Osage County Oil and Gas Final Environmental Impact Statement

United States Department of the Interior
Bureau of Indian Affairs
Eastern Oklahoma Regional Office
Osage Agency

October 2020

Estimated Costs to Develop this EIS: $836,280

BIA Mission Statement

The Bureau of Indian Affairs' mission is to enhance the quality of life, to promote economic opportunity, and to carry out the responsibility to protect and improve the trust assets of American Indians, Indian tribes, and Alaska Natives.

United States Department of the Interior
BUREAU OF INDIAN AFFAIRS
Eastern Oklahoma Region
Eastern Oklahoma Regional Office
Post Office Box 8002
Muskogee, Oklahoma 74402-8002

October 16, 2020

Dear Reader:

The U.S. Department of the Interior, Bureau of Indian Affairs (BIA) is pleased to announce the completion of the Osage County Oil and Gas Final Environmental Impact Statement (Final EIS). The Final EIS addresses the potential impacts associated with the BIA's administration of the oil and gas leasing program in Osage County, Oklahoma. The BIA is the lead agency for the Final EIS and the Osage Nation, Osage Minerals Council, U.S. Geological Survey, and U.S. Environmental Protection Agency are cooperating agencies. The BIA prepared this document in accordance with the National Environmental Policy Act of 1969 (NEPA), as amended, the Indian Affairs NEPA Guidebook (59 IAM 3-H), Departmental policy, and other applicable law.

The federal actions analyzed in this EIS are the approval of oil and gas leases, drilling permits, and workover permits. Pursuant to the Osage Allotment Act of 1906 (1906 Act), as amended, the subsurface mineral estate underlying Osage County, Oklahoma (Osage Mineral Estate) is held in trust by the United States for the benefit of the Osage Nation and administered by the BIA. The 1906 Act authorizes the Osage Nation to lease the Osage Mineral Estate subject to the approval of the Secretary of Interior and under such rules and regulations as s/he may prescribe. The regulations governing leasing of the Osage Mineral Estate are set forth in 25 Code of Federal Regulations (CFR) part 226 – Leasing of Osage Reservation Lands for Oil and Gas Mining.

The BIA selected four alternatives for detailed analysis in the EIS: (1) the No Action Alternative; (2) Emphasize Oil and Gas Development; (3) Hybrid Development; and (4) Enhanced Resource Protection. The alternatives represent a reasonable range of management scenarios that satisfy the purpose of and need for the BIA's action. The alternatives are designed to promote development of the Osage Mineral Estate in a manner that is economical and efficient, while minimizing or avoiding adverse impacts on the environment, historic properties, and cultural resources that are important to federal recognized Tribes. The BIA selected Alternative 3 – Hybrid Development as the preferred alternative.

Please note that the Final EIS does not authorize any oil and gas leasing, exploration, or development activities in Osage County. All future leasing and development actions require the BIA's prior approval and, where operations involve new ground-disturbing activities, further NEPA analysis.

A hard copy of the Final EIS is available for viewing at the Osage Agency, 813 Grandview Avenue, Pawhuska, OK 75820. You can also access the Final EIS on the internet at https://www.bia.gov/regional-offices/eastern-oklahoma/osage-agency/osage-oil-and-gas-eis.

A 30-day waiting period will begin upon publication of the Notice of Availability for the Final EIS in the Federal Register. The waiting period will close on November 16, 2020. The BIA will sign a Record of Decision no sooner than 30 days following publication of the Notice of Availability in the Federal Register.

Thank you for your interest in the Osage County Oil and Gas EIS. We appreciate your contributions to the planning process. For additional information regarding the Final EIS, please contact Mr. Mosby Halterman, Project Lead, BIA Eastern Oklahoma Regional Office, P.O. Box 8002, Muskogee, OK 74402-8002; tel. (918) 781-4660; fax (918) 781-4667; email osagecountyoilgaseis@bia.gov.

Sincerely,

Eddie Streater
Regional Director

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Executive Summary

ES.1 Introduction and Regional Setting

The United States (US) Department of the Interior, Bureau of Indian Affairs (BIA) Eastern Oklahoma Regional Office prepared the Osage County Oil and Gas Environmental Impact Statement (EIS), in accordance with the National Environmental Policy Act of 1969 (NEPA). This programmatic EIS analyzes the potential impacts of future oil and gas development on the surface estate and subsurface mineral estate in Osage County, Oklahoma. Osage County, the planning area for this EIS, is located in northeast Oklahoma and encompasses approximately 1,474,500 acres.

In accordance with the Osage Allotment Act of 1906 (1906 Act), as amended, the subsurface mineral estate underlying Osage County (Osage Mineral Estate) is held in trust by the United States for the benefit of the Osage Nation and is administered by the BIA. The federal actions analyzed in this EIS are the approval of oil and/or gas leases, drilling permits, and workover permits. All leases and permit applications in Osage County are approved under the authority of the 1906 Act and 25 Code of Federal Regulations (CFR) 226 – Leasing of Osage Reservation Lands for Oil and Gas Mining.

Oil and gas development in Osage County has been ongoing since 1896. While the planning area has been substantially developed for conventional oil and gas production and coal bed methane production, historical development is heavily concentrated in certain parts of the county, leaving much of the area pristine. In addition to oil and gas development, Osage County also supports residential, agricultural, commercial, and recreational land uses.

Four alternatives were selected for detailed analysis in this EIS: (1) the No Action Alternative; (2) Emphasize Oil and Gas Development; (3) Hybrid Development; and (4) Enhanced Resource Protection. The alternatives are designed to promote development of the Osage Mineral Estate in a manner that is economical and efficient while minimizing or avoiding adverse impacts on the environment, historic properties, and cultural resources significant to federally recognized Tribes (Tribes).

The impact analysis uses the best available data and is based on the reasonably foreseeable development of oil and gas resources under each alternative through 2037.

ES.2 Purpose of and Need for the EIS

The purpose of the BIA's action is to promote leasing and development of the Osage Mineral Estate in the best interest of the Osage Nation pursuant to the 1906 Act, as amended, balancing resource conservation and maximization of oil and gas production in the long term. In addition, the BIA is required, under more generally applicable statutes, to include in the best interest calculation, protection of the environment in Osage County in order to enhance conservation of resources and protection of the health and safety of the Osage people. Based on those considerations, the BIA's action will promote the maximization of oil and gas production from the Osage Mineral Estate in a manner that is economic, efficient, and safe; prevents pollution; and is consistent with the mandates of federal law.

The BIA needs this EIS in order to fulfill its trust responsibility under the 1906 Act to administer leasing and development of the Osage Mineral Estate. In the Hayes I litigation, the US District Court for the Northern District of Oklahoma ruled that the programmatic 1979 Environmental Assessment for the Oil and Gas Leasing Program of the Osage Indian Tribe (1979 EA) was no longer valid. Accordingly, the BIA may not rely on the 1979 EA to review and approve oil and gas leases and permits. The BIA's current NEPA review process utilizes 3 separate NEPA documents: the 2014 Programmatic Environmental Assessment for Leasing Activities (Leasing PEA), the 2015 Programmatic Environmental Assessment for the Approval of Workover Operