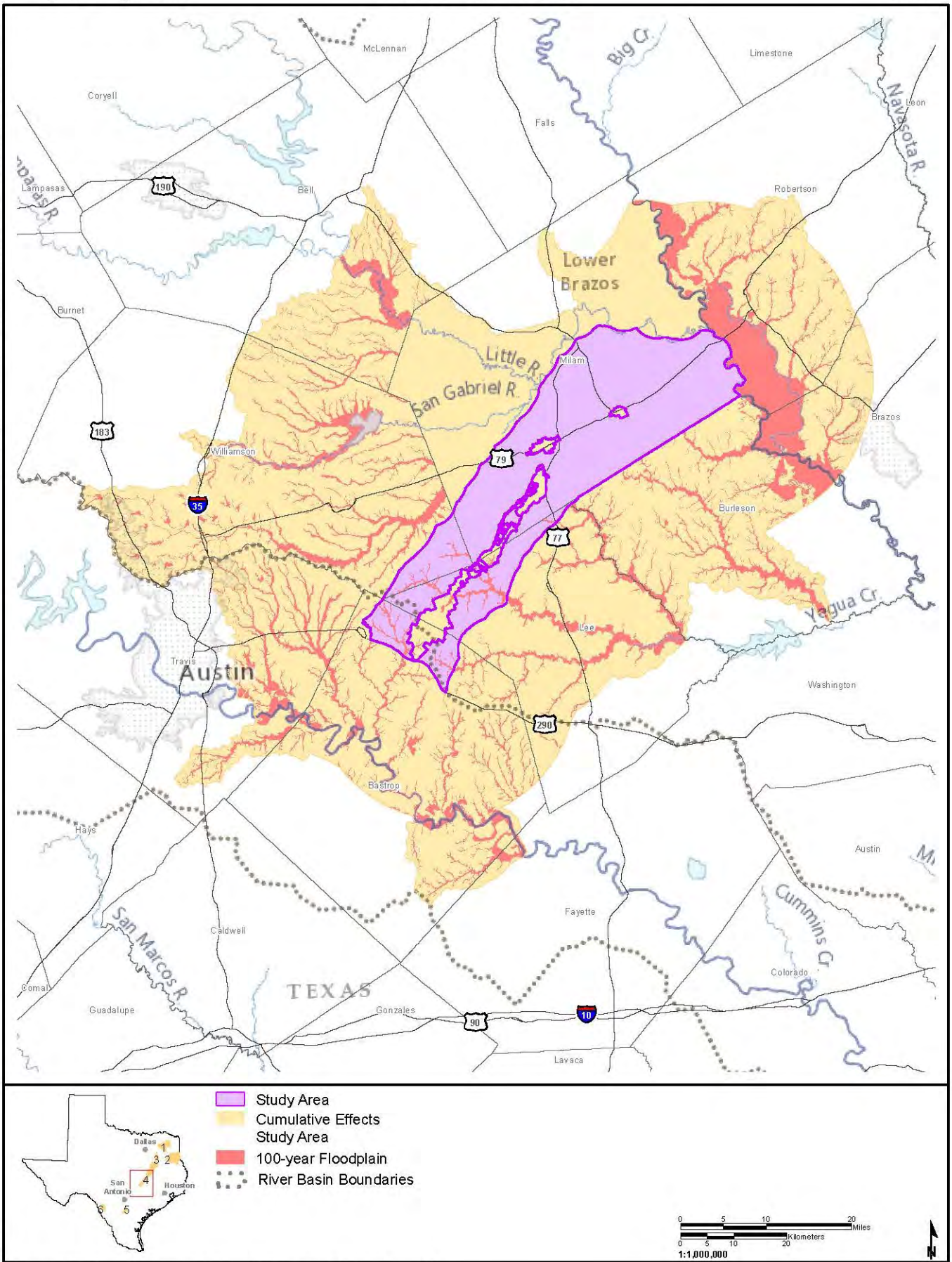
These following waterbodies provide sole-source drinking water supplies in the analysis area (TAC 2014d):

- 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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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 – **Limited**
- 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



**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 <sup>1</sup>	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	No Data	6 to 94	32 to 118	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	1.2 to 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

<sup>1</sup> 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.



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 Limited 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).

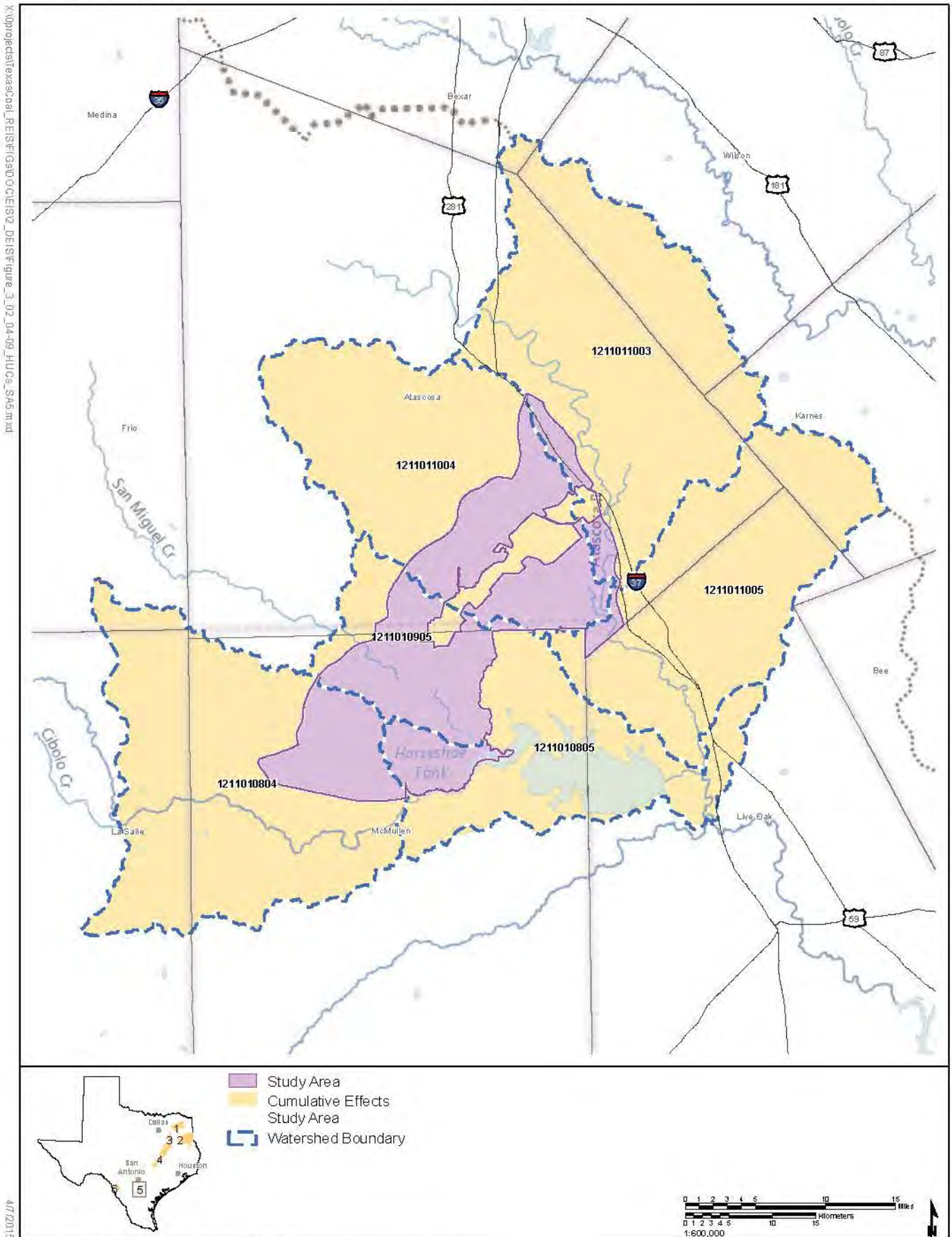
More consistent water quality issues are reflected in the bi-annual list of impaired waterbodies prepared by TCEQ in accordance with Clean Water Act Section 303(d). The following impaired waters occur in Study Area 4 and its CESA (TCEQ 2012):

- 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)

### Study Area 5

#### *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



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Figure 3.2-14 Study Area 5 Surface Water Features

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 3.2-22 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
<b>Totals</b>		<b>180,841</b>	<b>868,857</b>	<b>1,049,698</b>

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<sup>1</sup>**

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)

<sup>1</sup> 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.

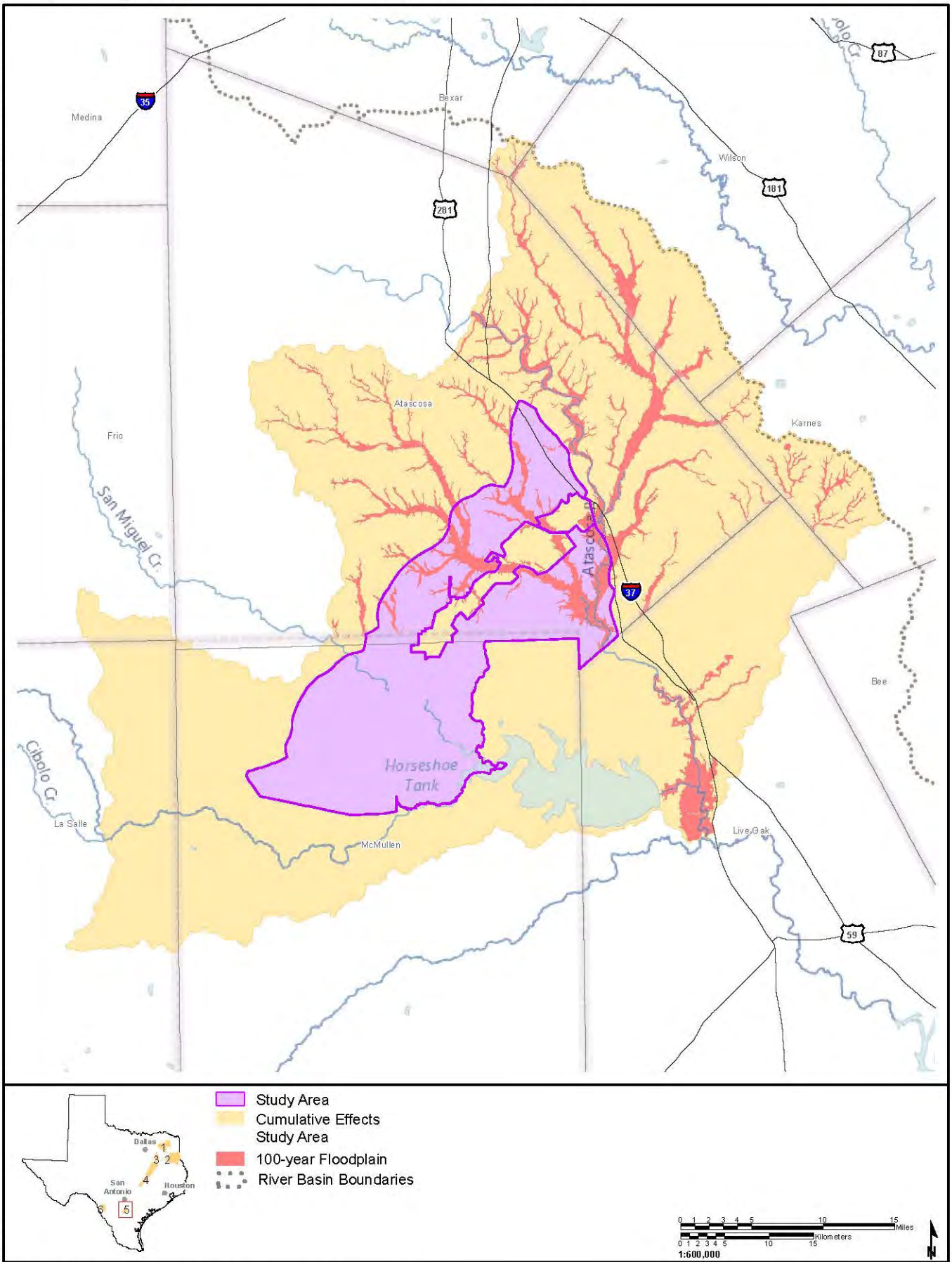
*Floodplains*

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).

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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.



**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 <sup>1</sup>	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 to 123	2 to 22	4.8 to 463	41 to 592	3.8 to 395	11 to 225	No Data	No Data

<sup>1</sup> 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.



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 chlorophyll-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

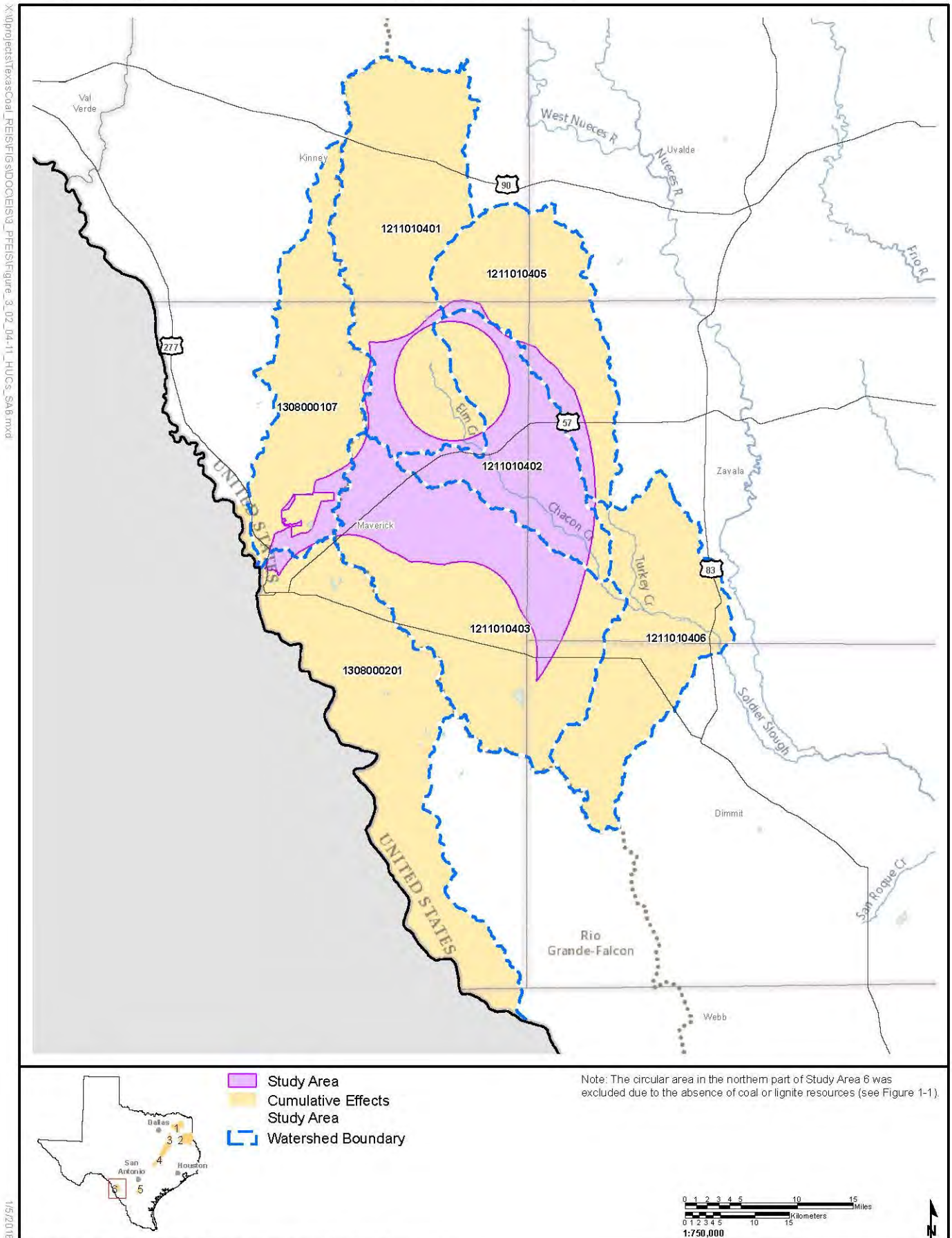
#### *Surface Water Features and Flows*

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 Picoso, 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 **391** square miles), and the outlying CESA (approximately **1,506** 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 **flow** data for generally similar streams are available regionally. Data from these sources are reflected in **Table 3.2-27**.



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Figure 3.2-16 Study Area 6 Surface Water Features

**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	<b>13,064</b>	<b>130,205</b>	143,269
1308000108	Quemado Creek-Rio Grande	0	3,337	3,337
1308000201	Rosita Creek-Rio Grande	2,201	199,405	201,606
<b>Totals</b>		<b>249,982</b>	<b>964,162</b>	<b>1,213,144</b>

**Table 3.2-27 General Monthly Flow Characteristics for Select Streams in or near Study Area 6<sup>1</sup>**

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)

<sup>1</sup> Based on available data for a multi-year period of record.

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

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 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.

According to the NHD, approximately 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 1,006 miles of intermittent stream reaches are within Study Area 6. Approximately 2,754 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**.

**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.

*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 **58,352** acres (**91** square miles). In the outlying CESA, approximately **146,427** acres (**229** square miles) of additional delineated floodplains occur.

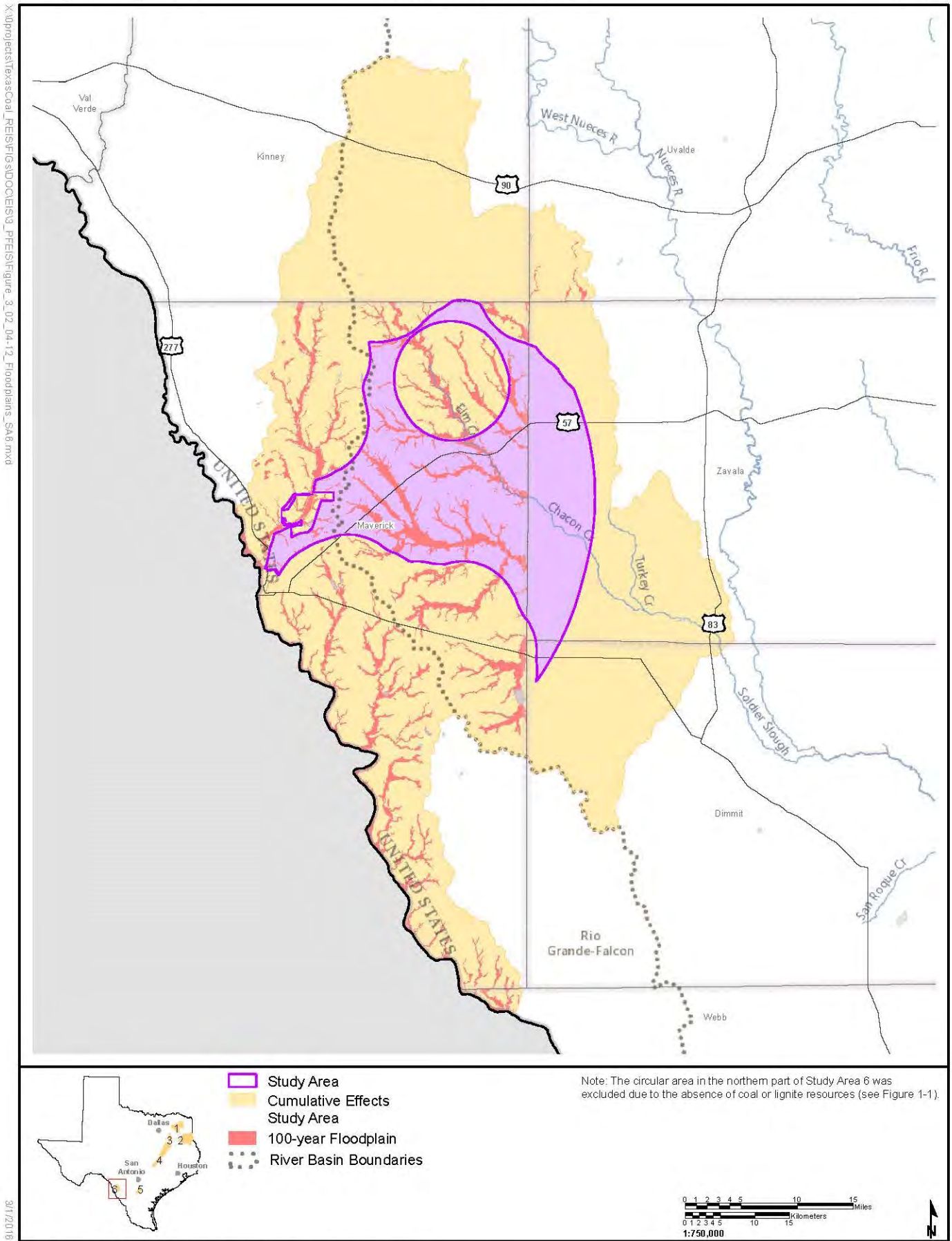


Figure 3.2-17 100-year Floodplains - Study Area 6

### *Surface Water Uses and Quality*

The Rio Grande 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). **The municipal water intake is on the river, downstream of its confluence with Elm Creek. Elm Creek is the receiving water for currently authorized mine discharges in its watershed. Lower reaches of the creek also receive agricultural runoff and irrigation return flows.**

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. **There are no other classified water body segments in the western part of the study area.** 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).

Along the Rio Grande, **a regional water quality study was conducted by the International Boundary Waters Commission during the 1990s (International Boundary Water Commission 1994). This regional program broadly summarized the water quality setting along the river. While reduced water quality is generally known to occur in the area, the program from the 1990s presents the most comprehensive data interpretations and discussion published for the study region. For more specific representative locations, selected water quality data and findings from later dates and sources are presented in Table 3.2-29.**

**The regional investigation along the Rio Grande indicated that** 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 **at specific sites outside the study area (e.g., Laredo) in other phases of international programs conducted since the 1990s. In Study Area 6, elevated concentrations of fecal coliform bacteria are frequently indicated in recent river data archived by the state (TCEQ Texas Clean Rivers Program Data Tool 2015).** 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).



**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	10/2006	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
<b>Rio Grande near Highway 277/Eagle Pass</b>	<b>TCEQ Segment 2304, Station 13205</b>	<b>4/2006</b>	<b>Value</b>	<b>7.9</b>	<b>538</b>	<b>960</b>	<b>8.3</b>	<b>25</b>	<b>No Data</b>	<b>No Data</b>	<b>77.1</b>	<b>20.9</b>	<b>98.7</b>	<b>No Data</b>	<b>98.6</b>	<b>150</b>	<b>No Data</b>	<b>No Data</b>
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

<sup>1</sup> 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; **TCEQ - Texas Clean Rivers Program Data Tool 2015.**



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/Ciudad 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 chlorophyll-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.

#### Proposed Action

##### *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 (**e.g., acid mine drainage**), 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. **The potential for acid mine drainage has been well-documented in East Texas for several decades, and to some degree in Central Texas as well. Naturally acidic springs and seeps also occur in some geologic settings in those regions, in locales that have not been disturbed by coal mining (Horbaczewski 2007; Mercier 2014). Research, material handling applications, and monitoring have been used to address mine-related issues in those regions. Elsewhere, geologic and climatic factors (particularly aridity and the more alkaline chemical nature of soils and overburden) are less likely to generate acid- or toxic-material impacts in the study areas to the west and south.**

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 **other dissolved metals**. 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. **Notices to the public are part of the permit review process, and the public may submit comments, request a public meeting, or request a public hearing on the draft permit.** 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 materials 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. **Based on RCT regulations (Title 16, Part 1, Chapter 12, Subchapter K, Division 2, Rule 12.339), permit provisions to accommodate larger design storms or other considerations may be applied at the judgment of the agency, and RCT may require additional preventative, remedial, or monitoring measures to ensure that material damage to the hydrologic balance outside a permit area is prevented.**

In any hydrologic setting, however, it is possible that water control structures designed and constructed according to regulations **or additional agency requirements** 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 settleable 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. **Public review and comment opportunities are part of the RCT process for a surface coal mine permit and CHIA issuance.**

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 NWP's 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.

### Study Area 4

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. 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 81 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 **mine-related discharge to Elm Creek, or** 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 **Elm Creek and** 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. **As previously discussed under “Effects Common to All Study Areas,” RCT and TCEQ permit requirements for potential future surface coal of lignite mine expansion areas or satellite mines could be tailored to site-specific issues, based on regulatory reviews, public interactions, and agency decisions.**

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. **Flooding that causes channel migration or** damages to nearby structures would potentially **create** severe impacts from bypassed or damaged sediment ponds, diversions, or other **mine** water controls. These impacts would be temporary, and would interact with more widespread similar impacts from severe storms and high flows.

#### No Action

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**

<b>CESA</b>	<b>Area of Combined Hydrologic Units by CESA (acres)</b>	<b>Estimated Maximum Disturbance from Potential Future Authorizations (acres)</b>	<b>Estimated Percent of CESA Potentially Disturbed under Potential Future Authorizations</b>	<b>Approximate Current Acreage of Existing Coal/Lignite Disturbance by CESA</b>	<b>Estimated Percent of CESA Cumulatively Disturbed by Future and Existing Coal/Lignite Mining</b>
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**

<b>CESA</b>	<b>Area of Combined Hydrologic Units by CESA (acres)</b>	<b>Approximate Area of Major Existing Reservoirs (acres)</b>	<b>Estimated Percent of CESA Occupied by Major Reservoirs</b>
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 **and mitigation** 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.

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

Study Area	Wetland Type <sup>1</sup> (acres)																Water Courses or Drainage Features <sup>2</sup> (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	<b>128</b>	36	38	0	0	0	2	2	6	<b>1,084</b>	0	0	0	7	4,582,847 (868 miles)

<sup>1</sup> Based on NWI (USFWS 2014) and NHD (USGS 2014) mapped data.

<sup>2</sup> 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 <sup>1</sup> (acres)															Water Courses or Drainage Features <sup>2</sup> (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)

<sup>1</sup> Based on NWI (USFWS 2014) and NHD (USGS 2014) mapped data.

<sup>2</sup> Based on NHD (USGS 2014) mapped data.

### 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 (191,486 acres) comprise approximately 74 percent of all mapped wetlands in the six study areas, with the lacustrine-type wetlands (64,253 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 3.2-34 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	<b>248,983</b>	<b>1,404</b>	<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 **248,983** acres, of which approximately **1,404** acres (0.6 percent) are occupied by wetlands. There are also approximately **4,598,120** linear feet (**854** 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 **1,084** acres. The next most abundant wetland type is the Lacustrine Littoral (associated with shores of lakes and reservoirs) at **128** 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	303	1,404	22
Palustrine	1,094	1,404	78
Riverine	7	1,404	<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. **Aquatic resources identified as perennial streams, least disturbed forested wetlands, or other high quality designations typically are planned for avoidance during the pre-application phase.** 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 **140** 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	22	31
Palustrine	78	109
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**

<b>Study Area</b>	<b>Disturbed Inside Study Area (acres)</b>	<b>Disturbed Outside Study Area/Inside CESA (acres)</b>	<b>Total CESA Disturbed (acres)</b>
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. **Utilizing sequential backfilling of the mine pits and concurrent reclamation practices (reclamation of previously mined areas while mining progresses to other areas), active mine pit-related disturbance at any given time during operations typically would range from 250 to 650 acres, thus minimizing temporal impacts.** 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**

**No residual adverse effects to waters of the U.S., including wetlands, have 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 (USDA) 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:

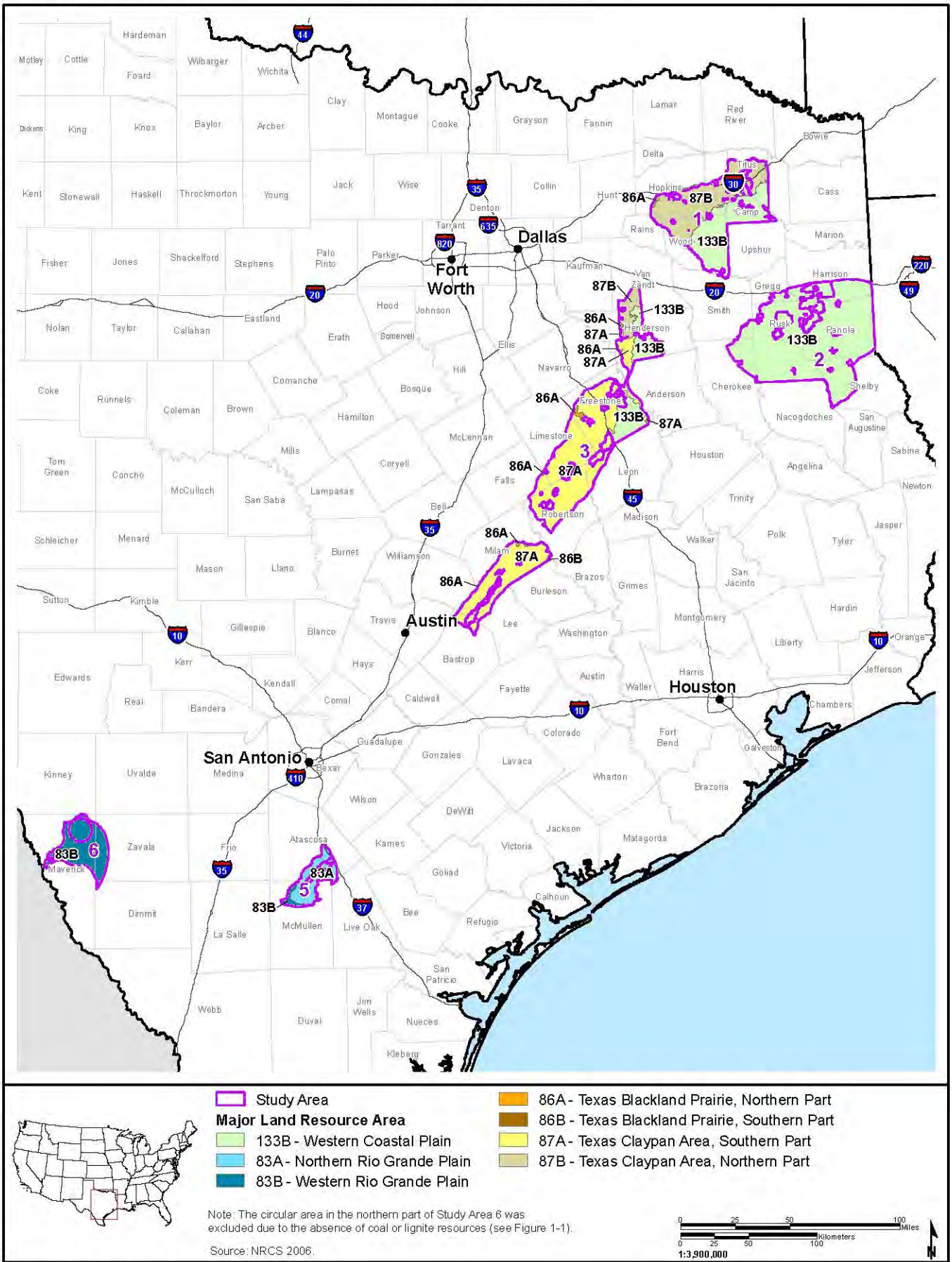
- 83A—Northern Rio Grande Plain
- 83B—Western Rio Grande Plain
- 86A—Northern Part of the Texas Blackland Prairie
- 87A—Southern Part of the Texas Claypan Area
- 87B—Northern Part of the Texas Claypan Area
- 133B—Western Coastal Plain

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.

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Figure 3.3-1 Major Land Resource Areas



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 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 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 (USDA, NRCS 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 <sup>1</sup>	Wind Erodible		Water Erodible		LRP <sup>2</sup>		Acidic Soils <sup>3</sup>		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	<b>248,982</b>	2,035	1	<b>196,639</b>	79	<b>165,014</b>	66	0	0	<b>0</b>	0	<b>228,997</b>	92	<b>15,015</b>	6
Total	<b>4,376,120</b>	1,037,497	24	<b>2,983,666</b>	68	<b>262,632</b>	6	1,273,747	29	<b>284,741</b>	7	<b>4,096,872</b>	94	<b>91,466</b>	2

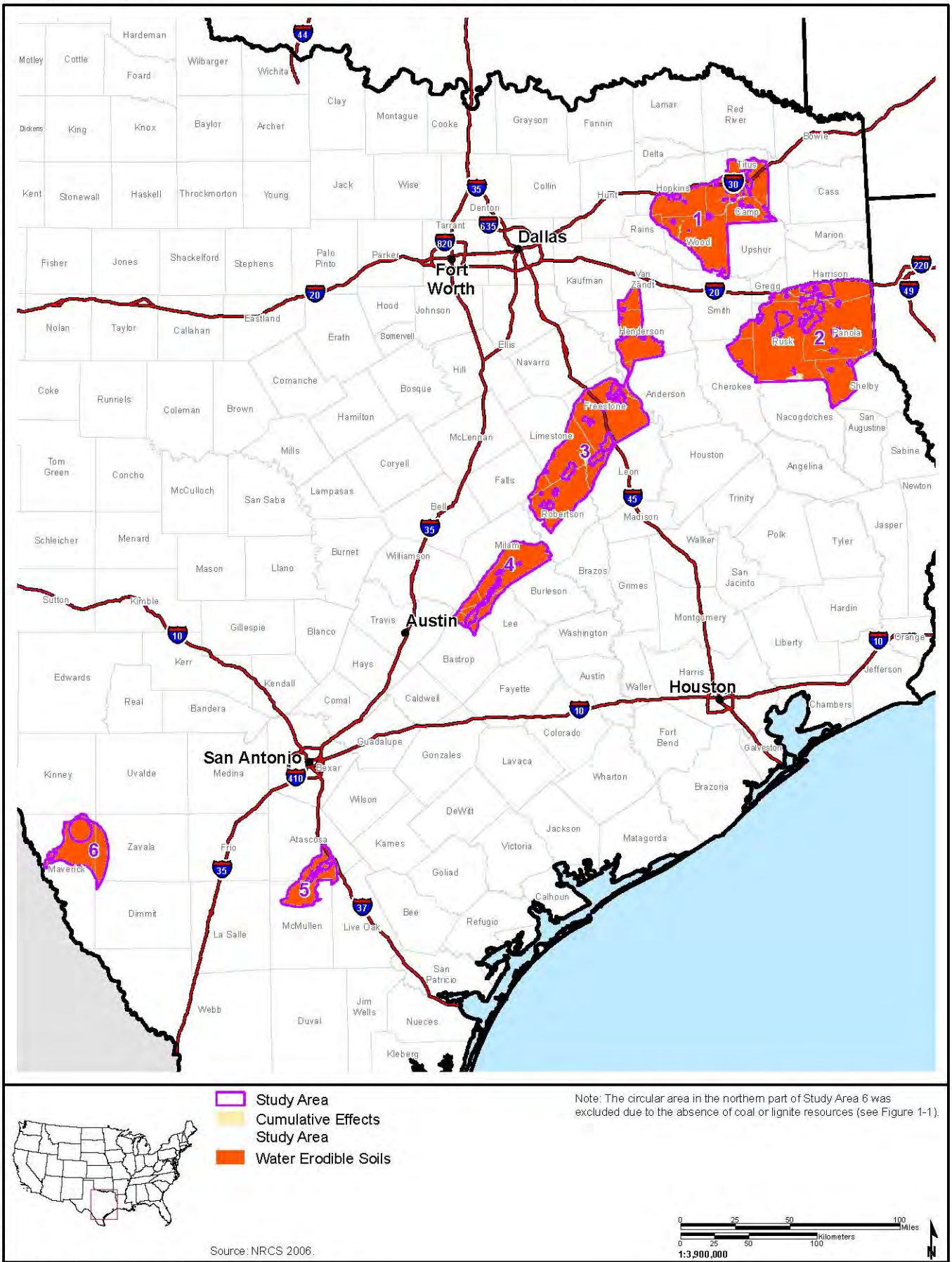
<sup>1</sup> Acreages based on GIS analysis

<sup>2</sup> LRP = low revegetation potential

<sup>3</sup> pH ≤ 5.5

Source: NRCS 2014b.

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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.

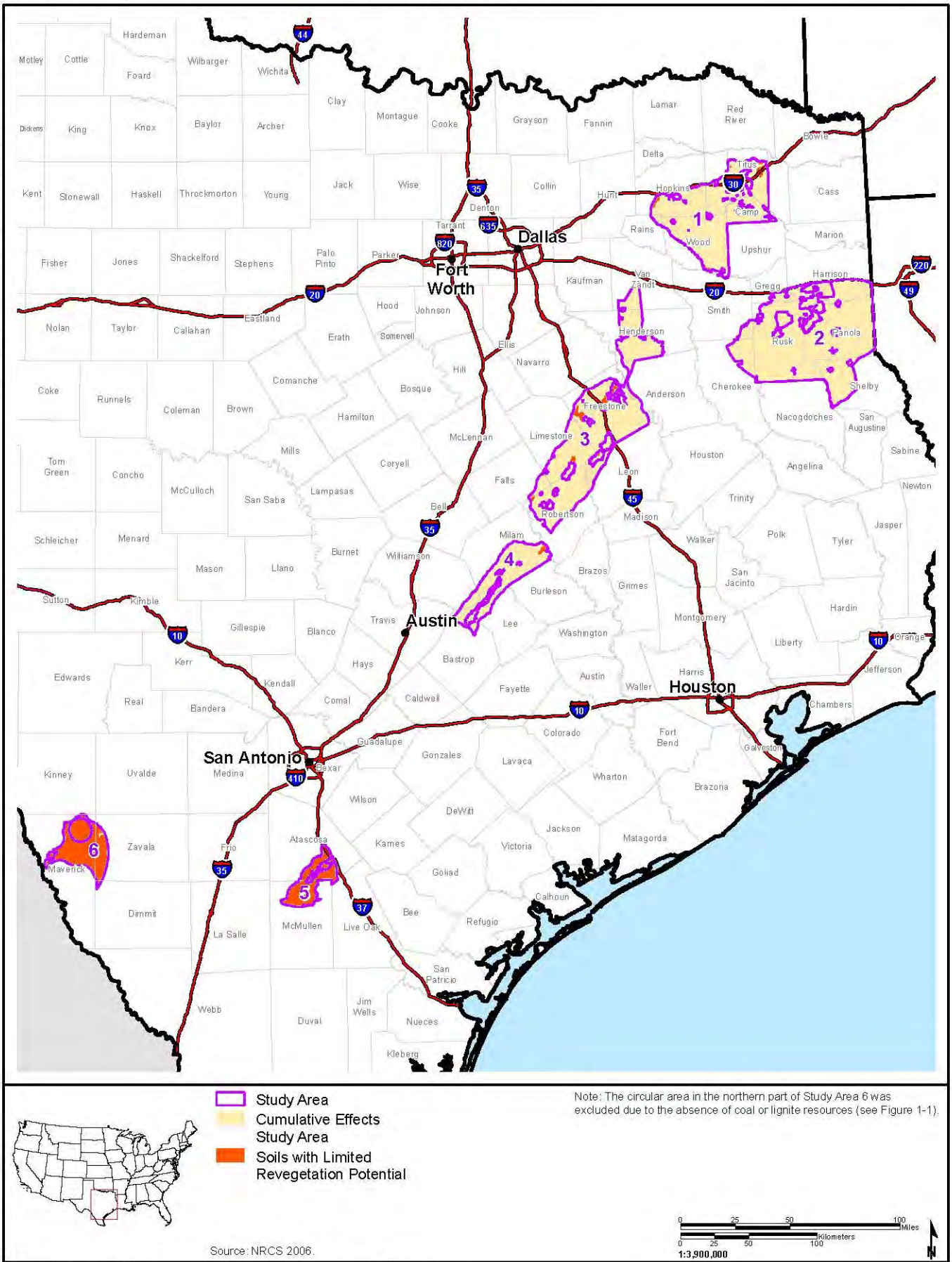
Soil compaction occurs when soil particles are pressed together and the pore spaces between them are reduced. Soil compaction destroys soil structure, reduces porosity, limits water and air infiltration, and increases resistance to root penetration. Moist, fine textured soils are most susceptible to 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.

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- Study Area
- Cumulative Effects Study Area
- Soils with Limited Revegetation Potential

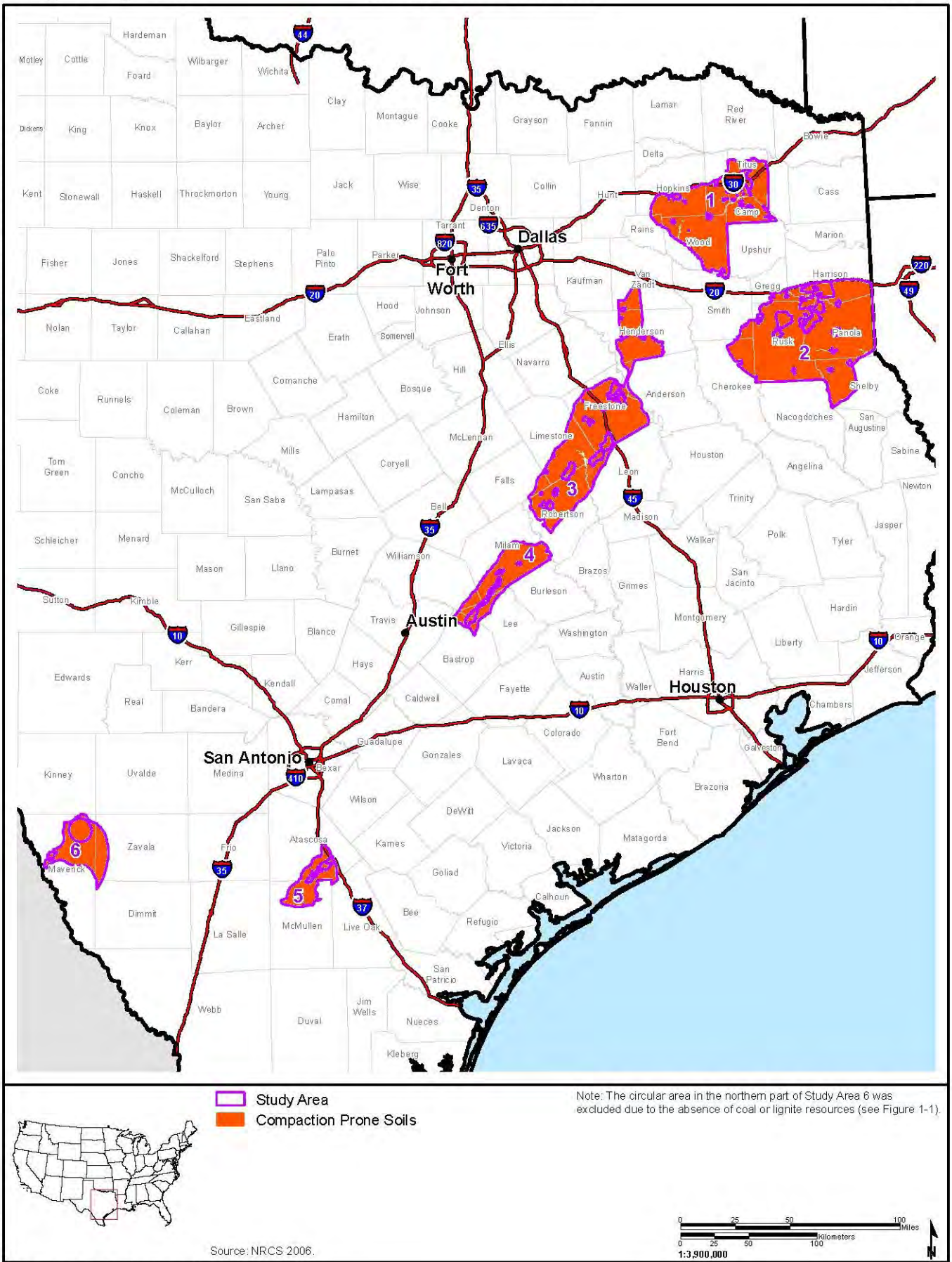
Note: The circular area in the northern part of Study Area 6 was excluded due to the absence of coal or lignite resources (see Figure 1-1).

Source: NRCS 2006.

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Figure 3.3-3 Soils with Limited Revegetation Potential

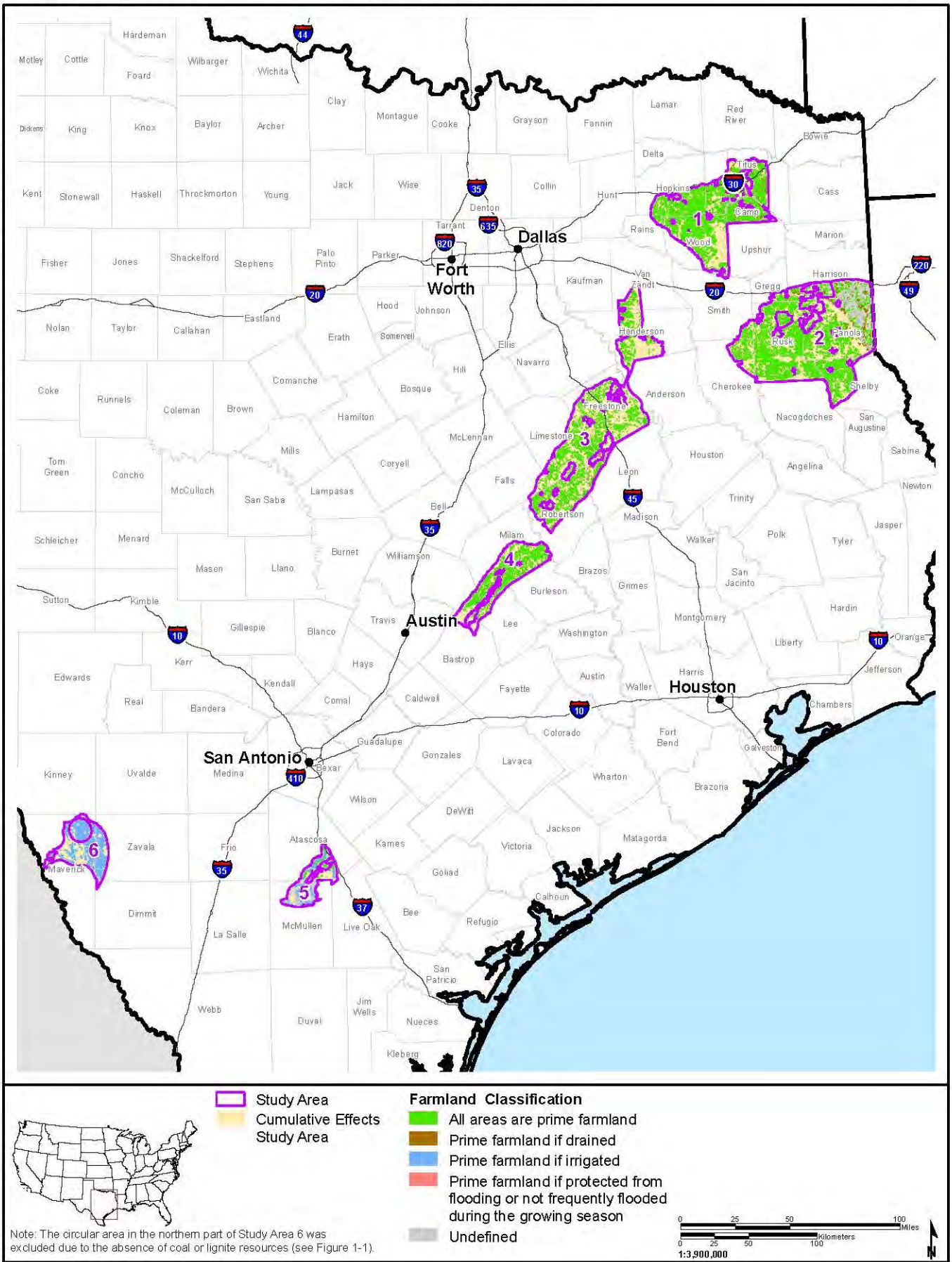
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Figure 3.3-4 Compaction Prone Soils

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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	<b>248,983</b>	0	0	0	0	<b>85,365</b>	34	0	0	<b>163,617</b>	66
Total	<b>4,376,121</b>	822,655	19	33,841	1	<b>122,912</b>	3	3,177	<1	<b>3,282,737</b>	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 <sup>1</sup>	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

<sup>1</sup> 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).

#### Southern Texas Plains (31)

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*), bristlegresses (*Setaria* spp.), lovegrasses (*Eragrostis* spp.), and tobosa (*Pleuraphis mutica*). Grass species on drier or overgrazed areas include red grama (*Bouteloua trifida*), Texas grama (*Bouteloua rigidisetata*), buffalograss (*Buchloe dactyloides*), and curlymesquite (*Hilaria belangeri*).

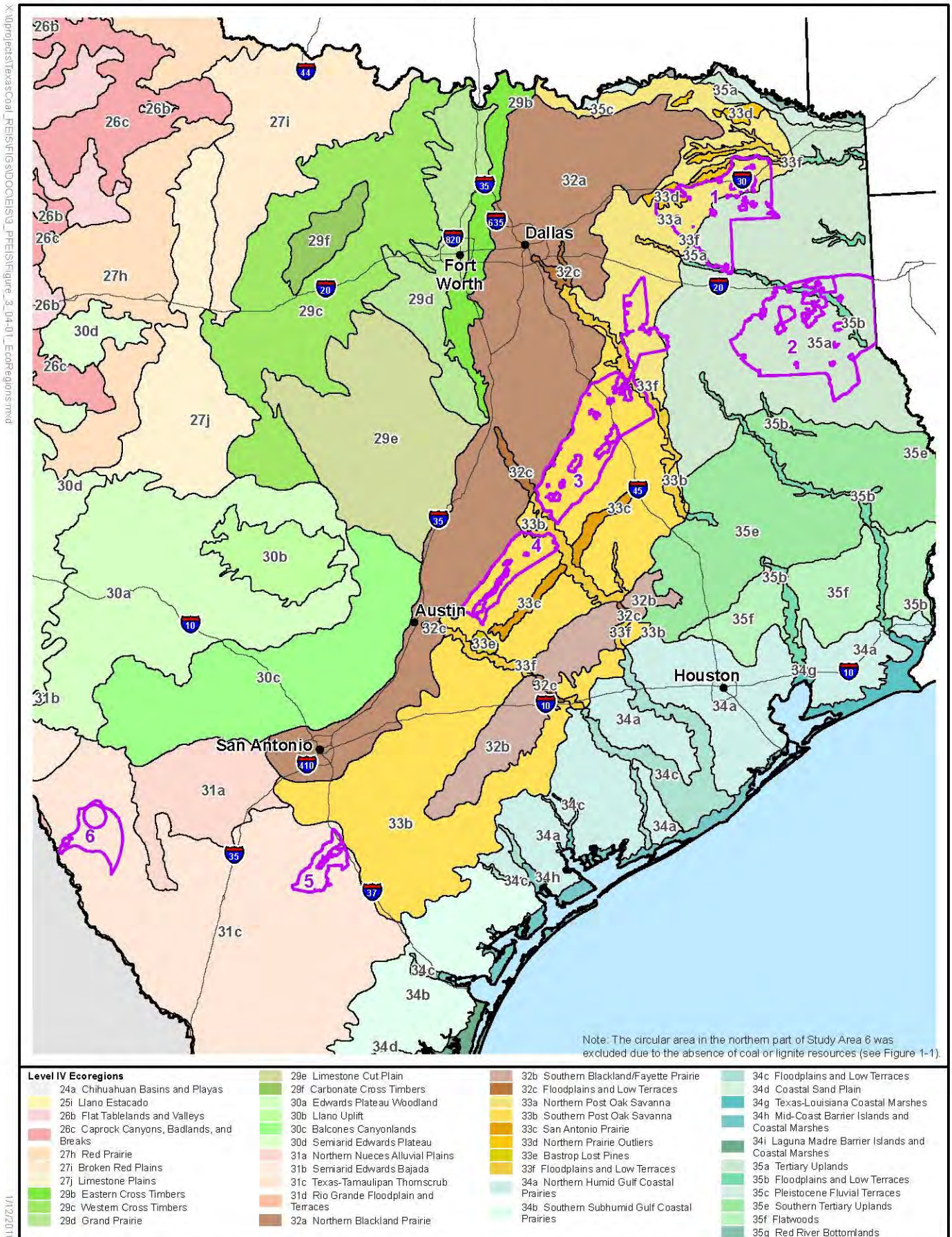


Figure 3.4-1 Level IV Ecoregions

**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)		Total
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)	
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	<b>248,960</b>	23	0	0	0	0	0	0	0	<b>248,983</b>
Total	<b>429,802</b>	23	19,880	683,775	1,272,206	49,699	41,449	1,792,218	87,012	<b>4,376,063</b>

### *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.

### Texas Blackland Prairies (32)

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 indiagrass (*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 cherts, 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 indiagrass, 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.

### East Central Texas Plains (33)

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 indiagrass, 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 indiagrass, 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 illinoensis*), 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.

#### South Central Plains (35)

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 indiagrass, 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 <sup>1</sup>	Study Areas (acres)					
	1	2	3	4	5	6
Agriculture	30,045	89,263	46,566	6,095	2,003	<b>3,224</b>
Coastal Barrens and Glades	0	140	0	0	0	0
Disturbed Prairie	130,304	334,678	20,337	19,100	33,385	<b>31,837</b>
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	<b>16,004</b>
ROWS	11,881	15,863	11,967	2,120	0	770
Scrub, Thornscrub, Shrubland	0	0	0	0	85,640	<b>158,656</b>
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	<b>1,582</b>
Wet Savanna, Swamp, Baygall	505	2,118	0	0	0	0
<b>Total Acreage<sup>2</sup></b>	<b>912,496</b>	<b>1,449,251</b>	<b>1,219,144</b>	<b>365,348</b>	<b>180,841</b>	<b>248,983</b>

<sup>1</sup> Based on TxDOT vegetation classes plus ROWs.

<sup>2</sup> Differences are due to rounding.

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 indiagrass, 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 Plateau 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. Dominant 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, dominant 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 (*Symphotrichum 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 dominant pine species include loblolly pine and shortleaf pine, with longleaf pine (*Pinus palustris*) dominant 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*), fringleaf paspalum (*Paspalum setaceum*), threeawns, rough dropseed (*Sporobolus clandestinus*), fall witchgrass (*Digitaria cognata*), Scribner's panicgrass (*Dichantherium oligosanthes* var. *scribnerianum*), and Heller's rosette grass (*Dichantherium 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 (*Dichantherium* 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 Pineywoods 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 jorii*), 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.

Dominant 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 pennsylvanica*), 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.

Dominant 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 dominant 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 dominant 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 steamed bristlegrass often are present, as are forbs and 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 (*Symphotrichum 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 plume grass (*Saccharum giganteum*), and gaping panicum (*Steinchisma hians*). Sedges and rushes may include false nutgrass (*Cyperus strigosus*), needle spikeweed (*Eleocharis acicularis*), hairy umbrellaweed (*Fuirena squarrosa*), forked rush (*Juncus dichotomus*), slimpod rush (*Juncus diffusissimus*), common rush (*Juncus effusus*), and beakrushes (*Rhynchospora* spp.).

### Tallgrass Prairie, Grassland

The Tallgrass 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 balsamgrass (*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 (*Cnidocolus texanus*), lazy daisy (*Aphanostephus skirrhobasis*), black-

eyed 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 <sup>1</sup>	Ecoregion	County	Common Name	Scientific Name	Habitat <sup>2</sup>	ESA Status <sup>3</sup>	State Status <sup>3</sup>
2	South Central Plains	Cherokee and Harrison	Neches River rose-mallow	<i>Hibiscus dasycalyx</i>	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)	<i>Geocarpon minimum</i>	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	<i>Abronia macrocarpa</i>	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	<i>Spiranthes parksii</i>	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 <sup>1</sup>	Ecoregion	County	Common Name	Scientific Name	Habitat <sup>2</sup>	ESA Status <sup>3</sup>	State Status <sup>3</sup>
6	Southern Texas Plains	Kinney	Tobusch fishhook cactus	<i>Sclerocactus brevihamatus</i> <i>ssp tobuschii</i>	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	<i>Styrax platanifolius</i> <i>ssp texanus</i>	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

<sup>1</sup> Based on USFWS Information, Planning, and Conservation, TPWD, and LDWF county list searches.

<sup>2</sup> Based on habitat descriptions from TPWD (2014a) county lists.

<sup>3</sup> 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 stemmed 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 it 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 **10.0** 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 on 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**

<b>Study Area</b>	<b>Disturbance Area Inside Study Area (acres)</b>	<b>Disturbance Area Outside Study Area/Inside CESA (acres)</b>	<b>Total CESA Disturbance Area (acres)</b>
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 at 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	<b>248,983</b>	0	0	0	<b>248,983</b>
<b>Total</b>	<b>429,825</b>	<b>19,880</b>	<b>2,047,129</b>	<b>1,879,230</b>	<b>4,376,063</b>

**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
<b>Total</b>	<b>637,368</b>	<b>32,517</b>	<b>3,918,711</b>	<b>2,317,232</b>	<b>6,905,828</b>

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 **Table 3.4-2**. 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 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 it 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. No Date). 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. No Date).

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

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

Common Name	Scientific Name	Seasonal Occurrence
Wood Thrush	<i>Hylocichla mustelina</i>	Breeding
Worm-eating Warbler	<i>Helmitheros vermivorum</i>	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 <sup>1</sup>	State Status <sup>1</sup>	Counties						
				Camp	Franklin	Hopkins	Rains	Smith	Titus	Wood
<b>Birds</b>										
American Peregrine Falcon	<i>Falco peregrinus anatum</i>		T	X	X	X	X	X	X	X
Bachman's Sparrow	<i>Aimophila aestivalis</i>		T	X	X	X	X	X	X	X
Bald Eagle	<i>Haliaeetus leucocephalus</i>		T	X	X	X	X	X	X	X
Interior Least Tern	<i>Sterna antillarum athalassos</i>	E	E	X	X	X	X	X	X	X
Peregrine Falcon	<i>Falco peregrinus</i>		T	X	X	X	X	X	X	X
Wood Stork	<i>Mycteria americana</i>		T	X	X	X	X	X	X	X
<b>Mammals</b>										
Louisiana Black Bear	<i>Ursus americanus luteolus</i>	T	T							
Black Bear	<i>Ursus americanus</i>	T/SA	T	X	X	X	X	X	X	X
Rafinesque's big-eared bat	<i>Corynorhinus rafinesquii</i>		T							
<b>Reptiles</b>										
Louisiana Pine Snake	<i>Pituophis ruthveni</i>	C	T					X		X
Northern Scarlet Snake	<i>Cemophora coccinea copei</i>		T	X	X		X	X	X	X
Texas Horned Lizard	<i>Phrynosoma cornutum</i>		T	X	X	X	X	X	X	X
Timber/Canebreak rattlesnake	<i>Crotalus horridus</i>		T	X	X	X	X	X	X	X

<sup>1</sup> 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	<i>Falco sparverius ssp. paulus</i>	Year-round
American Bittern	<i>Botaurus lentiginosus</i>	Wintering
Bald Eagle	<i>Haliaeetus leucocephalus</i>	Wintering, Year-round
Bell's Vireo	<i>Vireo bellii</i>	Breeding
Bewick's Wren	<i>Thryomanes bewickii ssp. bewickii</i>	Wintering
Brown-headed Nuthatch	<i>Sitta pusilla</i>	Year-round
Chuck-will's-widow	<i>Caprimulgus carolinensis</i>	Breeding
Harris's Sparrow	<i>Zonotrichia querula</i>	Wintering
Le Conte's Sparrow	<i>Ammodramus leconteii</i>	Wintering
Least Bittern	<i>Ixobrychus exilis</i>	Breeding
Lesser Yellowlegs	<i>Tringa flavipes</i>	Wintering
Little Blue Heron	<i>Egretta caerulea</i>	Breeding
Mississippi Kite	<i>Ictinia mississippiensis</i>	Breeding
Orchard Oriole	<i>Icterus spurius</i>	Breeding
Rusty Blackbird	<i>Euphagus carolinus</i>	Wintering
Swainson's Warbler	<i>Limnithlypis swainsonii</i>	Breeding
Wood Thrush	<i>Hylocichla mustelina</i>	Breeding
Worm-eating Warbler	<i>Helmitheros vermivorum</i>	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 <sup>1</sup>	State Status <sup>1</sup>	Counties						
				Cherokee	Gregg	Harrison	Panola	Rusk	Shelby	Smith
American Peregrine Falcon	<i>Falco peregrinus anatum</i>		T	X	X	X	X	X	X	X
Bachman's Sparrow	<i>Aimophila aestivalis</i>		T	X	X	X	X	X	X	X
Bald Eagle	<i>Haliaeetus leucocephalus</i>		T	X	X	X	X	X	X	X
Interior Least Tern	<i>Sterna antillarum athalassos</i>	E	E	X	X	X	X	X	X	X
Peregrine Falcon	<i>Falco peregrinus</i>		T	X	X	X	X	X	X	X
Red-cockaded Woodpecker	<i>Picoides borealis</i>	E	E	X			X		X	
Sprague's Pipit	<i>Anthus spragueii</i>	C								
Swallow-tailed Kite	<i>Elanoides forficatus</i>		T						X	
Wood Stork	<i>Mycteria americana</i>		T	X	X	X	X	X	X	X
<b>Mammals</b>										
Louisiana Black Bear	<i>Ursus americanus luteolus</i>	T	T	X	X	X	X	X	X	
Black Bear	<i>Ursus americanus</i>	T/SA	T	X	X	X	X	X	X	X
Rafinesque's Big-eared Bat	<i>Corynorhinus rafinesquii</i>		T	X	X	X	X	X	X	
<b>Reptiles</b>										
Louisiana Pine Snake	<i>Pituophis ruthveni</i>	C	T	X				X	X	X
Northern Scarlet Snake	<i>Cemophora coccinea copei</i>		T	X	X	X	X	X	X	X
Texas Horned Lizard	<i>Phrynosoma cornutum</i>		T	X				X		X
Timber/Canebrake Rattlesnake	<i>Crotalus horridus</i>		T	X	X	X	X	X	X	X

<sup>1</sup> 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	<i>Falco sparverius ssp. paulus</i>	Year-round
Bald Eagle	<i>Haliaeetus leucocephalus</i>	Wintering, Year-round
Bell's Vireo	<i>Vireo bellii</i>	Breeding
Brown-headed Nuthatch	<i>Sitta pusilla</i>	Year-round
Burrowing Owl	<i>Athene cunicularia</i>	Wintering
Harris's Sparrow	<i>Zonotrichia querula</i>	Wintering
Lark Bunting	<i>Calamospiza melanocorys</i>	Wintering
Le Conte's Sparrow	<i>Ammodramus leconteii</i>	Wintering
Least Bittern	<i>Ixobrychus exilis</i>	Breeding
Lesser Yellowlegs	<i>Tringa flavipes</i>	Wintering
Little Blue Heron	<i>Egretta caerulea</i>	Breeding
Louisiana Waterthrush	<i>Parkesia motacilla</i>	Breeding
Mississippi Kite	<i>Ictinia mississippiensis</i>	Breeding
Mountain Plover	<i>Charadrius montanus</i>	Wintering
Orchard Oriole	<i>Icterus spurius</i>	Breeding
Rusty Blackbird	<i>Euphagus carolinus</i>	Wintering
Scissor-tailed Flycatcher	<i>Tyrannus forficatus</i>	Breeding
Swainson's Warbler	<i>Limnithlypis swainsonii</i>	Breeding
Wood Thrush	<i>Hylocichla mustelina</i>	Breeding
Worm-eating Warbler	<i>Helmitheros vermivorum</i>	Breeding, Migrating
Yellow Rail	<i>Coturnicops noveboracensis</i>	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 <sup>1</sup>	State Status <sup>1</sup>	County							
				Anderson	Falls	Freestone	Henderson	Leon	Limestone	Robertson	Van Zandt
<b>Birds</b>											
American Peregrine Falcon	<i>Falco peregrinus anatum</i>		T	X	X	X	X	X	X	X	X
Bachman's Sparrow	<i>Aimophila aestivalis</i>		T	X		X	X	X			X
Bald Eagle	<i>Haliaeetus leucocephalus</i>		T	X	X	X	X	X	X	X	X
Interior Least Tern	<i>Sterna antillarum athalassos</i>	E	E	X	X	X	X	X	X	X	X
Peregrine Falcon	<i>Falco peregrinus</i>		T	X	X	X	X	X	X	X	X
White-faced Ibis	<i>Plegadis chihi</i>		T	X	X				X		
Whooping Crane	<i>Grus americana</i>	E	E	X	X	X	X	X	X	X	X
Wood Stork	<i>Mycteria americana</i>		T	X	X	X	X	X	X	X	X
<b>Mammals</b>											
Louisiana Black Bear	<i>Ursus americanus luteolus</i>	T	T	X				X		X	
Black Bear	<i>Ursus americanus</i>	T/SA	T	X			X				X
<b>Reptiles</b>											
Northern Scarlet Snake	<i>Cemophora coccinea copei</i>		T				X				X
Texas Horned Lizard	<i>Phrynosoma cornutum</i>		T	X	X	X	X	X	X	X	X
Timber/Canebrake Rattlesnake	<i>Crotalus horridus</i>		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) (**Table 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	<i>Icterus graduacauda</i>	Year-round
Bald Eagle	<i>Haliaeetus leucocephalus</i>	Wintering
Bell's Vireo	<i>Vireo bellii</i>	Breeding
Burrowing Owl	<i>Athene cunicularia</i>	Wintering, Year-round
Chestnut-collared Longspur	<i>Calcarius ornatus</i>	Wintering
Harris's Sparrow	<i>Zonotrichia querula</i>	Wintering
Lark Bunting	<i>Calamospiza melanocorys</i>	Wintering
Le Conte's Sparrow	<i>Ammodramus leconteii</i>	Wintering
Least Bittern	<i>Ixobrychus exilis</i>	Breeding
Lesser Yellowlegs	<i>Tringa flavipes</i>	Wintering
Little Blue Heron	<i>Egretta caerulea</i>	Breeding
Mississippi Kite	<i>Ictinia mississippiensis</i>	Breeding
Mountain Plover	<i>Charadrius montanus</i>	Wintering
Orchard Oriole	<i>Icterus spurius</i>	Breeding
Rufous-crowned Sparrow	<i>Aimophila ruficeps</i>	Year-round
Rusty Blackbird	<i>Euphagus carolinus</i>	Wintering
Scissor-tailed Flycatcher	<i>Tyrannus forficatus</i>	Breeding
Swainson's Warbler	<i>Limnothlypis swainsonii</i>	Breeding
Worm-eating Warbler	<i>Helmitheros vermivorum</i>	Breeding, Migrating
Yellow Rail	<i>Coturnicops noveboracensis</i>	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 <sup>1</sup>	State Status <sup>1</sup>	Counties				
				Bastrop	Burleson	Lee	Milam	Williamson
<b>Birds</b>								
American Peregrine Falcon	<i>Falco peregrinus anatum</i>		T	X	X	X	X	X
Bald Eagle	<i>Haliaeetus leucocephalus</i>		T	X	X	X	X	X
Black-capped Vireo	<i>Vireo atricapilla</i>	E	E					X
Golden-cheeked Warbler	<i>Setophaga chrysoparia</i>	E	E					X
Interior Least Tern	<i>Sterna antillarum athalassos</i>	E	E	X	X	X	X	
Peregrine Falcon	<i>Falco peregrinus</i>		T	X	X	X	X	X
Whooping Crane	<i>Grus americana</i>	E	E	X	X	X	X	X
Wood Stork	<i>Mycteria americana</i>		T	X	X	X	X	
<b>Mammals</b>								
Louisiana Black Bear	<i>Ursus americanus luteolus</i>	T	T		X			
<b>Reptiles</b>								
Texas Horned lizard	<i>Phrynosoma cornutum</i>		T	X	X	X	X	X
Timber/Canebrake Rattlesnake	<i>Crotalus horridus</i>		T	X	X	X	X	X

<sup>1</sup> 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	<i>Icterus graduacauda</i>	Year-round
Audubon's Shearwater	<i>Puffinus lherminieri</i>	Wintering
Bald Eagle	<i>Haliaeetus leucocephalus</i>	Wintering
Bell's Vireo	<i>Vireo bellii</i>	Breeding
Black Skimmer	<i>Rynchops niger</i>	Year-round
Burrowing Owl	<i>Athene cunicularia</i>	Wintering
Cassin's Sparrow	<i>Aimophila cassinii</i>	Year-round
Chestnut-collared Longspur	<i>Calcarius ornatus</i>	Wintering
Curve-billed Thrasher	<i>Toxostoma curvirostre</i>	Year-round
Harris's Hawk	<i>Parabuteo unicinctus</i>	Year-round
Harris's Sparrow	<i>Zonotrichia querula</i>	Wintering
Hooded Oriole	<i>Icterus cucullatus</i>	Breeding
Lark Bunting	<i>Calamospiza melanocorys</i>	Wintering
Le Conte's Sparrow	<i>Ammodramus leconteii</i>	Wintering
Least Bittern	<i>Ixobrychus exilis</i>	Breeding
Lesser Yellowlegs	<i>Tringa flavipes</i>	Wintering
Little Blue Heron	<i>Egretta caerulea</i>	Breeding
Mountain Plover	<i>Charadrius montanus</i>	Wintering
Orchard Oriole	<i>Icterus spurius</i>	Breeding
Scissor-tailed Flycatcher	<i>Tyrannus forficatus</i>	Breeding
Sedge Wren	<i>Cistothorus platensis</i>	Wintering
Solitary Sandpiper	<i>Tringa solitaria</i>	Wintering
Summer tanager	<i>Piranga rubra</i>	Breeding
Verdin	<i>Auriparus flaviceps</i>	Year-round
Worm-eating Warbler	<i>Helmitheros vermivorum</i>	Migrating
Yellow Rail	<i>Coturnicops noveboracensis</i>	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 <sup>1</sup>	State Status <sup>1</sup>	Counties		
				Atascosa	Live Oak	McMullen
<b>Birds</b>						
American Peregrine Falcon	<i>Falco peregrinus anatum</i>		T	X	X	X
Peregrine Falcon	<i>Falco peregrinus</i>		T	X	X	X
Sprague's Pipit	<i>Anthus spragueii</i>	C		X	X	X
White-tailed Hawk	<i>Buteo albicaudatus</i>		T		X	
Whooping Crane	<i>Grus americana</i>	E	E	X	X	X
Wood Stork	<i>Mycteria americana</i>		T	X	X	X
<b>Mammals</b>						
Black Bear	<i>Ursus americanus</i>	T/SA	T	X		X
Jaguarundi	<i>Herpailurus yaguarondi</i>	E	E		X	
Ocelot	<i>Leopardus pardalis</i>	E	E	X	X	X
<b>Reptiles</b>						
Reticulate collared lizard	<i>Crotaphytus reticulatus</i>		T		X	X
Texas horned lizard	<i>Phrynosoma cornutum</i>		T	X	X	X
Texas indigo snake	<i>Drymarchon melanurus erebennus</i>		T	X	X	X
Texas tortoise	<i>Gopherus berlandieri</i>		T	X	X	X

<sup>1</sup> 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 64 percent) (Table 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	<i>Icterus graduacauda</i>	Year-round
Bald Eagle	<i>Haliaeetus leucocephalus</i>	Wintering
Bell's Vireo	<i>Vireo bellii</i>	Breeding
Brewer's Sparrow	<i>Spizella breweri</i>	Wintering
Burrowing Owl	<i>Athene cunicularia</i>	Wintering, Year-round
Cassin's Sparrow	<i>Aimophila cassinii</i>	Year-round
Chestnut-collared Longspur	<i>Calcarius ornatus</i>	Wintering
Curve-billed Thrasher	<i>Toxostoma curvirostre</i>	Year-round
Curve-billed Thrasher	<i>Toxostoma curvirostre</i>	Breeding
Harris's Hawk	<i>Parabuteo unicinctus</i>	Year-round
Harris's Sparrow	<i>Zonotrichia querula</i>	Wintering
Hooded Oriole	<i>Icterus cucullatus</i>	Breeding
Lark Bunting	<i>Calamospiza melanocorys</i>	Wintering
Least Bittern	<i>Ixobrychus exilis</i>	Breeding
Lesser Yellowlegs	<i>Tringa flavipes</i>	Wintering
Mountain Plover	<i>Charadrius montanus</i>	Wintering
Orchard Oriole	<i>Icterus spurius</i>	Breeding
Rufous-crowned Sparrow	<i>Aimophila ruficeps</i>	Year-round
Summer Tanager	<i>Piranga rubra</i>	Breeding
Verdin	<i>Auriparus flaviceps</i>	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 <sup>1</sup>	State Status <sup>1</sup>	Counties			
				Dimmit	Kinney	Maverick	Zavala
<b>Birds</b>							
American Peregrine Falcon	<i>Falco peregrinus anatum</i>		T	X	X	X	X
Black-capped Vireo	<i>Vireo atricapilla</i>	E	E		X		
Golden-cheeked Warbler	<i>Setophaga chrysoparia</i>	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 <sup>1</sup>	State Status <sup>1</sup>	Counties			
				Dimmit	Kinney	Maverick	Zavala
Peregrine Falcon	<i>Falco peregrinus</i>		T	X	X	X	X
Sprague's Pipit	<i>Anthus spragueii</i>	C		X	X	X	X
Zone-tailed Hawk	<i>Buteo albonotatus</i>		T		X		
<b>Mammals</b>							
Black Bear	<i>Ursus americanus</i>	T/SA	T	X	X	X	X
Jaguarundi	<i>Herpailurus yaguarondi</i>	E	E	X		X	
Ocelot	<i>Leopardus pardalis</i>	E	E	X	X	X	X
White-nosed coati	<i>Nasua narica</i>		T	X	X	X	X
<b>Reptiles</b>							
Reticulate collared lizard	<i>Crotaphytus reticulatus</i>		T	X	X	X	X
Texas horned lizard	<i>Phrynosoma cornutum</i>		T	X	X	X	X
Texas indigo snake	<i>Drymarchon melanurus erebennus</i>		T	X	X	X	X
Texas tortoise	<i>Gopherus berlandieri</i>		T	X	X	X	X

<sup>1</sup> 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	<p><u>TPWD</u></p> <ul style="list-style-type: none"> <li>• Chapter 12 of the Texas Parks and Wildlife Code for protection of fish and wildlife resources.</li> <li>• 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.</li> <li>• <b>Chapter 68 of the Texas Parks and Wildlife Code regarding the introduction or relocation of non-listed species.</b></li> <li>• Section 68.002 of the Texas Parks and Wildlife Code that identifies endangered and threatened species in Texas.</li> <li>• Section 68.015 and 65.171 prohibits the take of state-listed species.</li> </ul> <p><u>Federal</u></p> <ul style="list-style-type: none"> <li>• Endangered Species Act—protect federally listed species.</li> <li>• 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.</li> </ul>
Invasive Species Control	<ul style="list-style-type: none"> <li>• Chapter 12 of the Texas Parks and Wildlife Code for the control of nuisance or <b>invasive</b> aquatic species.</li> <li>• <b>Chapter 57 of the Texas Parks and Wildlife Code for protection against the introduction of harmful or potentially harmful exotic fish, shellfish, and aquatic plants.</b></li> </ul>

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) **and waterbodies that support special status species, as discussed for each of the study areas.** 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**.

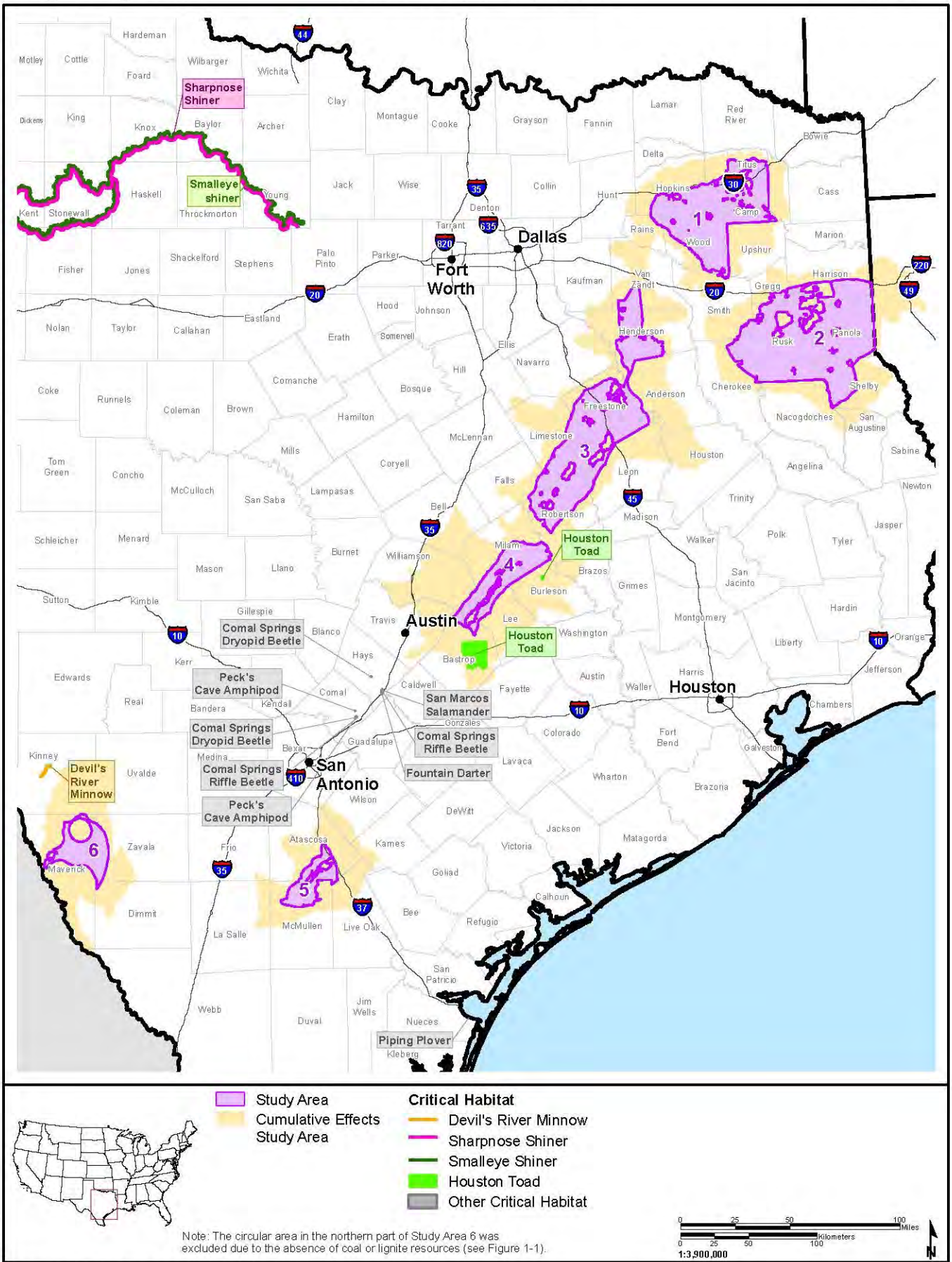
## Study Areas

### *Study Area 1*

#### Habitat

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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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
<b>Area 1</b>																								
Lake Fork	Dry-Creek-Lake Fork Creek Lake Fork Creek-Case Lake Running Creek-Case Lake								X															
Lake O' the Pines	Boggy Creek Brushy Creek-Big Cypress Creek Glade Branch-Big Cypress Creek		X		X				X		X	X				X								
Little Cypress	Little Cypress Creek				X		X	X			X		X			X								
Middle Sabine	Lake Winnsboro-Big Sandy Creek Old Sabine River Channel-Sabine River		X		X		X		X	X	X	X	X			X		X		X				
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 Upper White Oak Creek				X			X								X								
<b>Area 2</b>																								
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								
	Nacouche-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 Shawnee Creek-Angelina River Johnson Creek		X		X		X	X	X		X	X				X								
<b>Area 3</b>																								
Cedar	Cedar Creek Reservoir-Cedar Creek				X			X	X		X		X											
Lower Brazos-Little Brazos	Cedar Creek-Brazos River Little Brazos River-Brazos River Walnut Creek-Brazos River	X	X		X		X	X	X	X	X	X	X			X		X						
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 Cattfish Creek Lake Creek-Trinity River 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 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
<b>Area 4</b>																								
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				X			X																
	Lower Elm Creek Upper Little River																							
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			X	X	X	X				X	X	X					X						
	Turkey Creek-Brushy Creek																							
Yegua	Davidson Creek East Yegua River		X		X			X	X		X	X	X				X							
<b>Area 5</b>																								
Atascosa	Borrego Creek-Atascosa River	X						X			X													
	La Jarita Creek-San Miguel Creek																							
	La Jarita Creek-San Atascosa 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	
	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													
<b>Area 6</b>																									
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) <sup>1</sup>	Chaparrosa Creek Lower Turkey Creek Palo Blanco Creek-Comanche Creek																								

<sup>1</sup> 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**

<b>Study Area; Lake/Reservoir</b>	<b>Largemouth Bass</b>	<b>Sunfish Species</b>	<b>Bluegill</b>	<b>Redear Sunfish</b>	<b>Crappie Species</b>	<b>Spotted Bass</b>	<b>Catfish Species</b>	<b>Bluehead Catfish</b>	<b>Channel Catfish</b>	<b>Flathead Catfish</b>	<b>Spotted Bass</b>	<b>White Bass</b>	<b>Hybrid Striped Bass</b>	<b>Chain Pickerel</b>	<b>Red Drum</b>	<b>Smallmouth Buffalo</b>	<b>Carp</b>
<b>Study Area 1</b>																	
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					
<b>Study Area 2</b>																	
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								
<b>Study Area 3</b>																	
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
<b>Study Area 5</b>																	
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 2014b.

Table 3.5-18 Federal and State Listed Aquatic Species with Potential Habitat in the Study Area Counties

Common Name	Fish							Mussels													Amphibians		Reptiles		
	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	<i>Percina maculata</i>	<i>Cypleptus elongatus</i>	<i>Pteronotropis hubbsi</i>	<i>Erimyzon oblongus</i>	<i>Polydon spathula</i>	<i>Scaphirhynchus albus</i>	<i>Etheostoma grahami</i>	<i>Quadrula aurea</i>	<i>Truncilla cognata</i>	<i>Potamilus metnecktayi</i>	<i>Lampsilis satura</i>	<i>Quadrula houstonensis</i>	<i>Obovaria jacksoniana</i>	<i>Lampsilis bracteata</i>	<i>Truncilla macrodon</i>	<i>Potamilus amphichaenus</i>	<i>Poponia poppei</i>	<i>Fusconaia askewi</i>	<i>Quadrula petrina</i>	<i>Fusconaia lananensis</i>	<i>Notophthalmus meridialis</i>	<i>Anaxyrus houstonensis</i>	<i>Macrocelys temminckii</i>	<i>Nerodia harteri</i>	
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	
<b>Study Area 1 Counties</b>																									
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	
<b>Study Area 2 Counties</b>																									
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																			
<b>Study Area 3 Counties</b>																									
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

Common Name	Fish							Mussels													Amphibians		Reptiles	
	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	<i>Percina maculata</i>	<i>Cypleptus elongatus</i>	<i>Pteronotropis hubbsi</i>	<i>Erimyzon oblongus</i>	<i>Polydon spathula</i>	<i>Scaphirhynchus albus</i>	<i>Etheostoma grahami</i>	<i>Quadrula aurea</i>	<i>Truncilla cognata</i>	<i>Potamilus metnecktayi</i>	<i>Lampsilis satura</i>	<i>Quadrula houstonensis</i>	<i>Obovaria jacksoniana</i>	<i>Lampsilis bracteata</i>	<i>Truncilla macrodon</i>	<i>Potamilus amphichaenus</i>	<i>Popenaia poppei</i>	<i>Fusconaia askewi</i>	<i>Quadrula petrina</i>	<i>Fusconaia lananensis</i>	<i>Notophthalmus meridionalis</i>	<i>Anaxyrus houstonensis</i>	<i>Macrocelys temminckii</i>	<i>Nerodia harteri</i>
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	
<b>Study Area 4 Counties</b>																								
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	
<b>Study Area 5 Counties</b>																								
Atascosa								X																
Frio (CESA)																								
Karnes (CESA)								X											X					
LaSalle (CESA)																								
Live Oak (CESA)								X													X			
McMullen								X													X			
Wilson (CESA)								X											X					
<b>Study Area 6 Counties</b>																								
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), redbfin 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 Attoyoc River (17 miles). Large reservoirs or lakes in Study Area 2 include Brandy Branch Reservoir, Lake Murvail, 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 redbfin 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, Purtil 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 Purtil 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 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*

##### Habitat

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 Atascosa 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.

##### Game Fish/Commercial Species

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**).

##### Special Status Species

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, endangered, **and species already experiencing population decline in the region.**

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 3.4-2** 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-detering 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	<b>248,983</b>	<b>10.0</b>	<b>24,898</b>

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 <sup>1</sup> (acres)									Estimated Percent of Study Area Potentially Disturbed under Anticipated Requests for Future Authorizations	Suitable Habitat Potentially Affected by Future Mining
	Lacustrine	Lacustrine Limnetic	Lacustrine Littoral	Lake/Pond-Perennial	Reservoir-Treatment/ Other Uses	Reservoir-Water Storage	Swamp/ Marsh	Riverine Lower Perennial	Total Acres		
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	<b>84,752</b>	<b>10.0</b>	<b>8,475</b>

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	<b>31,843</b>	<b>10.0</b>	<b>3,184</b>

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	<b>1,422</b>	<b>10.0</b>	<b>142</b>

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) **avoidance of rookeries and raptor nest sits during the breeding season, to the extent possible;** 2) conducting clearing operations during non-breeding periods, to the extent possible, to avoid the peak migratory bird breeding season; 3) increasing the availability of water sources away from active mining areas; and 4) 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	<b>10.0</b>	<b>2,615</b>

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 Area 5. 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<sup>1</sup> 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

<sup>1</sup> 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 country, often near watercourses, and wooded canyons and tree-lined rivers along middle-slopes of desert mountains). Approximately **246,632** 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 **24,663** 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	<b>26,769</b>	<b>10.0</b>	<b>2,677</b>

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	<b>246,632</b>	<b>10.0</b>	<b>24,663</b>

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**

<b>Study Area</b>	<b>Suitable Habitat (acres)</b>	<b>Estimated Percent of Study Area Potentially Disturbed under Anticipated Requests for Future Authorizations</b>	<b>Suitable Habitat Potentially Affected by Future Mining (acres)</b>
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 18,543 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	246,632	<b>10.0</b>	<b>24,663</b>

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	<b>193,717</b>	<b>10.0</b>	<b>19,372</b>

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	<b>30,093</b>	<b>10.0</b>	<b>3,009</b>

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	<b>217,262</b>	<b>10.0</b>	<b>21,726</b>

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.

No Action Alternative

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. **As required by RCT under TAC 12.146, surface water monitoring would be required to protect the quality and quantity of surface water resources. Baseline monitoring also would be required for mine-specific Probable Hydrologic Consequences determinations as part of this regulation for the purpose of protecting surface water. These requirements also would help minimize impacts to aquatic habitats.**

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 TAC 12.146 regulation for protecting surface water quality and quantity also would apply to this impact issue.**

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 **and animal** 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. **Other aquatic invasive species include the zebra mussel. TPWD guidelines require cleaning and drying of all equipment that contacts inland water (TPWD 2015b).**

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, sandbank 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, Purvis 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 4 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.

#### No Action

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, Purtil 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).

#### CESA 5

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.

#### CESA 6

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 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. **Procedures for cleaning and drying equipment are described in the *TPWD Clean/Drain/Dry Procedures for Contractors Working in Inland Public Waters (TPWD 2015b)*. A summary of the cleaning and drying process includes 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.
    - **Drain or eliminate all water from equipment and gear before leaving the area.**
    - Allow everything to completely dry before launching into new waters; **5 to 10** days in warm, dry weather and **15 to 20** days in cool, moist weather.
    - If sufficient drying time is not available, **use a high-pressure washer (preferably  $\geq 140^{\circ}\text{F}$ ) to ensure equipment is clean.**
  - **If fill material must be placed in another waterway, it should be decontaminated by stockpiling the materials in an open flat area and periodically turning and grading for up to 2 weeks to kill any zebra mussel adults or larvae.**
- Avoidance of Direct Effects to Protect 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 (**33 CFR 325**) 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. Department of 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.

### State

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<sup>th</sup> and 17<sup>th</sup> centuries on Galveston Island and in south Texas. However, by the early 18<sup>th</sup> 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<sup>th</sup> 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 Coahuiltecan 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<sup>th</sup> 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<sup>th</sup>-early 20<sup>th</sup> 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 20<sup>th</sup> 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.

#### Cultural Resources in the Study Areas

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
<b>Study Area 1</b>	
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**

<b>County</b>	<b>Culture</b>
<b>Study Area 2</b>	
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
<b>Study Area 3</b>	
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
<b>Study Area 4</b>	
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
<b>Study Area 5</b>	
Atascosa	Coahuiltecan, Comanche, Lipan Apache, Mescalero Apache, American, Euro-American, Mexican, Spanish
McMullen	Prehistoric (unspecified), Coahuiltecan, American, Euro-American, Mexican, Spanish
<b>Study Area 6</b>	
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 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 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.

### Study Area 2

According to the NPS (no date) and HUD (2014), 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.

#### Study Area 3

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 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]).

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 8 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.

### Study Area 5

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 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 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.

### Study Area 6

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 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 Lipan and Coahuiltec (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 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 Types of Historic Properties Potentially Affected by Mining Activities**

Study Area and County	Types of Historic Properties Potentially Affected <sup>1</sup>
<b>Study Area 1</b>	
Camp	<i>Direct:</i> Caddo, Spanish, Mexican, Euro-American, and American sites; historic standing structures (HSS); historic districts. <i>Indirect:</i> HSS; historic districts; historical markers, including Cherokee Trace and Center Point Community; museums; cemeteries; churches; schools.
Franklin	<i>Direct:</i> Caddo, Shawnee, Delaware, Kickapoo, Spanish, Mexican, Euro-American, and American sites; HSS; historic districts; cemeteries. <i>Indirect:</i> HSS; historic districts; historical markers, including Ripley Massacre and Capt. Hastings burial; cemeteries; churches.
Hopkins	<i>Direct:</i> Caddo, Cherokee, Spanish, Mexican, Euro-American, and American sites; HSS; historic districts. <i>Indirect:</i> HSS; historic districts; historical markers; museums; cemeteries; churches.
Rains	<i>Direct:</i> Comanche, Caddo, Spanish, Mexican, Euro-American, and American sites; HSS; historic districts. <i>Indirect:</i> HSS; cemetery.
Titus	<i>Direct:</i> Caddo, Creek, Choctaw, Cherokee, Spanish, Mexican, Euro-American, and American sites; HSS; historic districts. <i>Indirect:</i> HSS; historic districts; historical markers, including Caddo Indian Communities in Cypress Creek Drainage; cemeteries; churches; gravesites.
Wood	<i>Direct:</i> Caddo, Spanish, Mexican, Euro-American, and American sites; HSS; historic districts. <i>Indirect:</i> HSS; historic districts; historical markers, including Caddo Indian Communities in Wood County, Indian Cemetery and Villages; cemeteries; churches; schools.
<b>Study Area 2</b>	
Cherokee	<i>Direct:</i> Caddo, Neches, Nacachau, Cherokee, Delaware, Shawnee, Kickapoo, Spanish, Mexican, Euro-American, and American sites; HSS; historic districts. <i>Indirect:</i> HSS; historic districts; cemeteries; churches; a school.
Gregg	<i>Direct:</i> Caddo, Cherokee, Spanish, Mexican, Euro-American, and American sites; HSS; historic districts. <i>Indirect:</i> HSS; historic districts; historical markers; cemeteries; churches.
Harrison	<i>Direct:</i> Caddo, Spanish, Mexican, Euro-American, and American sites; HSS; historic districts. <i>Indirect:</i> HSS; historic districts; historical markers; cemeteries; churches.
Panola	<i>Direct:</i> Caddo, Hasinai, French, Spanish, Mexican, Euro-American, and American sites; HSS; historic districts. <i>Indirect:</i> HSS; historic districts; museums; historical markers, including the International Boundary Marker; cemeteries; churches; schools.
Rusk	<i>Direct:</i> Caddo, Cherokee, Spanish, Mexican, Euro-American, and American sites; HSS; historic districts. <i>Indirect:</i> HSS; historic districts; museums; historical markers; cemeteries; churches; schools; historical homes.

**Table 3.6-2 Types of Historic Properties Potentially Affected by Mining Activities**

<b>Study Area and County</b>	<b>Types of Historic Properties Potentially Affected<sup>1</sup></b>
Shelby	<i>Direct:</i> Caddo, Spanish, Mexican, Euro-American, and American sites; HSS; historic districts. <i>Indirect:</i> HSS; historic districts; historical marker at the Truitt Community; cemeteries; churches.
Smith	<i>Direct:</i> Caddo, Spanish, Mexican, Euro-American, and American sites; HSS; historic districts. <i>Indirect:</i> HSS; historic districts; historical markers; cemeteries; churches.
<b>Study Area 3</b>	
Anderson	<i>Direct:</i> Comanche, Waco, Tawakoni, Kickapoo, Kichai, Spanish, Mexican, Euro-American, and American sites; HSS; historic districts. <i>Indirect:</i> HSS; historic districts; historical markers, including Early Settlement of Northwestern Anderson County; cemeteries; churches.
Falls	<i>Direct:</i> Waco, Tawakoni, Anadarko, Cherokee, Spanish, Mexican, Euro-American, and American sites; HSS; historic districts. <i>Indirect:</i> HSS; historic districts; historical markers, including Sarahville de Viesca; cemeteries; churches.
Freestone	<i>Direct:</i> Caddo, Kichai, Tawakoni, Spanish, Mexican, Euro-American, and American sites; HSS; historic districts. <i>Indirect:</i> HSS; historic districts; historical markers, including burials of Generals Joseph Burton Johnson and John Gregg; cemeteries; churches; schools; ghost towns; a museum.
Henderson	<i>Direct:</i> Hasinai, Cherokee, Shawnee, Delaware, Kickapoo, Spanish, Mexican, Euro-American, and American sites; HSS; historic districts. <i>Indirect:</i> HSS; historic districts; historical markers; cemeteries; churches; ghost towns; a museum; a campground/tabernacle.
Leon	<i>Direct:</i> Deadose, Spanish, Mexican, Euro-American, and American sites; HSS; historic districts. <i>Indirect:</i> HSS; historic districts; historical markers, including Long Hollow Community; cemeteries; churches.
Limestone	<i>Direct:</i> Tawakoni, Waco, Comanche, Kiowa, Spanish, Mexican, Euro-American, Afro-American, and American sites; HSS; historic districts. <i>Indirect:</i> HSS; historic districts; historical markers, including the Union Community and Fort Parker; cemeteries; churches; schools; ghost towns.
Robertson	<i>Direct:</i> Tawakoni, Tonkawa, Waco, Comanche, Kiowa, Lipan Apache, Spanish, Mexican, Euro-American, and American sites; HSS; historic districts. <i>Indirect:</i> HSS; historic districts; historical markers, including the Harvey Massacre; cemeteries; churches; schools; ghost towns.
Van Zandt	<i>Direct:</i> Caddo, Cherokee, Spanish, Mexican, Euro-American, and American sites; HSS; historic districts. <i>Indirect:</i> HSS; historic districts; historical markers; cemeteries; churches.
<b>Study Area 4</b>	
Bastrop	<i>Direct:</i> Comanche, Tonkawa, Spanish, Mexican, Euro-American, Afro-American, and American sites; HSS; historic districts. <i>Indirect:</i> HSS; historic districts; historical markers, including the Rock Front Saloon; cemeteries; a church.
Burlson	<i>Direct:</i> Tonkawa, Caddo, Wichita, Spanish, Mexican, Euro-American, and American sites; HSS; historic districts. <i>Indirect:</i> HSS; historic districts.

**Table 3.6-2 Types of Historic Properties Potentially Affected by Mining Activities**

Study Area and County	Types of Historic Properties Potentially Affected <sup>1</sup>
Lee	<i>Direct:</i> Tonkawa, Comanche, Cherokee, Spanish, Mexican, Euro-American, and American sites; HSS; historic districts. <i>Indirect:</i> HSS; historic districts; historical markers; a church; a school; a masonic lodge.
Milam	<i>Direct:</i> Tonkawa, Lipan Apache, Caddo, Tehuacana, Waco, Spanish, Mexican, Euro-American, and American sites; HSS; historic districts. <i>Indirect:</i> HSS; historic districts; historical markers, including the Salty Community; cemeteries; churches.
Williamson	<i>Direct:</i> Tonkawa, Comanche, Cherokee, Spanish, Mexican, Euro-American, Afro-American, and American sites; HSS; historic districts. <i>Indirect:</i> HSS; historic districts; historical markers; a church; a school; a fraternal organization.
<b>Study Area 5</b>	
Atascosa	<i>Direct:</i> Coahuiltecan, Mescalero Apache, Lipan Apache, Comanche, Spanish, Mexican, Euro-American, and American sites; HSS; historic districts. <i>Indirect:</i> HSS; historic districts; cemeteries; a church.
McMullen	<i>Direct:</i> Coahuiltecan, Spanish, Mexican, Euro-American, and American sites; HSS; historic districts. <i>Indirect:</i> 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.
<b>Study Area 6</b>	
Dimmit	<i>Direct:</i> Coahuiltecan, Mescalero Apache, Lipan Apache, Comanche, Spanish, Mexican, Euro-American, and American sites; HSS; historic districts. <i>Indirect:</i> HSS; historic districts.
Kinney	<i>Direct:</i> Coahuiltecan, Jumano, Tamaulipan, Tonkawa, Mescalero Apache, Lipan Apache, Comanche, Spanish, Mexican, Euro-American, and American sites; HSS; historic districts. <i>Indirect:</i> HSS; historic districts.
Maverick	<i>Direct:</i> Coahuiltecan, Mescalero Apache, Lipan Apache, Kickapoo, Comanche, Spanish, Mexican, Euro-American, and American sites; HSS; historic districts. <i>Indirect:</i> HSS; historic districts; Fort Duncan.
Zavala	<i>Direct:</i> Coahuiltecan, Tonkawa, Mescalero Apache, Lipan Apache, Comanche, Spanish, Mexican, Euro-American, and American sites; HSS; historic districts. <i>Indirect:</i> HSS; historic districts.

<sup>1</sup> The types of historic properties in this table include prehistoric and historic archaeological sites or landscapes, with cultural affiliations where known. The sites or landscapes associated with the sites are those that are eligible for the NRHP, protected under the Antiquities Code of Texas, or cemeteries protected under TAC Title 13 Part 2 Chapter 22.

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 ( $\mu\text{g}/\text{m}^3$ ). 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.

##### National Ambient Air Quality Standards

The NAAQS establish maximum acceptable concentrations for criteria pollutants, including nitrogen dioxide ( $\text{NO}_2$ ), carbon monoxide (CO), sulfur dioxide ( $\text{SO}_2$ ), particulate matter with an aerodynamic diameter of 2.5 microns or less ( $\text{PM}_{2.5}$ ), particulate matter with an aerodynamic diameter of 10 microns or less ( $\text{PM}_{10}$ ), 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 2015c). 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  $\text{SO}_2$  concentrations in specific counties, as noted in the table. “No person in the State of Texas may cause, suffer, allow, or permit emissions of  $\text{SO}_2$  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  $\text{PM}_{10}$  and  $\text{PM}_{2.5}$  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 <sup>(1)</sup>	9 ppm	None
		(10 mg/m <sup>3</sup> ) <sup>(2)</sup>	
	1-hour <sup>(1)</sup>	35 ppm	None
		(40 mg/m <sup>3</sup> )	
Lead	Rolling 3-month Average	0.15 µg/m <sup>3</sup> <sup>(3)</sup>	Same as Primary
	Quarterly average	1.5 µg/m <sup>3</sup>	Same as Primary
NO <sub>2</sub>	Annual (arithmetic mean)	0.053 ppm (100 µg/m <sup>3</sup> )	Same as Primary
	1-hour <sup>(4)</sup>	0.100 ppm (189 µg/m <sup>3</sup> )	None
PM <sub>10</sub>	24-hour <sup>(5)</sup>	150 µg/m <sup>3</sup>	Same as Primary
PM <sub>2.5</sub>	Annual <sup>(6)</sup> (arithmetic mean)	12 µg/m <sup>3</sup>	15 µg/m <sup>3</sup>
	24-hour <sup>(7)</sup>	35 µg/m <sup>3</sup>	Same as Primary
Ozone	8-hour <sup>(8)</sup>	0.070 ppm	Same as Primary
SO <sub>2</sub>	3-hour <sup>(1)</sup>	None	0.5 ppm (1,300 µg/m <sup>3</sup> )
	1-hour <sup>(9)</sup>	0.075 ppm	None
	30-minute <sup>(10)</sup>	0.27 ppm	None

<sup>1</sup> Not to be exceeded more than once per year.

<sup>2</sup> mg/m<sup>3</sup> = milligrams per cubic meter.

<sup>3</sup> Not to be exceeded. Final rule signed October 15, 2008.

<sup>4</sup> 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).

<sup>5</sup> Not to be exceeded more than once per year on average over 3 years.

<sup>6</sup> To attain this standard, the 3-year average of the weighted annual mean PM<sub>2.5</sub> concentrations from single or multiple community-oriented monitors must not exceed 15.0 µg/m<sup>3</sup>.

<sup>7</sup> 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<sup>3</sup> (effective December 17, 2006).

<sup>8</sup> 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 0.070 ppm. This standard **was updated from the previous standard of 0.075 ppm on October 1, 2015 (USEPA 2015c,d).**

<sup>9</sup> Effective August 23, 2010.

<sup>10</sup> Texas AAQS 30-minute SO<sub>2</sub> 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.

**New Ozone Standard—Impact on Attainment Designations**

**On October 1, 2015, the USEPA strengthened the NAAQS for ozone from 0.075 ppm to 0.070 ppm based on extensive scientific evidence about ozone effects on public health and welfare (USEPA 2015d). This will likely impact some attainment area designations, especially those where attainment is based on ozone monitoring values above 0.070 ppm. Currently, attainment designations are based on the previous 0.075 ppm standard. According to USEPA (2015e), designating areas is typically a 2-year process (and in some cases 3). Final designations will utilize future air quality data (i.e., 2014-2016 data), and USEPA plans to issue new guidance to**



**facilitate the designation process in the near future. The statutory deadline for final area designations by USEPA is October 1, 2017, and state recommendations on area designation are due October 1, 2016 (USEPA 2015e). Thus, the attainment designation of some counties may change in the near future due to the new ruling.**

#### 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.

#### Air Quality Related Values

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**.

#### 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.

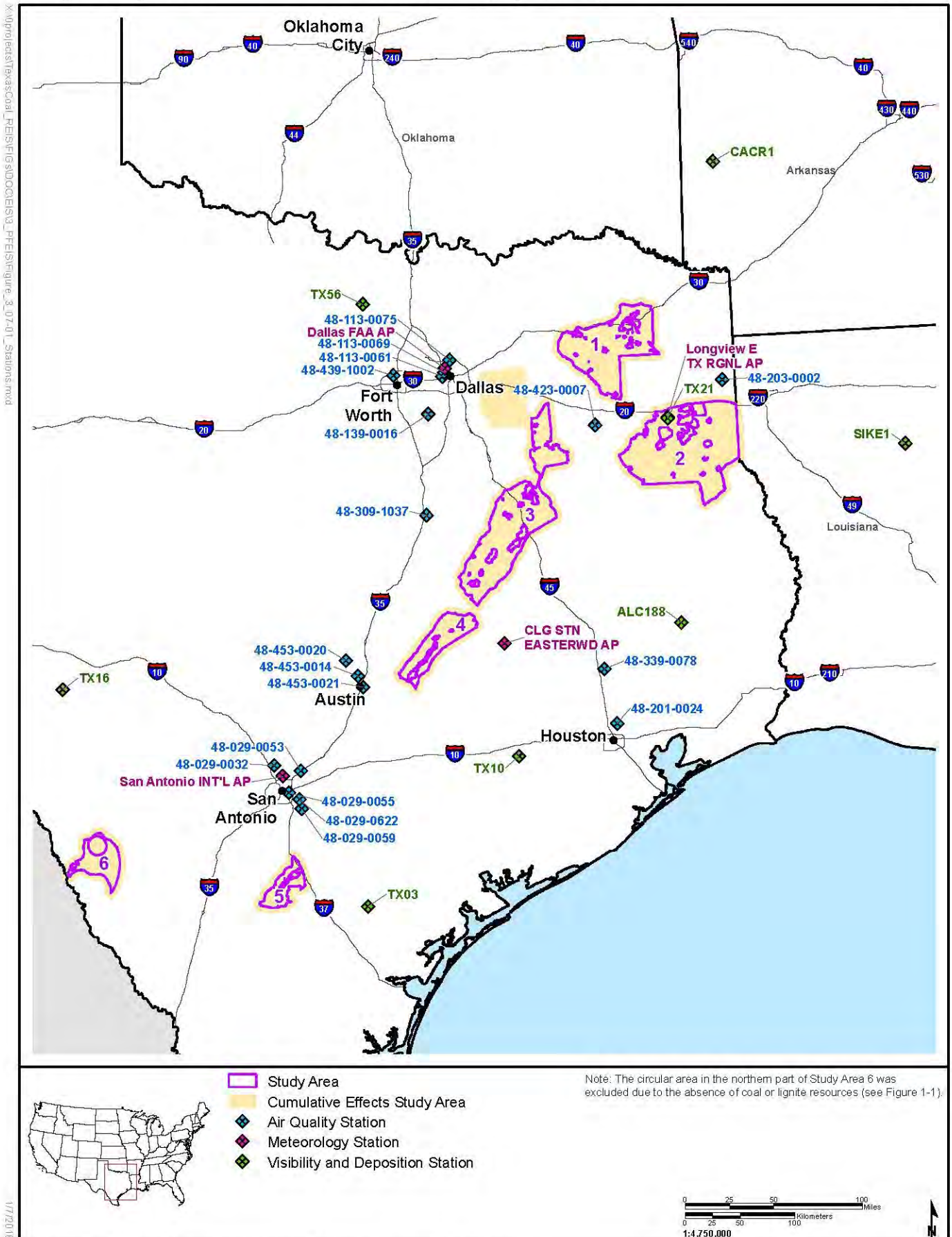
#### National Emission Standards for Hazardous Air Pollutants

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<sub>10</sub> as 24-hour average concentrations equal to or greater than 420 µg/m<sup>3</sup>. A Level 2 air pollution episode for PM<sub>10</sub> is defined as a 24-hour average concentration equal to or greater than 500 µg/m<sup>3</sup>. 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).



X:\p\re\at\TexasCoal\_FREIS\GIS\DOCS\FIG\_3\_07-01\_Station.mxd

1/7/2016

Figure 3.7-1 Air Quality Monitoring and Meteorology Stations

### Greenhouse Gases

Greenhouse gases (GHGs) include carbon dioxide (CO<sub>2</sub>), 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<sub>2</sub>e), which factors in the global warming potential of each GHG and normalizes this to an equivalent of CO<sub>2</sub> emissions. Under the rule, facilities with GHG emissions of 100,000 or more tpy CO<sub>2</sub>e are required to obtain PSD permits if they are making changes resulting in increased GHG emissions of 75,000 tpy CO<sub>2</sub>e 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<sub>2</sub>e or more. New and existing sources with GHG emissions above 100,000 tpy CO<sub>2</sub>e 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<sub>2</sub>e 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 <sup>1</sup>	AQS Site Number	County	Monitored Criteria Pollutants Monitored					
			PM <sub>2.5</sub>	PM <sub>10</sub>	Ozone	SO <sub>2</sub>	NO <sub>2</sub>	CO
<b>Study Area 1</b>								
Karnack <sup>2</sup>	48-203-0002	Harrison	Y	Y	Y		Y	
Dallas North #2 <sup>3</sup>	48-113-0075	Dallas		Y	Y		Y	
Dallas Hinton <sup>3</sup>	48-113-0069	Dallas	Y		Y	Y	Y	Y
Fort Worth Northwest <sup>2</sup>	48-439-1002	Tarrant	Y		Y		Y	Y
<b>Study Area 2</b>								
Karnack <sup>2</sup>	48-203-0002	Harrison	Y	Y	Y		Y	
Dallas Hinton <sup>3</sup>	48-113-0069	Dallas	Y		Y	Y	Y	Y
<b>Study Area 3</b>								
Midlothian OFW <sup>2</sup>	48-139-0016	Ellis	Y		Y	Y	Y	
East of Bickers and Furey Streets <sup>3</sup>	48-113-0061	Dallas		Y				
Tyler Airport (Relocated) <sup>2</sup>	48-423-0007	Smith			Y		Y	
Waco Mazane	48-309-1037	McLennan			Y	Y	Y	Y
Dallas Hinton <sup>3</sup>	48-113-0069	Dallas	Y		Y	Y	Y	Y
Fort Worth Northwest <sup>2</sup>	48-439-1002	Tarrant	Y		Y		Y	Y
<b>Study Area 4</b>								
Austin Audubon Society <sup>2</sup>	48-453-0020	Travis	Y	Y	Y		Y	
Austin Webberville Road <sup>3</sup>	48-453-0021	Travis	Y	Y				
Conroe (Relocated)	48-339-0078	Montgomery			Y		Y	
Austin Northwest <sup>2</sup>	48-453-0014	Travis			Y			Y
Waco Mazanec	48-309-1037	McLennan			Y	Y	Y	Y
Houston Aldine <sup>2</sup>	48-201-0024	Harris	Y	Y	Y		Y	Y

**Table 3.7-2 Monitoring Sites Utilized for Criteria Pollutants**

Network/Station <sup>1</sup>	AQS Site Number	County	Monitored Criteria Pollutants Monitored					
			PM <sub>2.5</sub>	PM <sub>10</sub>	Ozone	SO <sub>2</sub>	NO <sub>2</sub>	CO
<b>Study Area 5</b>								
Calaveras Lake <sup>3</sup>	48-029-0059	Bexar	Y		Y		Y	
Camp Bullis <sup>2</sup>	48-029-0032	Bexar	Y		Y			
Selma <sup>3</sup>	48-029-0053	Bexar		Y				
Unnamed	48-029-0622	Bexar				Y		Y
<b>Study Area 6</b>								
Calaveras Lake <sup>3</sup>	48-029-0059	Bexar	Y		Y		Y	
Camp Bullis <sup>2</sup>	48-029-0032	Bexar	Y		Y		Y	
Selma	48-029-0053	Bexar		Y				
Unnamed <sup>3</sup>	48-029-0622	Bexar			Y	Y	Y	Y

<sup>1</sup> 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.

<sup>2</sup> Measurement scales designated by AQS was Urban, Neighborhood, or, Microscale. Data from these stations may have been compromised due to local source effects.

<sup>3</sup> AQS designated measurement scales were not available.

**Table 3.7-3 Visibility and Deposition Monitoring Sites**

Monitoring Network	Monitoring Site ID	Variables Monitored at Site			Distance to Study Area (km)					
		Wet Deposition	Dry Deposition	Visibility	Study Area 1	Study Area 2	Study Area 3	Study Area 4	Study Area 5	Study Area 6
CASTNET <sup>1</sup>	ALC188		Y	Y	209.9	109.0	148.4	185.1	410.5	552.5
IMPROVE <sup>2</sup>	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 <sup>3</sup>	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

<sup>1</sup> USEPA 2014d.

<sup>2</sup> Interagency Monitoring of Protected Visual Environments (IMPROVE) 2014.

<sup>3</sup> 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	<b>0.070</b>	Karnack	Harrison County
	2012	0.072				
	2013	0.070				
AQS 48-113-0075	2011	0.088	0.084	<b>0.070</b>	Dallas North #2	Dallas County
	2012	0.086				
	2013	0.077				
AQS 48-113-0069	2011	0.084	0.084	<b>0.070</b>	Dallas Hinton	Dallas County
	2012	0.087				
	2013	0.081				
AQS 48-439-1002	2011	0.082	0.081	<b>0.070</b>	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 <sup>th</sup> Percentile 1-hour Concentration (ppm)		Location	County
		Monitored Value	NAAQS		
AQS 48-113-0069	2011	0.0077	0.070	Dallas Hinton	Dallas County
	2012	0.0059			
	2013	0.0050			

Source: USEPA 2014c.

**Table 3.7-8 24-hour PM<sub>10</sub> Monitoring Data for Study Area 1**

Monitoring Station	Year	Second-Highest 24-hour Concentration (µg/m <sup>3</sup> )		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<sub>2.5</sub> Monitoring Data for Study Area 1**

Monitoring Station	Year	98 <sup>th</sup> -percentile 24-hour or Annual Concentration (µg/m <sup>3</sup> )		Location	County
		Monitored Value	NAAQS		
AQS 48-203-0002 <sup>1</sup>	2005	19.2	35	Karnack	Harrison County
	2006	23.6			
	2007	23.3			
AQS 48-113-0069 <sup>1</sup>	2005	23.0	35	Dallas Hinton	Dallas County
	2006	19.9			
	2007	23.2			
AQS 48-203-0002 <sup>1</sup>	2005	22.1	35	Fort Worth Northwest	Harrison County
	2006	22.1			
	2007	26.4			
AQS 48-203-0002 <sup>2</sup>	2005	11.9	12	Karnack	Harrison County
	2006	10.4			
	2007	9.3			
AQS 48-113-0069 <sup>2</sup>	2005	10.4	12	Dallas Hinton	Dallas County
	2006	9.7			
	2007	9.6			
AQS 48-203-0002 <sup>2</sup>	2005	10.7	12	Fort Worth Northwest	Harrison County
	2006	10.5			
	2007	10.4			

<sup>1</sup> Reflects 98<sup>th</sup> percentile 24-hour data.

<sup>2</sup> 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)
<b>Wet Deposition</b>				
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
<b>Dry Deposition</b>				
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

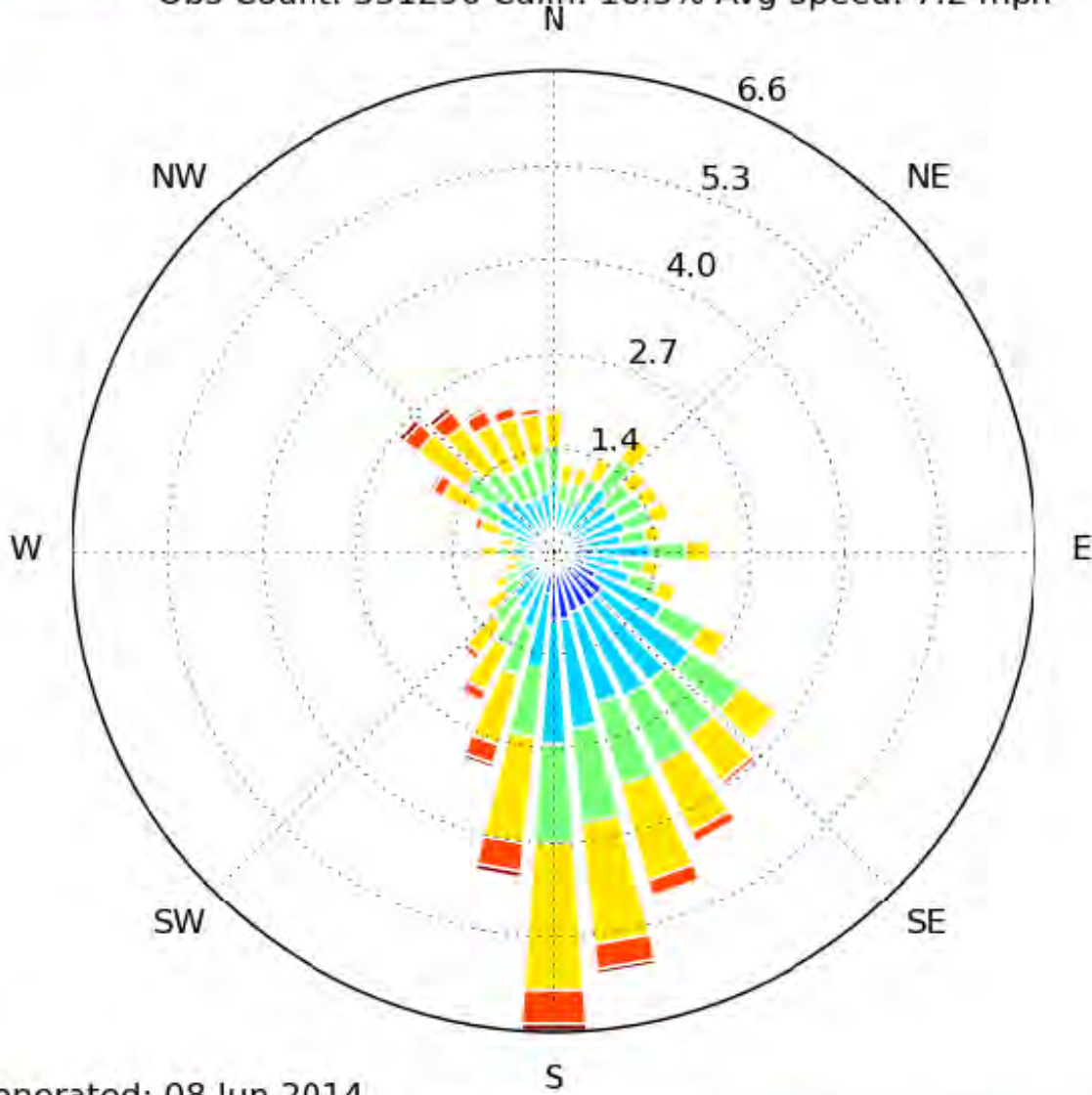
Source: IMPROVE 2014.

*Climate*

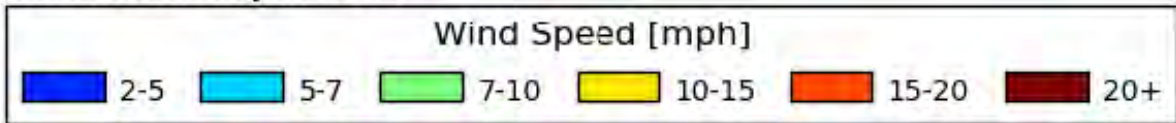
Northeast Texas is characterized by warm humid summers and relatively mild winters. Due to its proximity to the Gulf of Mexico, it is typically humid throughout the year. **Table 3.7-12** represents typical temperature and precipitation data for Study Area 2, based on data for the Longview Regional Airport. A wind rose showing typical wind conditions is presented in **Figure 3.7-2**.



[GGG] LONGVIEW/GREGG CO.  
Windrose Plot [All Year]  
Period of Record: 31 Dec 1972 - 07 Jun 2014  
Obs Count: 331296 Calm: 16.3% Avg Speed: 7.2 mph



Generated: 08 Jun 2014



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<sub>2</sub> (IPCC 2013). In addition, “the atmospheric concentrations of CO<sub>2</sub>, methane, and nitrous oxide have increased to levels unprecedented in at least the last 800,000 years. CO<sub>2</sub> 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 than 1.5°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<sup>th</sup> 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<sup>st</sup> 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 approximate 10 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 the 1971-2000 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<sub>2.5</sub> 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	<b>0.070</b>	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 <sup>th</sup> Percentile 1-hour Concentration (ppm)		Location	County
		Monitored Value	NAAQS		
AQS 48-113-0069	2011	0.0077	0.070	Dallas Hinton	Dallas County
	2012	0.0059			
	2013	0.0050			

Source: USEPA 2014c.

**Table 3.7-17 PM<sub>10</sub> Monitoring Data for Study Area 2**

Monitoring Station	Year	Second-Highest 24-hour Concentration (µg/m <sup>3</sup> )		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<sub>2.5</sub> Monitoring Data for Study Area 2**

Monitoring Station	Year	98 <sup>th</sup> -percentile 24-hour or Annual Concentration (µg/m <sup>3</sup> )		Location	County
		Monitored Value	NAAQS		
AQS 48-203-0002 <sup>1</sup>	2005	19.2	35	Karnack	Harrison County
	2006	23.6			
	2007	23.3			
AQS 48-113-0069 <sup>1</sup>	2005	23.0	35	Dallas Hinton	Dallas County
	2006	19.9			
	2007	23.2			
AQS 48-203-0002 <sup>2</sup>	2005	11.9	12	Karnack	Harrison County
	2006	10.4			



**Table 3.7-18 PM<sub>2.5</sub> Monitoring Data for Study Area 2**

Monitoring Station	Year	98 <sup>th</sup> -percentile 24-hour or Annual Concentration (µg/m <sup>3</sup> )		Location	County
		Monitored Value	NAAQS		
AQS 48-113-0069 <sup>2</sup>	2007	9.3		Dallas Hinton	Dallas County
	2005	10.4	12		
	2006	9.7			
	2007	9.6			

<sup>1</sup> Reflects 98<sup>th</sup> percentile 24-hour data.

<sup>2</sup> 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)
<b>Wet Deposition</b>				
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
<b>Dry Deposition</b>				
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<sub>2.5</sub>, 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	<b>0.070</b>	Midlothian OFW	Ellis County
	2012	0.078				
	2013	0.075				
AQS 48-423-0007	2011	0.078	0.075	<b>0.070</b>	Tyler Airport (Relocated)	Smith County
	2012	0.076				
	2013	0.071				
AQS 48-309-1037	2011	0.078	0.074	<b>0.070</b>	Waco Mazanec	McLennan County
	2012	0.073				
	2013	0.072				
AQS 48-113-0069	2011	0.084	0.084	<b>0.070</b>	Dallas Hinton	Dallas County
	2012	0.087				
	2013	0.081				
AQS 48-439-1002	2011	0.082	0.081	<b>0.070</b>	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	99 <sup>th</sup> Percentile 1-hour Concentration (ppm)		Location	County
		Monitored Value	NAAQS		
AQS 48-139-0016	2011	0.0107	0.070	Midlothian OFW	Ellis County
	2012	0.0146			
	2013	0.0160			
AQS 48-309-1037	2011	0.0042	0.070	Waco Mazanec	McLennan County
	2012	0.0067			
	2013	0.0073			
AQS 48-113-0069	2011	0.0077	0.070	Dallas Hinton	Dallas County
	2012	0.0059			
	2013	0.0050			

Source: USEPA 2014c.

**Table 3.7-25 PM<sub>10</sub> Monitoring Data for Study Area 3**

Monitoring Station	Year	Second-Highest 24-hour Concentration (µg/m <sup>3</sup> )		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<sub>2.5</sub> Monitoring Data for Study Area 3**

Monitoring Station	Year	98 <sup>th</sup> -percentile 24-hour or Annual Concentration (µg/m <sup>3</sup> )		Location	County
		Monitored Value	NAAQS		
AQS 48-139-0016 <sup>1</sup>	2005	20.2	35	Midlothian OFW	Ellis County
	2006	22.6			
	2007	24.9			
AQS 48-113-0069 <sup>1</sup>	2005	23.0	35	Dallas Hinton	Dallas County
	2006	19.9			
	2007	23.2			
AQS 48-439-1002 <sup>1</sup>	2005	22.1	35	Fort Worth Northwest	Tarrant County
	2006	22.1			
	2007	26.4			
AQS 48-139-0016 <sup>2</sup>	2005	10.2	12	Midlothian OFW	Ellis County
	2006	10.1			
	2007	8.8			

**Table 3.7-26 PM<sub>2.5</sub> Monitoring Data for Study Area 3**

Monitoring Station	Year	98 <sup>th</sup> -percentile 24-hour or Annual Concentration (µg/m <sup>3</sup> )		Location	County
		Monitored Value	NAAQS		
AQS 48-113-0069 <sup>2</sup>	2005	10.4	12	Dallas Hinton	Dallas County
	2006	9.7			
	2007	9.6			
AQS 48-439-1002 <sup>2</sup>	2005	10.7	12	Fort Worth Northwest	Tarrant County
	2006	10.5			
	2007	10.4			

<sup>1</sup> Reflects 98<sup>th</sup> percentile 24-hour data.

<sup>2</sup> 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)
<b>Wet Deposition</b>				
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
<b>Dry Deposition</b>				
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 transitional 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.

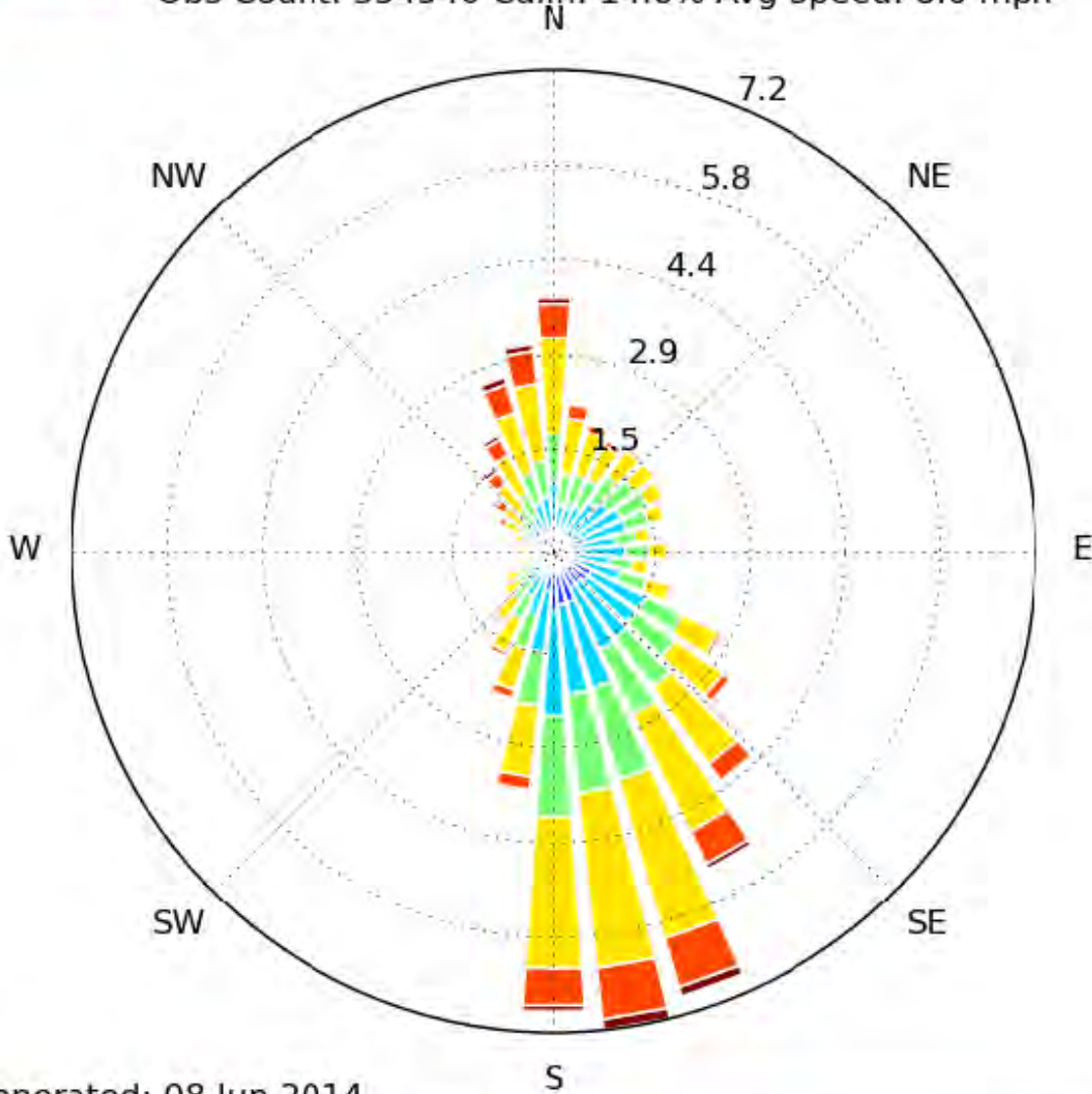
Study Area 4

*Criteria Pollutants*

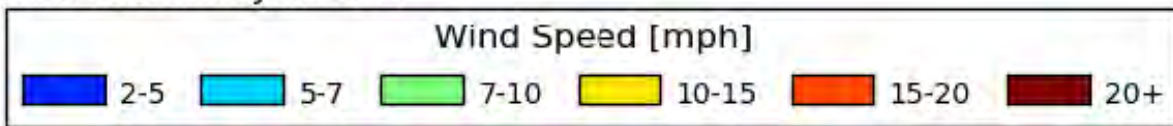
**Tables 3.7-29** through **3.7-34** present monitored criteria pollutant levels from selected air quality monitoring stations within or near Study Area 4 and the associated CESA for the period of 2011 through 2013. Monitoring stations used for this analysis are located in Travis, Conroe, McLennan, and 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<sub>2.5</sub> which is designated as attainment, pending, or unclassifiable.



**[CLL] COLLEGE STATION**  
**Windrose Plot [All Year]**  
Period of Record: 31 Dec 1972 - 07 Jun 2014  
Obs Count: 354540 Calm: 14.6% Avg Speed: 8.0 mph



Generated: 08 Jun 2014



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	<b>0.070</b>	Austin Audubon Society	Travis County
	2012	0.076				
	2013	0.070				
AQS 48-339-0078	2011	0.080	0.079	<b>0.070</b>	Conroe (Relocated)	Montgomery County
	2012	0.082				
	2013	0.075				
AQS 48-453-0014	2011	0.075	0.073	<b>0.070</b>	Austin Northwest	Travis County
	2012	0.074				
	2013	0.069				
AQS 48-309-1037	2011	0.078	0.074	<b>0.070</b>	Waco Mazanec	McLennan County
	2012	0.073				
	2013	0.072				
AQS 48-201-0024	2011	0.083	0.077	<b>0.070</b>	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 <sup>th</sup> Percentile 1-hour Concentration (ppm)		Location	County
		Monitored Value	NAAQS		
AQS 48-309-1037	2011	0.0042	0.070	Waco Mazanec	McLennan County
	2012	0.0067			
	2013	0.0073			

Source: USEPA 2014c.

**Table 3.7-33 PM<sub>10</sub> Monitoring Data for Study Area 4**

Monitoring Station	Year	Second-Highest 24-hour Concentration (µg/m <sup>3</sup> )		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<sub>2.5</sub> Monitoring Data for Study Area 4**

Monitoring Station	Year	98 <sup>th</sup> -percentile 24-hour or Annual Concentration (µg/m <sup>3</sup> )		Location	County
		Monitored Value	NAAQS		
AQS 48-453-0020 <sup>1</sup>	2005	21.3	35	Austin Audubon Society	Travis County
	2006	17.2			
	2007	24.4			
AQS 48-453-0021 <sup>1</sup>	2005	21.6	35	Austin Webberville Road	Travis County
	2006	23.4			
	2007	27.0			
AQS 48-201-0024 <sup>1</sup>	2005	20.9	35	Houston Aldine	Harris County
	2006	26.2			
	2007	22.1			
AQS 48-453-0020 <sup>2</sup>	2005	8.5	12	Austin Audubon Society	Travis County
	2006	7.7			
	2007	7.3			
AQS 48-453-0021 <sup>2</sup>	2005	10.8	12	Austin Webberville Road	Travis County
	2006	10.1			
	2007	8.3			
AQS 48-201-0024 <sup>2</sup>	2005	11.5	12	Houston Aldine	Harris County
	2006	11.2			
	2007	10.7			

<sup>1</sup> Reflects 98<sup>th</sup> percentile 24-hour data.

<sup>2</sup> 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)
<b>Wet Deposition</b>				
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
<b>Dry Deposition</b>				
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<sub>2.5</sub> 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	<b>0.070</b>	Calaveras Lake	Bexar County
	2012	0.069				
	2013	0.067				
AQS 48-029-0032	2011	0.075	0.082	<b>0.070</b>	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 <sup>1</sup>	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			

<sup>1</sup> 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 <sup>th</sup> Percentile 1-hour Concentration (ppm)		Location	County
		Monitored Value	NAAQS		
AQS 48-029-0622	2011	0.0370	0.070	7145 Gardner Road	Bexar County
	2012	0.0310			
	2013	0.0280			

Source: USEPA 2014c.

**Table 3.7-40 PM<sub>10</sub> Monitoring Data for Study Area 5**

Monitoring Station	Year	Second-Highest 24-hour Concentration (µg/m <sup>3</sup> )		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<sub>2.5</sub> Monitoring Data for Study Area 5**

Monitoring Station	Year	98 <sup>th</sup> -percentile 24-hour or Annual Concentration (µg/m <sup>3</sup> )		Location	County
		Monitored Value	NAAQS		
AQS 48-029-0059 <sup>1</sup>	2005	27.3	35	Calavaras Lake	Bexar County
	2006	23.4			
	2007	18.9			
AQS 48-029-0032 <sup>1</sup>	2005	25.7	35	Camp Bullis	Bexar County
	2006	18.2			
	2007	26.1			
AQS 48-029-0059 <sup>2</sup>	2005	9.5	12	Calavaras Lake	Bexar County
	2006	8.6			
	2007	7.7			
AQS 48-029-0032 <sup>2</sup>	2005	9.4	12	Camp Bullis	Bexar County
	2006	0.04			
	2007	8.8			

<sup>1</sup> Reflects 98<sup>th</sup> percentile 24-hour data.

<sup>2</sup> 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 transitional 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 Bexar 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<sub>2.5</sub> which is designated as attainment, pending, or unclassifiable.

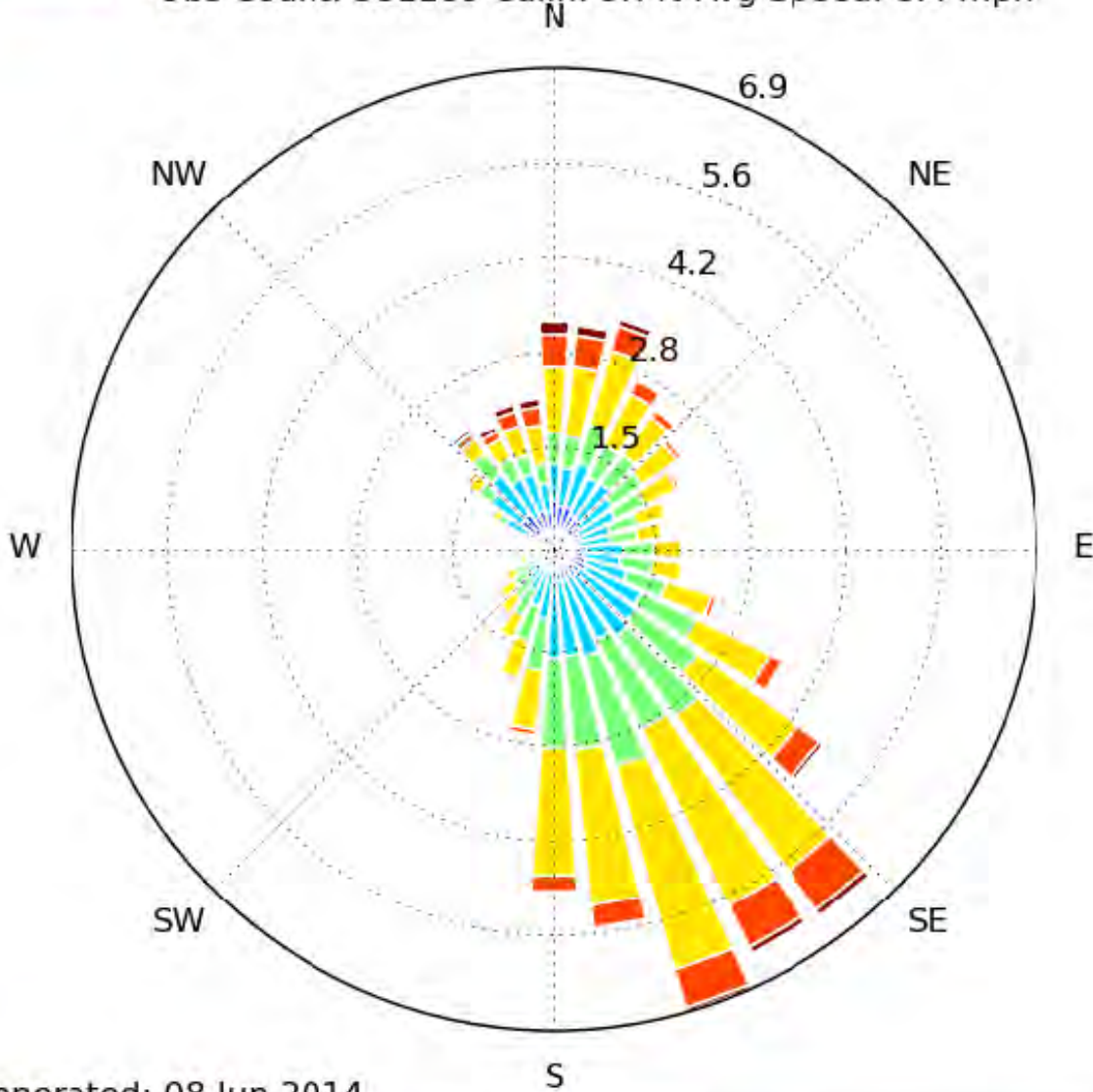
**Table 3.7-44 Ozone Monitoring Data for Study Area 6**

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	<b>0.070</b>	Calaveras Lake	Bexar County
	2012	0.070				
	2013	0.069				

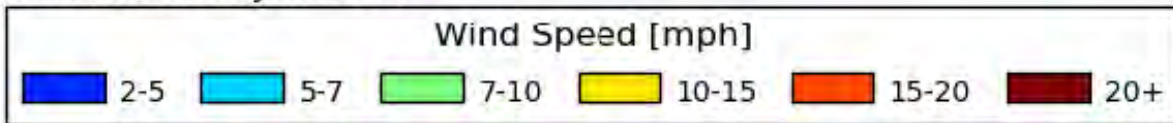
Source: USEPA 2014c.



[SAT] SAN ANTONIO INTL  
Windrose Plot [All Year]  
Period of Record: 01 Jan 1970 - 07 Jun 2014  
Obs Count: 381189 Calm: 9.7% Avg Speed: 8.4 mph



Generated: 08 Jun 2014



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			

<sup>1</sup> 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 <sup>th</sup> Percentile 1-hour Concentration (ppm)		Location	County
		Monitored	NAAQS		
AQS 48-029-0622	2011	0.0370	0.070	7145 Gardner Road	Bexar County
	2012	0.0310			
	2013	0.0280			

Source: USEPA 2014c.

**Table 3.7-48 PM<sub>10</sub> Monitoring Data for Study Area 6**

Monitoring Station	Year	Second-Highest 24-hour Concentration (µg/m <sup>3</sup> )		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<sub>2.5</sub> Monitoring Data for Study Area 6**

Monitoring Station	Year	98 <sup>th</sup> -percentile 24-hour or Annual Concentration (µg/m <sup>3</sup> )		Location	County
		Monitored Value	NAAQS		
AQS 48-029-0059 <sup>1</sup>	2005	27.3	35	Calavaras Lake	Bexar County
	2006	23.4			
	2007	18.9			
AQS 48-029-0032 <sup>1</sup>	2005	25.7	35	Camp Bullis	Bexar County
	2006	18.2			
	2007	26.1			
AQS 48-029-0059 <sup>2</sup>	2005	9.5	12	Calavaras Lake	Bexar County
	2006	8.6			
	2007	7.7			
AQS 48-029-0032 <sup>2</sup>	2005	9.4	12	Camp Bullis	Bexar County
	2006	0.04			
	2007	8.8			

<sup>1</sup> Reflects 98<sup>th</sup> percentile 24-hour data.

<sup>2</sup> 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<sub>10</sub>, and PM<sub>2.5</sub>. Fuel-burning mobile sources would emit low levels of gaseous pollutants (e.g., SO<sub>2</sub>, oxides of nitrogen [NO<sub>x</sub>], 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<sub>10</sub> and PM<sub>2.5</sub> 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<sub>10</sub> and PM<sub>2.5</sub> emissions. Truck haulage also would emit other criteria pollutants, such as NO<sub>x</sub>. The primary sources of NO<sub>x</sub> 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 be 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<sub>2</sub> and methane (CH<sub>4</sub>), 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<sub>2</sub>e. CO<sub>2</sub>e is a quantity that describes, for a given GHG, the amount of CO<sub>2</sub> that would have the same amount of radiative forcing, when measured over 100 years. To calculate CO<sub>2</sub>e, first the total CO<sub>2</sub> emissions and the CH<sub>4</sub> emissions are calculated. To convert CH<sub>4</sub> emissions into CO<sub>2</sub>e units, the CH<sub>4</sub> emissions are multiplied by a global warming potential of 28. The resulting CO<sub>2</sub>e from CH<sub>4</sub> is added to CO<sub>2</sub> emissions to calculate the total CO<sub>2</sub>e.

The total CO<sub>2</sub>e estimated to be released by a typical mine is shown in **Table 3.7-51**. CH<sub>4</sub> emissions would be less than 0.01 percent of the total GHG emissions. Nearly all of the CO<sub>2</sub>e emissions (more than 97 percent) would be attributed to mobile sources. The mobile sources would include, but would not be 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 <sub>x</sub>	SO <sub>x</sub>	PM <sub>10</sub>	PM <sub>2.5</sub>	CO <sub>2</sub> e (metric tpy) <sup>1</sup>
	(typ)						
<b>Mobile Sources</b>							
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
<b>Total Mobile Sources</b>	198	658	2,022	2.00	69	69	187,803
<b>Stationary Sources</b>							
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
<b>Total Stationary Sources</b>	7	31	59	0.07	3.0	3.0	5,331
Wind Blown Dust <sup>2</sup>	--	--	--	--	3.3	0.3	--
Fugitive Dust <sup>2</sup>	--	--	--	--	9.8	1.0	--
<b>Total Emissions (All Sources)</b>	205	689	2,081	2.10	84.7	73.0	193,134

<sup>1</sup> Assumes the global warming potential of CH<sub>4</sub> emissions is 25 (USEPA 2015a).

<sup>2</sup> 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<sub>2</sub>e) 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<sub>2</sub>e 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<sub>2</sub>e. 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<sub>2</sub>e) and major modifications (greater than 75,000 tpy increase of CO<sub>2</sub>e) 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 2014e); the emissions from a typical mine would be equivalent to the GHG emissions of approximately 35,000 individuals. The total global CO<sub>2</sub>e emissions is approximately 30,000 million metric tons per year. Over the period of 1 year, CO<sub>2</sub>e is essentially evenly distributed throughout the atmosphere around the earth. Since the projected total emissions of CO<sub>2</sub>e for a typical mine as shown in **Table 3.7-51** would be a tiny fraction of total global CO<sub>2</sub>e 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, **power plants, and** 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**

<b>Analysis Areas</b>	<b>Counties that Overlap with the Study Area</b>	<b>Additional Counties that Overlap with the CESA</b>
Analysis Area 1	Camp Franklin Hopkins Rains Titus Wood	Morris Smith Upshur
Analysis Area 2	Cherokee Gregg Harrison Panola Rusk Shelby Smith	Caddo (Louisiana) De Soto (Louisiana) Nacogdoches San Augustine
Analysis Area 3	Anderson Falls Freestone Henderson Leon Limestone Robertson Van Zandt	Navarro
Analysis Area 4	Bastrop Burlison Lee Milam Williamson	Robertson Travis
Analysis Area 5	Atascosa McMullen	Live Oak
Analysis Area 6	Dimmit Kinney Maverick 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. **Navigable streams in the study areas and associated CESAs that may provide recreational opportunities are identified in Section 3.2.4.1.**

**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 <sup>1</sup>			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

<sup>1</sup> 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 2014j). 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 <sup>1</sup>			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

<sup>1</sup> 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 <sup>1</sup>			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

<sup>1</sup> 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.

Study Area 4

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 <sup>1</sup>			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

<sup>1</sup> 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 <sup>1</sup>			Total
	Producing Wells	Shut-in Wells	Injection Wells	
Atascosa	1,423	277	54	1,754
McMullen	1,182	233	34	1,449

<sup>1</sup> 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 2014j). 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 **389** 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	262	20
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 <sup>1</sup>			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

<sup>1</sup> 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 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 4,376,100 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**

##### Impacts Common to all Study Areas

###### *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 or 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<sub>10</sub> and PM<sub>2.5</sub>) 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 to 13,500 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.

**There are no navigable streams in Study Area 1 (see Section 3.2.4.2). Therefore, no impacts to navigable waters or related recreational opportunities as the result of potential future mines would occur.**

#### 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.

**The Sabine River is the one navigable stream in Study Area 2 (see Section 3.2.4.2). If boating restrictions were to occur from potential future mine-related ancillary activities (e.g., construction of a transportation corridor over the river), they would be short-term and have negligible to minor local effects.**

#### 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.

**The Trinity River is the one navigable stream in Study Area 2 (see Section 3.2.4.2). If boating restrictions were to occur from potential future mine-related ancillary activities (e.g., construction**

**of a transportation corridor over the river), they would be short-term and have negligible to minor local effects.**

#### 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.

**The Brazos River that forms the northeastern boundary of Study Area 4 is a navigable stream (see Section 3.2.4.2). No river disturbance is anticipated from potential future mining activities; therefore, no impacts to related recreational activities would occur.**

#### 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.

**There are no navigable streams in Study Area 5 (see Section 3.2.4.2). Therefore, no impacts to navigable waters or related recreational opportunities as the result of potential future mines would occur.**

#### Study Area 6

It is estimated that future mine-related surface disturbance would affect 25,000 acres (10.0 percent) of the 249,000 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 Area 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.

**The Rio Grande to the west of Study Area 6 is a navigable stream (see Section 3.2.4.2). No river disturbance would occur as a result of potential future mining activities; therefore, no impacts to related recreational activities would occur.**

**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**

<b>CESA</b>	<b>Disturbed Inside Study Area (acres)</b>	<b>Disturbed Outside Study Area/Inside CESA (acres)</b>	<b>Total CESA Disturbed (acres)</b>
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

### Study Area 1 CESA

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 Nacogdoches 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 <sup>1</sup>	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 <sup>2</sup>	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

<sup>1</sup> Analysis area data apply to the study areas and CESAs.

<sup>2</sup> 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 <sup>1</sup>	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 <sup>1</sup>	Population Levels			Population Change (percent)		Analysis Area
	2000	2010	2020 (Projected)	2000 to 2010	2010 to 2020	
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	--

<sup>1</sup> 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 <sup>1</sup>	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

<sup>1</sup> 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 <sup>1</sup>	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 <sup>1</sup>	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	--

<sup>1</sup> 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 of the Six Analysis Areas <sup>1</sup>	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

<sup>1</sup> 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 <sup>1</sup>	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 <sup>1</sup>	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	

<sup>1</sup> 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 <sup>1</sup>	\$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

<sup>1</sup> 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 <sup>1</sup>	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 <sup>1</sup>	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	--

<sup>1</sup> 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 Commission 2013). This rate is calculated from the appraised value and revenue produced. However, Analysis Area 4 also has more than half of the total appraised 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 <sup>1</sup>	\$358,250,829,882	\$1,399,244,130	0.39

<sup>1</sup> 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 Commission 2013; Texas County Property Tax 2013.

**Table 3.9-10 Property Tax for 2013 by County**

County <sup>1</sup>	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 <sup>2</sup>	\$19,331,000,000	\$103,816,883	0.54	2
DeSoto Parish, Louisiana <sup>2</sup>	\$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 <sup>1</sup>	County Property Taxes			Analysis Area
	Total Appraised Property Value	Revenue Produced	Actual Tax Rate (percent)	
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

<sup>1</sup> Counties in Texas, unless otherwise noted.

<sup>2</sup> 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 Commission 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) (Window on State Government 2013; Avalara TaxRates 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**

<b>County<sup>1</sup></b>	<b>Sales Tax by County and State (percent)</b>	<b>Analysis Area</b>
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 <sup>1</sup>	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	

<sup>1</sup> Counties in Texas, unless otherwise noted.

Source: Louisiana Sales Tax 2013; **Window on State Government** 2013; **Avalara TaxRates** 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 Commission 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 <sup>1</sup>	\$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

<sup>1</sup> 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 Commission 2013; Texas School District Tax Rates 2013.

**Table 3.9-13 School District 2013 Funding Received from Property Taxes by County**

County <sup>1</sup>	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 <sup>2</sup>	\$19,331,000,000	\$126,533,857	0.65	2
DeSoto Parish, Louisiana <sup>2</sup>	\$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 <sup>1</sup>	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	

<sup>1</sup> Counties in Texas, unless otherwise noted.

<sup>2</sup> 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 Commission 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 <sup>1</sup>	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

<sup>1</sup> 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 <sup>1</sup>	Housing Units			Vacancy Rate (percent)	Vacancy Rate by Type (percent)		Analysis 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 <sup>1</sup>	Housing Units			Vacancy Rate (percent)	Vacancy Rate by Type (percent)		Analysis 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	

<sup>1</sup> 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.

#### Population and Housing

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.

**It is anticipated that residences in close enough proximity to mining activities to experience disturbance from mining operations (i.e., visual, auditory) would be less in demand and may experience a temporary decline in value. This type of effect would not be anticipated for ranch or farm lands. As mining activities move away from a residential property and as the lands are reclaimed, it would be expected that the property demand and value would return to the level of**

**similar properties in the general vicinity. In the long term, it is not anticipated that mining activities would result in adverse effects to property values.**

#### Employment

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 Board 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 of the six analysis study areas are presented in **Table 3.10-1**.

**Table 3.10-1 Highways and Status by Study Area**

Highway Number <sup>1</sup>	Average Annual Daily Traffic <sup>2</sup>	Estimated LOS	TxDOT Classification
<b>Study Area 1</b>			
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
<b>Study Area 2</b>			
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 <sup>1</sup>	Average Annual Daily Traffic <sup>2</sup>	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
<b>Study Area 3</b>			
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
<b>Study Area 4</b>			
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
<b>Study Area 5</b>			
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
<b>Study Area 6</b>			
U.S. Highway 57	3,600	A	Rural Minor Arterial
U.S. Highway 277	3,700	A	Rural Principal Arterial

<sup>1</sup> I = Interstate Highway; SH = State Highway.

<sup>2</sup> 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 McMullen 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.

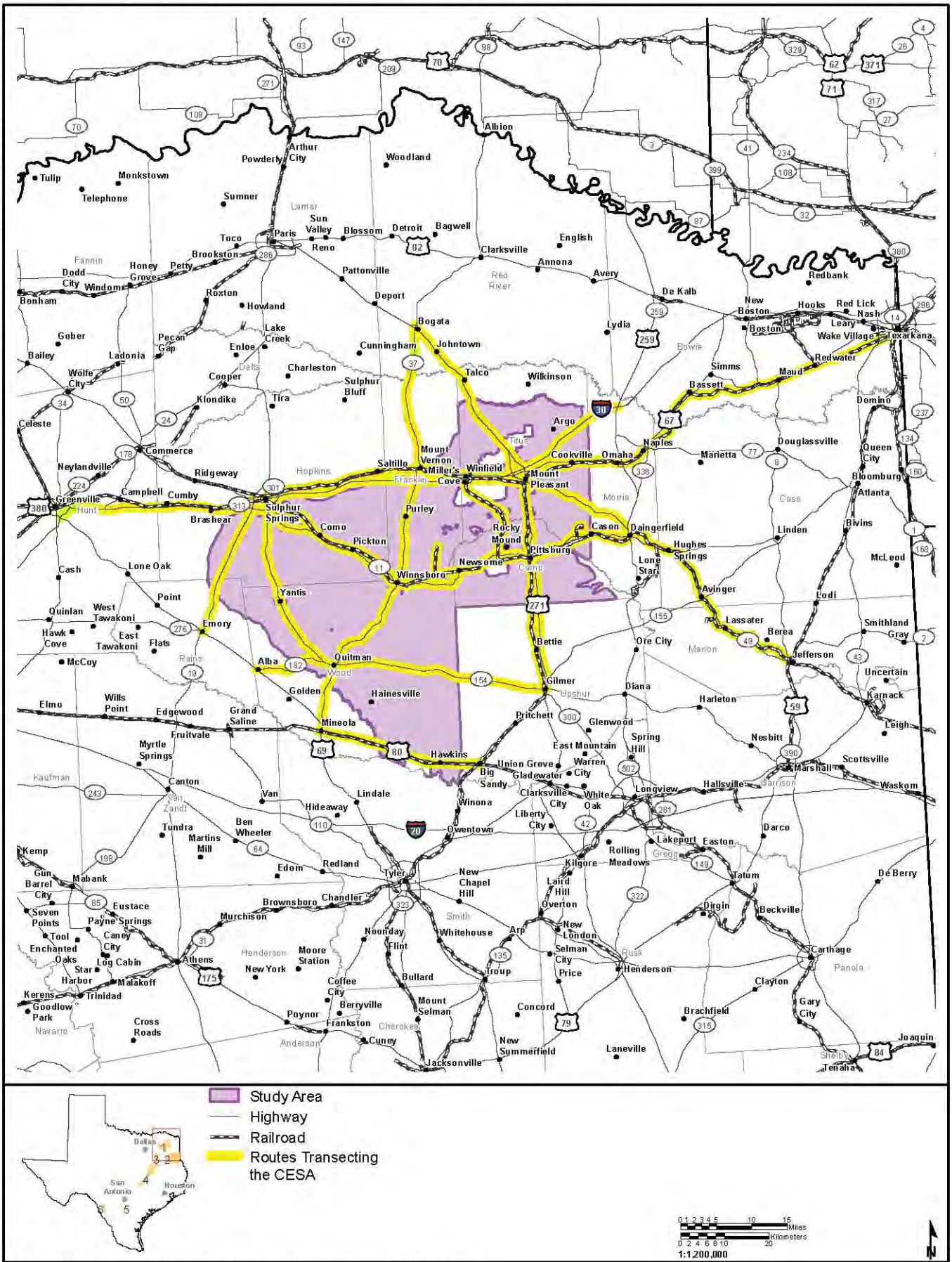


Figure 3.10-1 Study Area 1 – Major Roads and Rail Lines

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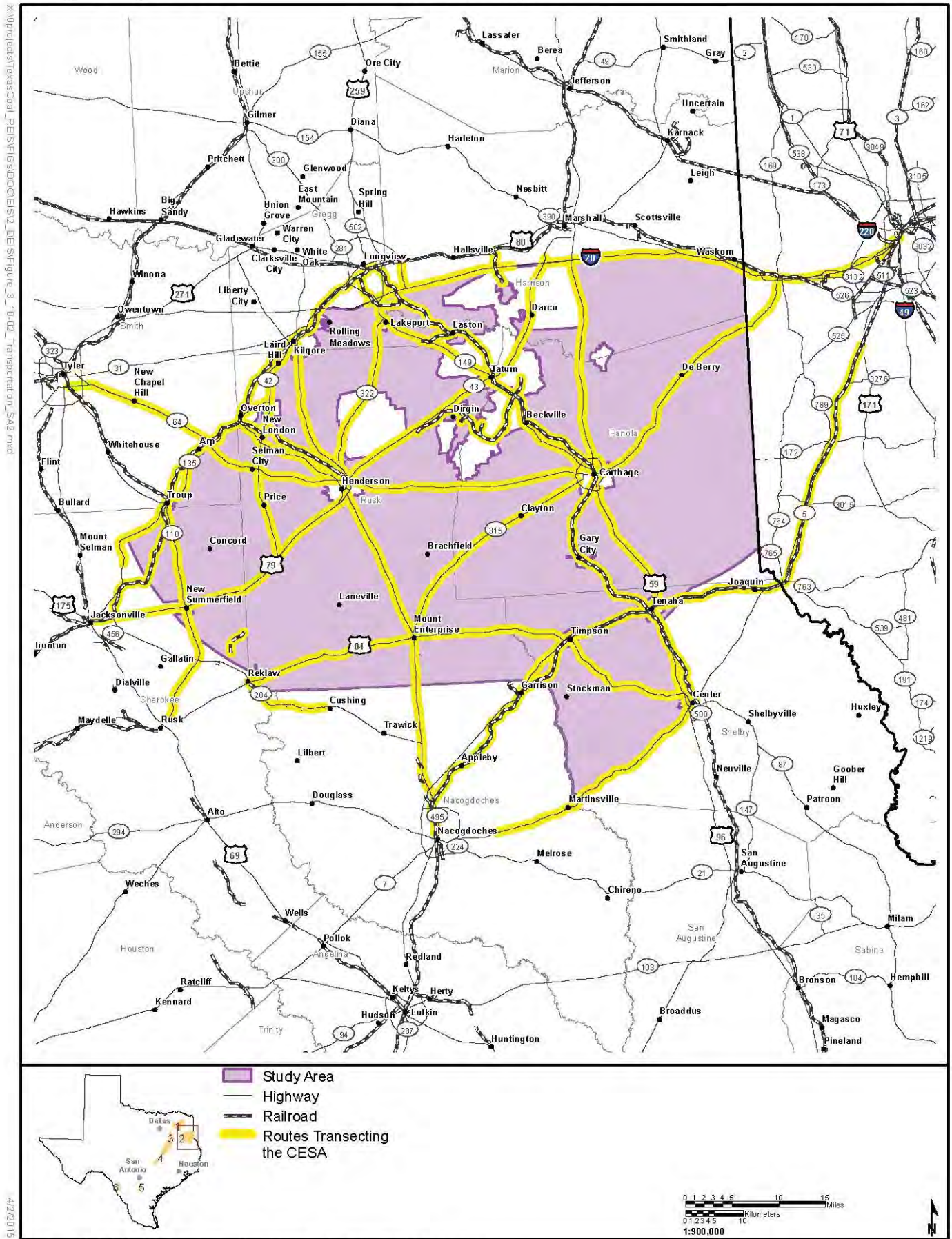


Figure 3.10-2 Study Area 2 – Major Roads and Rail Lines



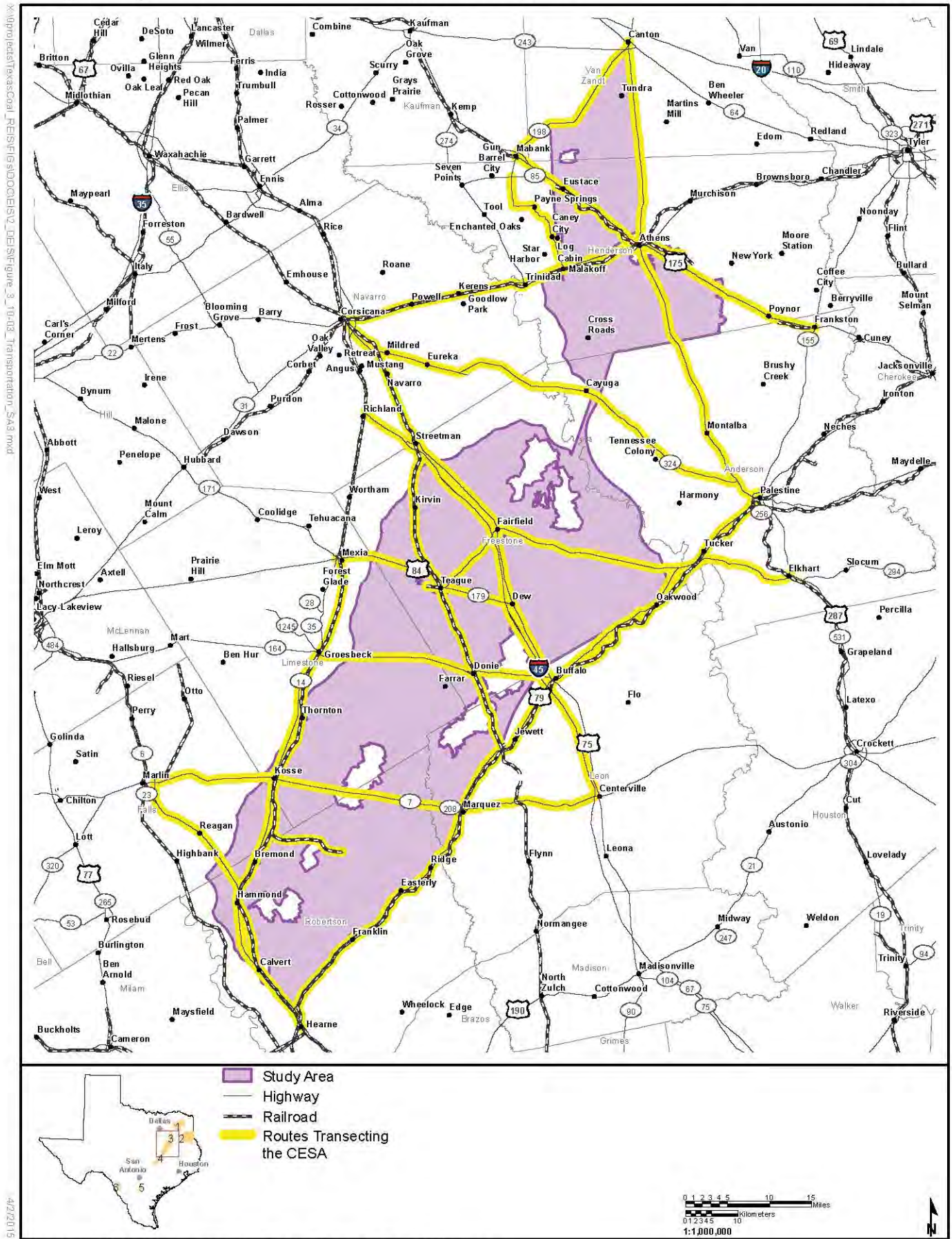


Figure 3.10-3 Study Area 3 – Major Roads and Rail Lines

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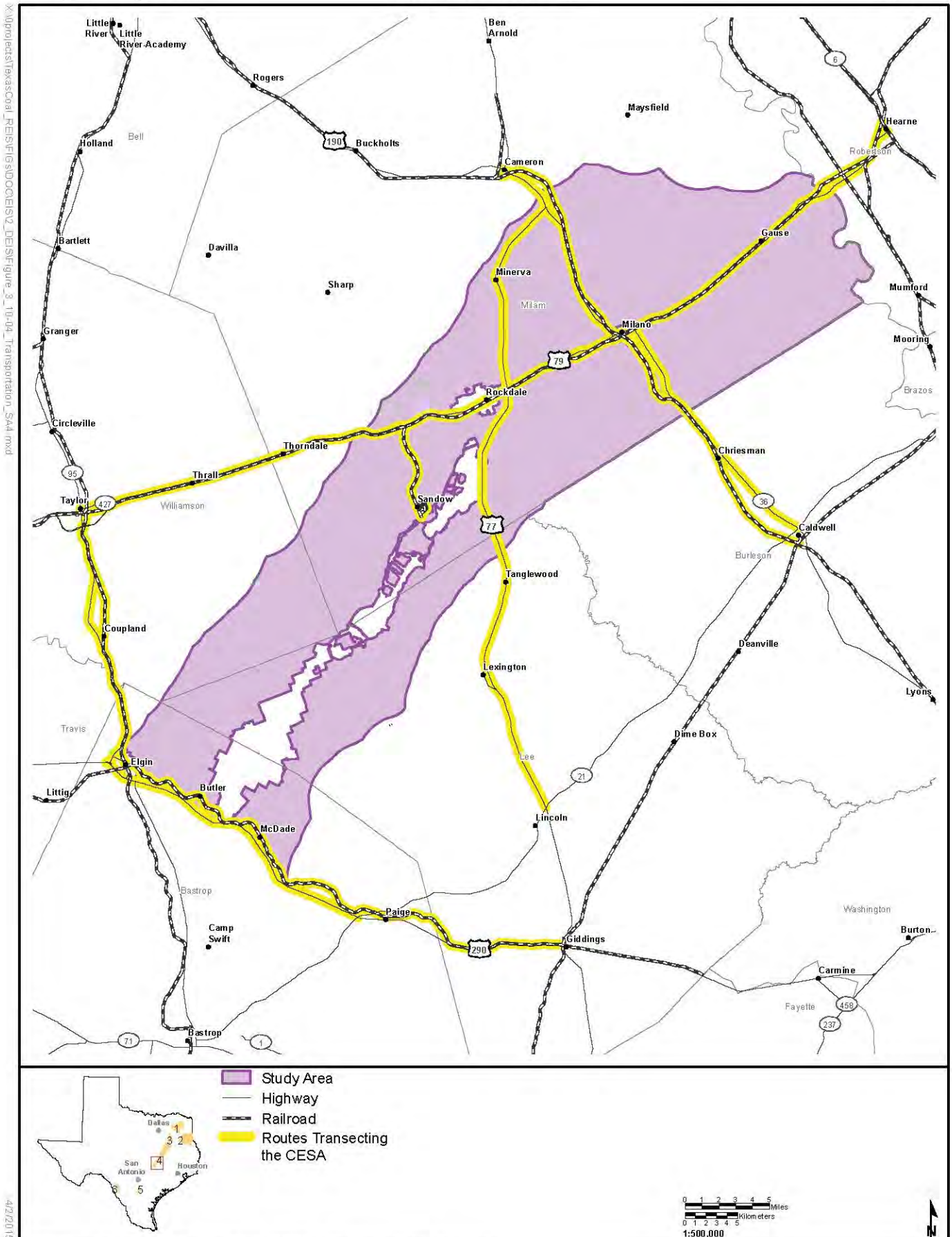
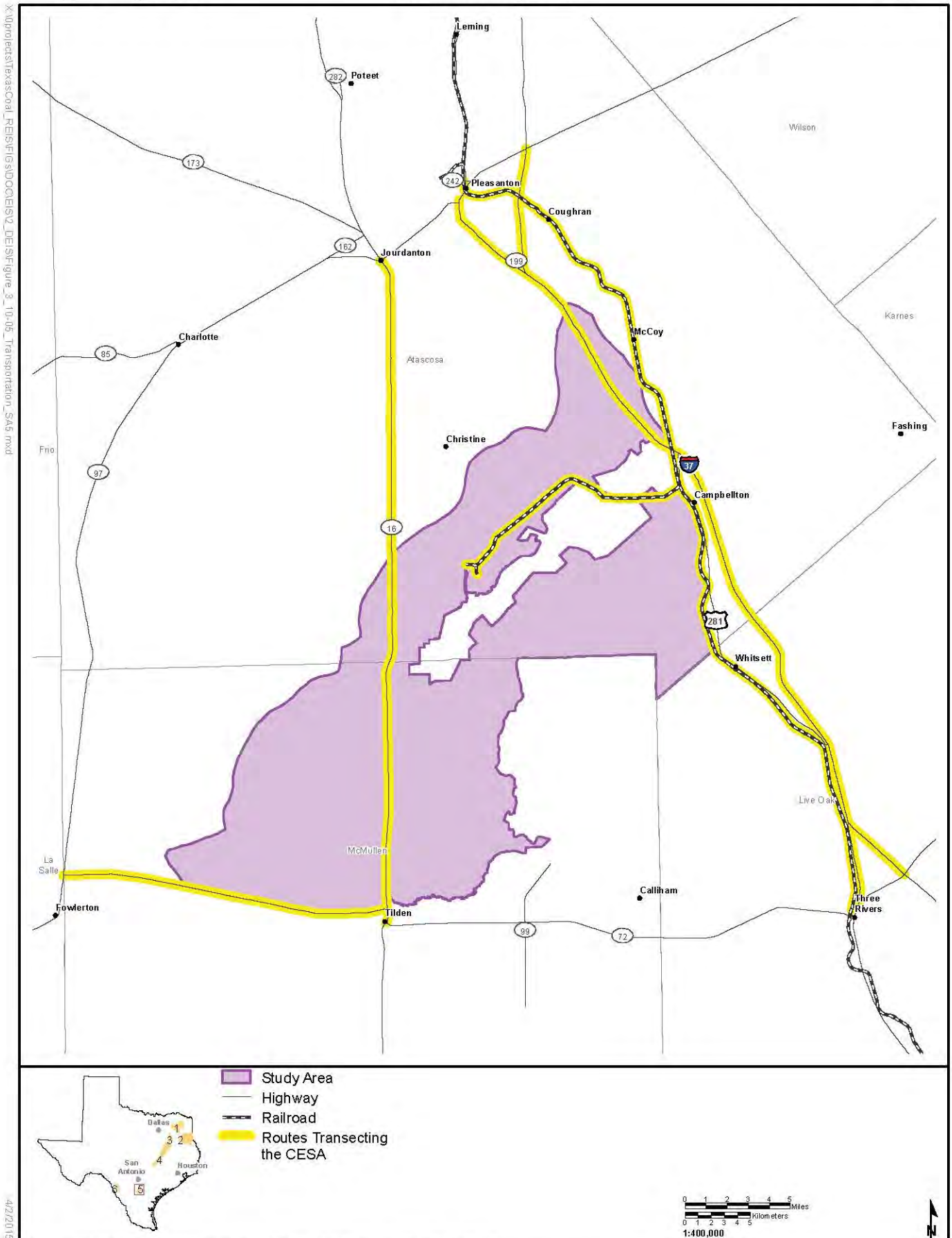


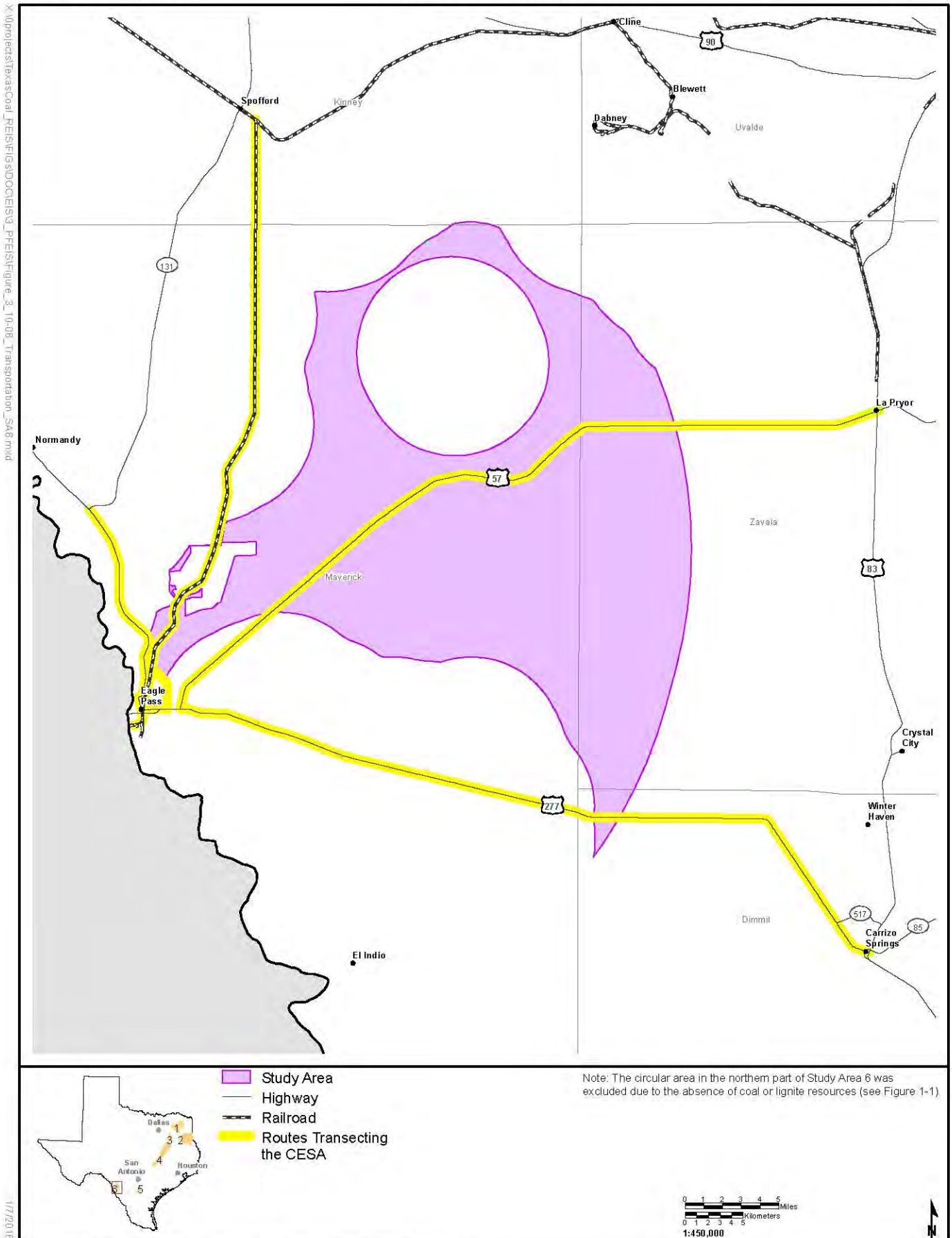
Figure 3.10-4 Study Area 4 – Major Roads and Rail Lines



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Figure 3.10-5 Study Area 5 – Major Roads and Rail Lines



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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.

#### Railroads

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 be 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 be 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 be 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 be 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 be 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 be 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 (Purdue 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.

##### Study Areas 1

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) <sup>1</sup>
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

<sup>1</sup> 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 versus 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 (EIA 2014b). 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 Coastal 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.

#### Study Area 1

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 <sup>1</sup>	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

<sup>1</sup> 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 <sup>1</sup>	Distance (miles) <sup>2</sup>	Incident Rate per Million Miles <sup>3</sup>	Calculated Number of Incidents <sup>4</sup>
Diesel Fuel	2,185,000	10,500	4,160	208,000	0.0000007	0.15

<sup>1</sup> 20-year life of mine (208 shipments X 20 years).

<sup>2</sup> 208 trips per year x 50 miles; 10400 miles x 20 years.

<sup>3</sup> Battelle (2001) includes accidents and en route leaks, but not loading/unloading incidents.

<sup>4</sup> 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 **public** 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, 3.7.1, 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 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<sub>10</sub> and PM<sub>2.5</sub> NAAQS. Fugitive dust emissions (i.e., PM<sub>10</sub> and PM<sub>2.5</sub>) 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 be expected to cause adverse health effects or contribute 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	Minority Populations							
		Non-Hispanic - White Alone	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) <sup>2</sup>
		(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 <sup>1</sup>	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

<sup>1</sup> 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.

<sup>2</sup> 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 <sup>1</sup>	Total Population	Minority Populations								Analysis Area
		Non-Hispanic - White Alone	Non-Hispanic - Black or African American Alone	Non-Hispanic - 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) <sup>2</sup>	
		(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 <sup>1</sup>	Total Population	Minority Populations								Analysis Area
		Non-Hispanic - White Alone	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) <sup>2</sup>	
		(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 <sup>1</sup>	Total Population	Minority Populations								Analysis Area
		Non-Hispanic - White Alone	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) <sup>2</sup>	
		(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	--

<sup>1</sup> Counties in Texas, unless otherwise noted.

<sup>2</sup> 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 <sup>1</sup>	\$46,625	18.6
Texas	\$48,622	17.9
Louisiana	\$42,510	18.8
U.S.	\$50,046	15.3

<sup>1</sup> 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 <sup>1</sup>	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**

<b>County<sup>1</sup></b>	<b>Median Household Income</b>	<b>Percent of People Living Below the Poverty Line</b>	<b>Analysis Area</b>
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	

<sup>1</sup> 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	<p>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.</p> <p>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.</p>
Paleontological Resources	No	No	<p>No irretrievable or irreversible impacts would be anticipated to unique or scientifically important or valuable paleontological resources.</p>
Water Resources	No	Yes	<p>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.</p> <p>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.</p> <p>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.</p>
Soils	Yes	Yes	<p>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.</p>
Vegetation	Yes	Yes	<p>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.</p>

**Table 3.18-1 Irreversible and Irretrievable Commitment of Resources by the Proposed Action**

<b>Resource</b>	<b>Irreversible Impacts</b>	<b>Irretrievable Impacts</b>	<b>Description</b>
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.





## 4.0 Consultation and Coordination

### 4.1 Public Participation and Scoping

Public participation for the REIS began with the scoping process. Scoping is the process of actively soliciting input from the public and interested federal, state, and local agencies about a proposed action. The process provides a mechanism for determining the EIS scope and significant issues (40 CFR 1501.7 and 40 CFR 1508.25) so the EIS can focus the analyses on areas of interest and concern. Therefore, the public's participation during the scoping period is a vital component to preparing a comprehensive and sound NEPA document. The USACE Fort Worth District's overall scoping goal for the REIS was to engage a diverse group of public, tribal, and agency participants in the NEPA process, solicit relevant input, and provide timely information during the REIS process.

The USACE Fort Worth District initiated the scoping process by publishing the Notice of Intent to prepare the REIS in the Federal Register on October 24, 2013. Additionally, a Public Notice was mailed to over 485 federal, state, and local government agencies; private businesses and organizations; private landowners; and tribes. Public notices were also placed in the following local newspapers announcing the public scoping meeting date, time, and location:

- *Austin American-Statesman*
- *Longview News Journal*
- *Marshall News Messenger*
- *Waco Tribune Herald*
- *Temple Daily Telegram*
- *Bryan/College Station Eagle*
- *Eagle Pass News Gram*
- *Mt. Pleasant Daily Tribune*
- *Tyler Morning Telegraph*
- *Henderson Daily News*
- *Uvalde Leader-News*
- *Freestone County Times*
- *Pleasanton Express*
- *Elgin Courier*
- *Jewett Messenger*
- *Three Rivers Progress*
- *Robertson County News*
- *Rockdale Reporter*

The USACE Fort Worth District conducted public scoping meetings on December 3, 2014, in Uvalde, Texas; December 4, 2014, in Temple/Belton, Texas; and December 5, 2014, in Tyler, Texas. The meetings were held in an informal, open house format to promote information exchange about the REIS and to gather public input. A total of 110 meeting participants signed their attendance at the meetings. Display boards showing various aspects of the six Proposed Action study areas for the REIS were presented to facilitate information exchange. The scoping announcement, which included information about the REIS and NEPA process, as well as frequently asked questions, was distributed at the meetings along with comment forms.

The USACE Fort Worth District coordinated a meeting with interested agencies on July 16, 2013, to provide detailed technical information about the REIS and to solicit agency input regarding the scope, issues, and potential alternatives to be considered. Attendees included representatives from OSMRE, TPWD, RCT, USFWS, and TCEQ.

At the end of the comment period, the scoping comments were compiled and analyzed to identify key issues and concerns. Some of the scoping comments were eliminated from consideration in the REIS because they addressed issues outside of the scope of the NEPA analyses, or the comment stated an opinion rather than a substantive comment that could be addressed in the REIS. A Scoping Summary Report was prepared and posted to the USACE Fort Worth District's public website for the REIS.

The scope of the REIS reflects input received from the public and from government agencies. Key issues identified during the scoping process include the following:

#### **Procedural/NEPA Process**

- Suggest analysis of all relevant resources and inclusion of methodologies used for assessing potential resource-specific cumulative effects
- Concerns that the REIS would exempt or lessen the NEPA requirements for future proposed mine expansions
- Suggest USACE and USEPA work in tandem to limit sources of carbon pollution, especially from coal
- Suggest evaluation of waters of the U.S., including wetlands, mitigation success to date in relation to the 2008 Compensatory Mitigation Rule
- Concern that the level of detail in the REIS would be less than in site-specific NEPA documents
- Concerns relative to changes in conditions between the time the REIS is issued and development of tiered NEPA documents for future coal and lignite mine expansions
- Suggest development of individual programmatic agreements to mitigate potential impacts to cultural resources
- Suggest future mine expansion areas avoid all ponds, streams, and wetlands
- Suggest future public meetings for Proposed Action Study Area 6 be held in Eagle Pass
- Concerns relative to the public notification process
- Suggest transcribers and translators be available at public meetings to facilitate verbal comments
- Suggest regulations be implemented to protect human health and wildlife
- Concern relative to potential impacts to property owners in potential future mine expansion areas
- Suggest conformance with the Climate Action Plan

#### **Proposed Action**

- Concerns relative to lack of a temporal limit on the REIS
- Suggest tiered documents include updated cumulative effects analyses
- Concerns that the REIS would exempt or lessen the NEPA requirements for future proposed mine expansions
- Suggest expansion of Study Areas 6 to include Elm Creek and the Rio Grande downstream to Eagle Pass
- Concern relative to placement of coal ash in pit backfill areas
- Suggest site protection assurances be consistent with the 2008 Compensatory Mitigation Rule, explore the purchase of land for conservation easements, and consider off-site mitigation for long-term protection
- Suggest use of ecologically based performance standards for determining reclamation success
- Suggest use of functional assessment tools in determining baseline conditions, mitigation needs, and ecologically based performance standards
- Concern relative to quality of newly created or restored wetlands and streams
- Concern relative to placement of sediment control ponds on-channel in mitigation streams

- Suggest inclusion of requirements for additional functional/conditional assessments
- Suggest the required monitoring period should be greater than 5 years
- Suggest inclusion of further rationale relative to thresholds for proposed categories for future tiering.

#### **Geology, Paleontology, Minerals**

- Concerns relative to potential blasting effects in areas with existing underground workings
- Suggest adequate assessment of unique geologic features on a site-by-site basis

#### **Groundwater**

- Potential impacts to groundwater recharge as related to the loss of wetlands
- Potential groundwater drawdown impacts
- Concerns relative to potential impacts to groundwater supply for the Mid-East Texas Groundwater Conservation District in Proposed Action Study Area 2
- Potential groundwater quality impacts as related to placement of coal ash in pit backfill areas
- Potential groundwater quality impacts as related to mercury and other heavy metals
- Concerns relative to groundwater quality impacts, including potential impacts to drinking water, domestic use, agricultural, and livestock water sources
- Potential impacts to the Edwards Aquifer
- Suggest evaluation of using subsurface concrete barriers to isolate groundwater dewatering areas to mitigate potential impacts

#### **Surface Water**

- Suggest documentation of existing surface water quality conditions
- Potential groundwater drawdown-related impacts on surface water recharge, including potential effects to ponds, streams, and wetlands
- Potential surface water quantity impacts, including potential impacts to Elm Creek, Rio Grande River, and water supply for the Maverick County Water Control and Improvement District #1 and Eagle Pass
- Potential surface water quality impacts, including potential impacts to drinking water, domestic use, agricultural, and livestock watering sources
- Potential surface water quality impacts to Elm Creek and the Rio Grande
- Potential impacts associated with the temporal loss of aquatic resources
- Potential impacts associated with stream diversions
- Potential impacts to flood mitigation as related to the loss of wetlands
- Potential surface water quality impacts as related to recharge from impacted groundwater
- Potential surface water quality impacts resulting from runoff, including acid or alkaline drainage
- Potential surface water quality impacts as related to mercury and other heavy metals
- Potential ongoing mercury contamination of water bodies designated by state and federal agencies as impaired by mercury
- Potential surface water impacts resulting from mining-related discharges

### **Waters of the U.S., including Wetlands**

- Potential impacts to waters of the U.S., including wetlands
- Potential groundwater drawdown-related impacts to wetlands
- Suggest previous mining-related impacts to wetlands be included in the cumulative effects analysis
- Suggest analysis of reclaimed wetlands and streams to reference sites

### **Soils and Reclamation**

- Potential impacts to topsoils and subsoils resulting from handling operations and stockpiling
- Suggest mitigation success be determined based on performance standards

### **Fish and Wildlife/Threatened and Endangered Species**

- Potential impacts to terrestrial and aquatic wildlife species and their habitats
- Potential surface water quality-related impacts to fish and wildlife species
- Potential impacts associated with the temporal loss of aquatic habitat
- Potential noise and lighting related effects on wildlife
- Potential impacts to threatened and endangered species
- Suggest the conduct of threatened and endangered species surveys and implementation of exclusion areas

### **Cultural Resources**

- Potential direct impacts to cultural resources
- Potential impacts to structures as a result of blasting in areas with underground workings
- Suggest the conduct of cultural resource surveys and appropriate protection

### **Air Quality**

- Potential air quality impacts resulting from airborne pollutants and fugitive dust emissions, including coal dust and crystalline silica
- Potential direct, indirect, and cumulative impacts as a result of greenhouse gas emissions
- Potential contribution to climate change

### **Land Use and Recreation**

- Potential effects on private properties
- Potential impacts on farming and ranching operations
- Potential conflict with growth and development of Eagle Pass
- Potential air quality and health effects for recreationists

### **Social and Economic Values**

- Potential impacts on property values as a result of mining-related noise, lighting, air quality effects, traffic-related effects, road closures, and blasting
- Potential impacts on quality of life for adjacent landowners
- Potential impacts to structures as a result of blasting in areas with underground workings

- Potential financial effects to individuals resulting from impacts to livestock
- Potential economic effects resulting from health impacts

### **Transportation**

- Potential impacts related to increased traffic and road closures

### **Public Health**

- Potential air quality-related health effects
- Potential health effects including bronchitis, emphysema, silicosis, chronic obstructive pulmonary disease, and cancer
- Potential water quality-related health effects, including impacts related to mercury and other heavy metals

### **Environmental Justice**

- Potential impacts to low income and minority communities

### **Cumulative**

- Suggest inclusion of potential future mine expansions in the cumulative effects analysis
- Suggest cumulative effects analysis consider effects on both sides of the Texas-Mexico border
- Suggest inclusion of Louisiana surface lignite mining in cumulative effects analysis for Proposed Action Study Area 2
- Potential cumulative impacts to groundwater and surface water quantity and quality
- Potential cumulative impacts to downstream water users
- Potential cumulative impacts to flood mitigation and groundwater recharge resulting from loss of wetlands
- Potential cumulative impacts to wetlands, streams, and ponds
- Suggest evaluation of mitigation success to date for waters of the U.S., including wetlands, in relation to the 2008 Compensatory Mitigation Rule
- Suggest cumulative analysis of previous mine-related wetland and stream restoration
- Suggest cumulative effects analysis include impacts to open water, forested and non-forested wetlands, perennial streams, and intermittent/ephemeral streams
- Potential cumulative impacts to aquatic species and habitats
- Potential cumulative effects to low income and minority communities
- Potential cumulative air quality-related health effects
- Potential cumulative effects on farming and ranching operations
- Potential cumulative effects on communities and property values
- Potential cumulative effects on recreational areas

## **4.2 Consultation and Coordination with Federal, State, and Local Government Agencies**

Specific regulations require the USACE to coordinate and consult with federal, state, and local agencies about the potential for a proposed action and alternatives to affect sensitive environmental and human resources. For the REIS, the USACE Fort Worth District initiated these coordination and consultation activities through the scoping process. In addition, the District invited interested agencies to serve as

cooperating agencies for preparation of the REIS. The OSMRE, USEPA, USFWS, and RCT are serving as cooperating agencies.

### 4.3 Tribal Government-to-Government Consultation

In compliance with NHPA and USACE Policy Guidance Letter No. 57 (Indian Sovereignty and Government-to-Government Relations with Indian Tribes) the USACE is required to establish regular and meaningful consultation and collaboration with Native American tribal governments on development of regulatory policies that could significantly or uniquely affect their communities. As such, the USACE Fort Worth District initiated consultation with Native American tribes **by sending letters to federally recognized tribes (as identified below) on November 1, 2013. No formal responses were received.**

- **Comanche Nation, Oklahoma**
- **Tonkawa Tribe of Indians of Oklahoma**
- **Kickapoo Traditional Tribe of Texas**
- **Kiowa Indian Tribe of Oklahoma**
- **Caddo Nation**
- **Wichita and Affiliated Tribes**
- **Mescalero Apache Tribe of The Mescalero Reservation**
- **Choctaw Nation of Oklahoma**
- **Alabama-Coushatta Tribe of Texas**

### 4.4 Agency Contacts

In preparing the REIS, the USACE Fort Worth District communicated with or received input from various federal, state, and local agencies in addition to the cooperating agencies listed in Section 4.2. The following list summarizes the types of agencies and local government contacts that provided information that supported this REIS. Specific references cited in this REIS can be found in Chapter 6.0, References.

- 5 federal agencies
- 9 state agencies
- 49 local agencies or officials

### 4.5 Distribution of Notifications or Copies of this REIS

#### 4.5.1 Draft REIS

Notifications were sent via email to the USACE public notice list that was current at the time of **the Draft REIS** distribution. The USACE list includes agencies, companies, public officials, organizations, and individuals who have expressed an interest in being on the list. In addition to the USACE list, notifications of the availability of the **Draft REIS** were sent via email **or postcard** to **individuals** who submitted public scoping comments **or** requested notification. The notification of the availability of the Draft REIS and the schedule for public hearings was published in 18 local and regional newspapers.

Following is a summary of the types of groups that received the **Draft REIS** document either in hard copy, compact disk, or both.

- **Federal agency offices, including cooperating agencies**
- **State agency offices**

- County libraries in Texas
- Texas Mining and Reclamation Association members
- Individuals specifically requesting a compact disk

#### **4.5.2 Final REIS**

**Notifications were sent via email to the USACE public notice list that was current at the time of the Final REIS distribution. The USACE list includes agencies, companies, public officials, organizations, and individuals who have expressed an interest in being on the list. In addition to the USACE list, notifications of the availability of the Final REIS were sent via email or postcard to individuals who provided comments or requested notification.**

**Following is a summary of the types of groups that received the Final REIS document either in hard copy, compact disk, or both.**

- Federal agency offices, including cooperating agencies
- State agency offices
- County libraries in Texas
- Texas Mining and Reclamation Association members
- Individuals specifically requesting a compact disk

#### **4.6 Public Comments and USACE Responses**

**A 60-day public comment period for the Draft REIS commenced on July 10, 2015, with publication of the Notice of Availability in the Federal Register.**

**The USACE Fort Worth District conducted both informal public information meetings and formal public hearings at Eagle Pass, Texas, on August 10, 2015; Pleasanton, Texas, on August 11, 2015; Belton, Texas, on August 12, 2015; and Tyler, Texas, on August 13, 2015. The total number of people that signed in at each of the meetings/hearings was 88, 7, 14, and 5, respectively. A court reporter was present at each of the public hearings to record formal oral comments. Also, a Spanish-speaking interpreter was present at the Eagle Pass and Pleasanton meetings, and the Draft REIS Executive Summary was available in Spanish at all locations.**

**During the Draft REIS public comment period, the USACE received a total of 23 unique comment letters, forms, and emails and 38 form letters, in addition to the oral comments provided by 44 individuals at the public hearings. Comments were provided by private individuals living in the region, elected officials, federal and state agencies, a mining company, tribal representatives, and organizations. The public comments and associated USACE responses are presented in Appendix D.**





## 5.0 EIS Preparers and Reviewers

Responsibility	Affiliation / Name	Degree and Experience
<b>U.S. Army Corps of Engineers EIS Team</b>		
Chief, Evaluation Branch, Regulatory Division	Jennifer Walker	BS Biology 27 years experience
Regulatory Project Manager	Darvin Messer	BS Physics/Mathematics 24 years experience
Public Affairs	Clay Church	BS Political Science 25 years experience
Cultural Resources	Skipper Scott	BA Anthropology 36 years experience
Technical Specialist	Chandler Peter	BS Biology 28 years experience
<b>AECOM EIS Team (Third-party Contractor to U.S. Army Corps of Engineers)</b>		
Project Manager	Ellen Dietrich AECOM Fort Collins, Colorado	BA Anthropology 39 years experience
Assistant Project Manager	Dolora Koontz AECOM Fort Collins, Colorado	BA Biology 28 years experience
Project Coordinator	Terra Mascarenas AECOM Fort Collins, Colorado	BS Soil and Crop Science 18 years experience
	Julie Barraza AECOM Fort Collins, Colorado	BS Biology 6 years experience
	Clint Anders AECOM Fort Collins, Colorado	BS Biology 1 year experience
Geology, Paleontology, Minerals, Groundwater Resources, Hazardous Materials and Solid Waste	Bill Berg AECOM Fort Collins, Colorado	MS Geology BS Geology 33 years experience
Surface Water Resources	James Burrell AECOM Fort Collins, Colorado	MS Civil Engineering BS Forest Management 31 years experience
Waters of the U.S., 404(b)(1) Alternatives	William (Roy) Knowles AECOM Houston, Texas	MS Wildlife and Fisheries Sciences BBA Finance 25 years experience
Soils and Reclamation	Terra Mascarenas AECOM Fort Collins, Colorado	BS Soil and Crop Science 18 years experience
Vegetation	Timothy Love AECOM Houston, Texas	MS Botany and Microbiology BA Biology 36 Years experience

<b>Responsibility</b>	<b>Affiliation / Name</b>	<b>Degree and Experience</b>
Fish (F) and Wildlife (W)	Patricia Lorenz (W) AECOM Fort Collins, Colorado	BS Wildlife Biology 12 years experience
	Rollin Daggett (F) AECOM Fort Collins, Colorado	MS Freshwater and Marine Biology BS Zoology 40 years experience
Cultural Resources	Amy Ollendorf AECOM Minneapolis, MN	PhD Ancient Studies MS Ancient Studies BS Anthropology and Geology 31 years experience
Air Quality	Courtney Taylor AECOM Fort Collins, Colorado	MS Atmospheric Science BA Environment, Economics, and Politics 13 years experience
	Dustin Rapp AECOM Fort Collins, Colorado	MS Atmospheric Science BS Physics 7 years experience
	Denise Hazelman AECOM Fort Collins, Colorado	BS Micro/Molecular Biology (minor chemistry) AA Biology 8 years experience
Land Use and Recreation, Noise	Chris Dunne AECOM Fort Collins, Colorado	BS Natural Resources Management 16 years experience
Social and Economic Resources	Guyton Durnin AECOM San Francisco, CA	MS Environmental Engineering BS Civil Engineering BA Economics 7 years experience
	Rima Ghannam AECOM San Francisco, CA	MS Environmental Planning BS Agriculture Engineering 14 years experience
Environmental Justice	Guyton Durnin AECOM San Francisco, CA	MS Environmental Engineering BS Civil Engineering BA Economics 7 years experience
Transportation	Steve Graber AECOM Fort Collins, Colorado	BS Natural Resource Management BA Economics 10 years experience
Visual Resources	Anita Richardson AECOM Phoenix, Arizona	BS Applied Geography 16 years experience
Public Health	Dolora Koontz AECOM Fort Collins, Colorado	BA Biology 27 years experience
Mine Engineering	Eldon Strid Mine Engineers, Inc. Cheyenne, Wyoming	BS Mine Engineering 41 years experience

<b>Responsibility</b>	<b>Affiliation / Name</b>	<b>Degree and Experience</b>
Geographic Information Systems	Brent Read AECOM Fort Collins, Colorado	MS Watershed Science BS Forestry 13 years experience
	Scott MacKinnon AECOM Fort Collins, Colorado	BS Physical Geography 11 years experience
	<b>Ben Tracy</b> <b>AECOM</b> <b>Fort Collins, Colorado</b>	<b>BS Natural Resources</b> <b>5 years experience</b>
Document Production	Susan Coughenour AECOM Fort Collins, Colorado	General Education Studies 29 years experience



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## 7.0 Glossary

Air quality related values (AQRVs)	Resources sensitive to air quality and include vegetation, soils, water, fish and wildlife, and visibility.
Ambient Noise	Background noise. The total volume of noise produced from nearby and distant sources.
Anthropogenic	Relating to, or resulting from the influence of human beings on nature
Antiquity	The ancient past, especially the period before the Middle Ages.
Aquifer	Any geological formation containing or conducting ground water, especially one that supplies the water for wells, springs, etc.
Archaic	The time period between 6000 B.C. to around A.D. 0.
Atmospheric Deposition	The process by which chemical substances, such as pollutants, are transferred from the atmosphere to the earth's surface.
Bituminous coal	Black coal having a relatively high volatile content. It burns with a characteristically bright smoky flame.
Brownfield	A term used in urban planning to describe land previously used for commercial uses or industrial purposes. Brownfields are real property, the expansion, redevelopment, or reuse of which may be complicated by the presence or potential presence of a hazardous substance, pollutant, or contaminant.
Caliche	A sedimentary rock, a hardened natural cement of calcium carbonate that binds other materials such as gravel, sand, clay, and silt.
Cambrian	The geologic span of time between 570 and 505 million years ago.
Caliche	A sedimentary rock, a hardened natural cement of calcium carbonate that binds other materials such as gravel, sand, clay, and silt.
Carbonaceous	Consisting of or containing carbon or its compounds.
Carrying Capacity	The maximum population or level of activity that can be supported without degradation of the habitat or the population.
Cenozoic	The geologic span of time between 66 million years ago to the present.
Classified Segment	A waterbody or portion of a waterbody that is defined individually by TCEQ in state surface water quality standards.
Clastic	Denoting rocks composed of broken pieces of older rocks.
Coal Combustion Residue (CCR)	The ash and other by-products from burning coal in power plants.
Confluence	The junction of two rivers, primarily rivers of approximately equal width.
Cretaceous	The geologic span of time between 144 and 66 million years ago.

Critical Habitat	Habitat that is present in minimum amounts and is the determining factor in the potential for population maintenance and growth.
Criteria Pollutants (Air)	Six commonly found air pollutants for which the USEPA sets standards. USEPA develops human health-based and/or environmentally based science-based guidelines for setting allowable levels of these pollutants. The six are: particle pollution, ground-level ozone, carbon monoxide, sulfur oxides, nitrogen oxides, and lead.
Cumulative Effects	The combined environmental impacts that accrue over time and space from a series of similar or related individual actions, contaminants, or projects. Although each action may seem to have a negligible impact, the combined effect can be significant. Included are activities of the past, present, and reasonably foreseeable future; synonymous with cumulative impacts.
dB Decibel	Unit of measure of sound pressure and sound power levels. Expresses relative difference in power between two signals equal to 10 times the logarithm (base 10) of the ratio of the two levels.
dBA	A-weighting. The most commonly used frequency weighting measure; simulates human sound perception and correlates well with human perception of the annoying aspects of noise.
Deposition	The geological process in which sediments, soil and rocks are added to a landform or land mass.
Depressurization Wells	Wells installed to prevent pit floor heaving.
Dewatering Wells	Well installed to provide for pit wall stability and safe working conditions.
Direct Impacts	Impacts that are caused by the action and occur at the same time and place (40 CFR 1508.7); synonymous with direct effects.
Discharge	The volume of water flowing past a point per unit time, commonly expressed as cubic feet per second, gallons per minute, or million gallons per day.
Disturbed Area	An area where natural vegetation and soils have been removed.
Drainage	The natural channel through which water flows some time of the year; natural and artificial means for affecting discharge of water as by a system of surface and subsurface passages.
Drawdown	The lowering of the water level in a well as a result of withdrawal; the reduction in head at a point caused by the withdrawal of water from an aquifer.
Ecoregion	A major ecosystem defined by distinctive geography and receiving uniform solar radiation and moisture.
Endangered Species	Any species in danger of extinction throughout all or a significant portion of its range. Plant or animal species identified by the Secretary of the Interior as endangered in accordance with the 1973 ESA.
Ecocene Epoch/Series	The geologic span of time between 37.5 to 54 million years before present.



Embankment	A wall or bank of earth or stone built to prevent a river flooding an area.
Ephemeral Stream	An ephemeral stream has flowing water only during, and for a short duration after, precipitation events in a typical year. Ephemeral stream beds are located above the water table year-round. Groundwater is not a source of water for the stream. Runoff from rainfall is the primary source of water for stream flow.
Evapotranspiration	The process by which water is transferred from the land to the atmosphere by evaporation from the soil and other surfaces and by transpiration from plants.
Fault	A fracture in rock units along which there has been displacement.
Flocculant	A reagent added to water to aggregate minute suspended particles so that they may precipitate out of suspension.
Floodplain	That portion of a river valley, adjacent to the channel, that is built of sediments deposited during the present regimen of the stream and that is covered with water when the river overflows its banks at flood stages.
Fluvial Environment	River environment.
Fluvial Geomorphology	The study of landform evolution related to rivers.
Forage	Vegetation used for food by wildlife, particularly big game wildlife, and domestic livestock.
Forb	Any herbaceous plant other than a grass, especially one growing in a field or meadow.
Fugitive Dust	Dust particles suspended randomly in the air from road travel, excavation, and rock loading operations.
Geomorphology	The scientific study of physical landforms and the processes that formed them.
Growth Media	Suitable material that may be used in place of topsoil for reclamation purposes.
Groundwater Gradient	Change in head per unit of distance measured in the direction of flow.
Groundwater Recovery	An increase in groundwater levels such that the groundwater elevations rise above initial baseline groundwater elevations. Used to refer to an increase in water levels following drawdown.
Groundwater Table	The surface between the zone of saturation and the zone of aeration; that surface of a body of unconfined groundwater at which the pressure is equal to that of the atmosphere.
Herpetofauna	A term referring to reptiles and amphibians. This group includes frogs, toads, turtles, salamanders, snakes and lizards.
Hertz (Hz)	Unit of frequency of one cycle per second.
Historic	The time period after A.D. 1600.
Holocene	Geologic span of time from 11.7 thousand years ago to present.
Homogeneous	Similar or of the same kind.

Hydraulic Conductivity	The capacity of a rock to transmit water. It is expressed as the volume of water at the existing kinematic viscosity that will move in unit time under a unit hydraulic gradient through a unit area measured at right angles to the direction of flow.
Hydraulic Gradient	See groundwater gradient.
Hydraulic Head	The height of the free surface of a body of water above a given subsurface point.
Hydrologic Unit Code (HUC)	A way of identifying all of the drainage basins in the United States in a nested arrangement from largest (Regions) to smallest (Cataloging Units).
Impact	A modification in the status of the environment brought about by the Proposed Action or an alternative.
Impaired Waterbodies	Waterbodies that have water quality characteristics that no longer support designated or presumed uses.
Impoundment	A body of water confined within an enclosure, such as a reservoir.
Indirect Impacts	Impacts that are caused by the action and are later in time or farther removed in distance but are still reasonably foreseeable (40 CFR 1508.8); synonymous with indirect effects.
Infiltration	The movement of water or some other liquid into the soil or rock through pores or other openings.
Infrastructure	The basic framework or underlying foundation of a community or project, including road networks, electric and gas distribution, water and sanitation services, and facilities.
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.
Interburden	Non-ore grade material interlayered with ore or located within or horizontally adjacent to the ore such that it must be removed in the process of extracting ore grade material.
Interfluve	The region of higher land between two rivers that are in the same drainage system.
Intermittent Stream	An intermittent stream has flowing water during certain times of the year, when groundwater provides water for stream flow. During dry periods, intermittent streams may not have flowing water. Runoff from rainfall is a supplemental source of water for stream flow.
Invertebrate	An animal without a backbone.
Irretrievable	Applies primarily to the lost production of renewable natural resources during the life of the project.
Irreversible	Applies primarily to the use of nonrenewable resources, such as minerals, cultural resources, wetlands, or to those factors that are renewable only over long time spans, such as soil productivity. Irreversible also includes loss of future options.
Jurassic	The span of time between 208 and 144 million years ago.

Jurisdictional Wetland	A wetland area identified and delineated by specific technical criteria, field indicators, and other information for purposes of public agency jurisdiction. The public agencies that administer jurisdictional wetlands are the USACE, USEPA, USFWS, and NRCS.
Lacustrine	Permanently flooded and intermittent lakes and reservoirs that typically have extensive areas of deep water
Late Prehistoric	The time period between approximately A.D. 700 – 1600.
Lignite	A low-grade form of coal; subbituminous coal.
Limnetic	Open waters of lakes and reservoirs
Lithic Scatter (Archaeology)	A discrete grouping of flakes of stone created as a byproduct in the tool making process. Often includes flakes used as tools as well as formal stone tools, such as projectile points, knives, or scrapers.
Lithologic Units	Rock formations.
Level of Service (LOS) (Transportation)	A standardized method of qualitatively measuring the operational conditions of traffic flows on roadways and the perception of those conditions by motorists and passengers.
Macrofossils	A fossil large enough to be observed by direct inspection.
Macroinvertebrate	Animals lacking a spinal cord that can be seen without magnification.
Microfossils	Fossils that can be seen with the use of a microscope.
Micromhos per Centimeter	A unit of measure for electrical conductivity in water. Higher values reflect greater levels of dissolved conductors, such as sodium, calcium, or magnesium salts.
Mitigate, Mitigation	To cause to become less severe or harmful; actions to avoid, minimize, rectify, reduce or eliminate, and compensate for impacts to environmental resources.
Monitor	To systematically and repeatedly watch, observe, or measure environmental conditions in order to track changes.
National Environmental Policy Act (NEPA)	The NEPA of 1969; the national charter for Protection Act protecting the environment. NEPA establishes policy, sets goals, and provides means for carrying out the policy. Regulations from 40 CFR 1500-1508 implement the act.
National Register of Historic Places (NRHP)	A list, maintained by the NPS, of areas that have been designated as being of historical significance.
Native American Consultation Database (NACD)	A tool for identifying consultation contacts for Indian tribes and Native Hawaiian organizations developed by the NPS.
Native Species	Plants that originated in the area in which they are found (i.e., they naturally occur in that area).
Nephelometric Turbidity Unit	A unit measuring the dispersion of a beam of light passed through a sample of water. Silt and other fine, suspended particles disperse the light. Higher values imply (qualitatively) more suspended material.

National Geodetic Vertical Datum of 1929 (NGVD)	The National geodetic vertical datum of 1929 is a vertical geodetic datum formerly called sea level datum of 1929 or “mean sea level.” It is based on sea level averages at 26 points along the U.S. and Canadian coasts over a period of many years.
Noise	Unwanted sound; one that interferes with one’s hearing of something; a sound that lacks agreeable musical quality or is noticeably unpleasant.
Outfalls	Discharge points from the drainage control system to downstream drainages.
Overburden	Material that must be removed to allow access to an orebody, particularly in a surface mining operation.
Oxidize	Having undergone a chemical reaction with oxygen.
Paleontology	The study of fossils; what fossils tell us about the ecologies of the past, about evolution, and about our place, as humans, in the world. Information about interrelationship between the biological and geological components of ecosystems over time.
Palustrine	Wetlands which include inland marshes and swamps as well as bogs, fens, tundra and floodplains.
Pangea	A supercontinent that existed during the late Paleozoic and early Mesozoic eras. It formed approximately 300 million years ago and then began to break apart after about 100 million years.
Parent Material	Unconsolidated organic and inorganic mineral material in which soil forms.
Passerine	Referring to birds in the order Passeriformes, which includes perching birds.
Peak Flow	The greatest flow attained during winter snowmelt or during a large precipitation event.
Perennial Stream	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. Groundwater is the primary source of water for stream flow. Runoff from rainfall is a supplemental source of water for stream flow.
pH	The measure of the acidity or basicity of a solution.
Physiographic	Based on terrain texture, rock type, and geologic structure and history.
Plastic Limit (Soils)	The minimum water mass content at which a small sample of soil material can be deformed without rupture.
Pleistocene	Geologic span of time occurring 1.8 million years ago and lasted until about 11,700 years ago.
Potentiometric Surface	A surface that represents the total head in an aquifer; that is, it represents the height above a datum plane at which the water level stands in tightly cased wells that penetrate the aquifer.

Prime Farmland	Prime farmland is a designation assigned by U.S. Department of Agriculture defining land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops and is also available for these land uses.
Pseudokarst	A topography that resembles karst but that is not formed by the dissolution of limestone; usually a rough-surfaced lava field in which ceilings of lava tubes have collapsed.
Pyrite	A shiny yellow mineral consisting of iron disulfide and typically occurring as intersecting cubic crystals.
Radionuclide	An unstable form of a chemical element that radioactively decays, resulting in the emission of nuclear radiation.
Raptor	A bird of prey, including eagles, hawks, falcons, osprey, and owls.
Reclamation	The process by which lands disturbed as a result of human activity are restored to the original condition.
Recovery (Groundwater)	Used to refer to an increase in water levels following drawdown. An increase in groundwater levels such that the groundwater elevations return to approximate initial baseline groundwater elevations.
Recurrence Intervals	Long-term averages that reflect the probability (based on 100 percent) of an event happening in any given year.
Reducing	To change (an element or ion) from a higher to a lower oxidation state.
Residual Effects	Remaining results or conditions after project and mitigation completion.
Right-of-way	Strip of land or corridor through which a power line, access road, or maintenance road would pass.
Riparian	Situated on or pertaining to the bank of a river, stream, or other body of water. Riparian is normally used to refer to plants of all types that grow along streams, rivers, or at spring and seep sites.
Runoff	That part of precipitation that appears in surface streams; precipitation that is not retained on the site where it falls and is not absorbed by the soil.
Sediment	Material suspended in or settling to the bottom of a liquid. Sediment input comes from natural sources, such as soil erosion and rock weathering, as well as construction activities or anthropogenic sources, such as forest or agricultural practices.
Selective Handling	Procedures for separating suitable growth media from overburden and interburden sources.
Short Ton	2,000 pounds.
Siemen	Per meter. A unit of electrical conductivity.
Smectitic	A soil that is made up of a type of clay mineral (e.g., montmorillonite) that undergoes reversible expansion on absorbing water.

Soil Horizon	A layer of soil material approximately parallel to the land surface differing from adjacent genetically related layers in physical, chemical, and biological properties.
Soil Profile	A vertical section of the soil through all its horizons and extending into the parent material or to a depth of 60 inches.
Spoils	The material that lies above an area of economic or scientific interest. In mining, it is most commonly the rock, soil, and ecosystem that lies above a coal seam or ore body.
Stratigraphy	Form, arrangement, geographic distribution, chronological succession, classification, and relationships of rocklayers.
<b>Surface water features</b>	<b>Includes streams, ponds, lakes, and reservoirs.</b>
Terrace	A nearly level strip of land with a more or less abrupt descent along the margin of the sea, a lake, or a river.
Terrestrial	Species living or growing on land or on or in the ground; not aquatic, arboreal, or epiphytic
Tertiary	The geologic span of time between 65 and 3 to 2 million years ago.
Texas Pollutant Discharge Elimination System (TPDES)	A part of the Clean Water Act that requires point source dischargers to obtain Elimination System permits. In Texas, these permits are referred to as TPDES permits and are administered by the state.
Threatened Species	Any species of plant or animal that is likely to become endangered within the foreseeable future throughout all or a significant portion of its range.
Topography	The form and structure of the surface of land.
Total Dissolved Solids	Total amount of dissolved material, organic or inorganic, contained in a sample of water.
Transmissivity	The rate at which water of the prevailing kinematic viscosity is transmitted through a unit width of an aquifer under a unit hydraulic gradient; it equals the hydraulic conductivity multiplied by the aquifer thickness.
Underburden (Groundwater)	Geologic layers that are located below the geologic unit of interest.
Understory	Underlying plants (smaller trees, saplings, shrubs) that grow below the larger trees in a forest.
Unity	The visual coherence and harmony of the landscape when considered as a whole.
Vertebrate	An animal of a large group distinguished by the possession of a backbone or spinal column, including mammals, birds, reptiles, amphibians, and fishes.
Viewshed (Visual)	The area from which a proposed project area can be seen.
Visual Resource	The composite of basic terrain, geologic features, water features, vegetation patterns, and land use effects that typify a land unit and influence the visual appeal the unit may have for viewers.

Visual Sensitivity	A relative measure of the degree of concern by the viewer for changes in the landscape.
Vividness	The memorability of the visual impression received from contrasting landscape elements as they combine to form a striking and distinctive visual pattern.
Water Table	Level of water in the saturated zone at which the pressure is equal to the atmospheric pressure.
Waters of the United States	A jurisdictional term from Section 404 of the CWA referring to water bodies such as lakes, rivers, streams (including intermittent streams), mudflats, sandflats, wetlands, sloughs, prairie potholes, wet meadows, playa lakes, or natural ponds. The use, degradation, or destruction of these waters could affect interstate or foreign commerce.
Watershed	A region or area bounded peripherally by a water parting divide, and draining ultimately to one particular location, usually a watercourse or body of water.
Wetlands	Areas that are inundated by surface or groundwater with a frequency sufficient to support (and under normal circumstances do or would support) a prevalence of vegetation or aquatic life that requires saturated or seasonally saturated soil conditions for growth and reproduction.
Wind Rose (Air)	Weather map showing the frequency and strength of winds from different directions.





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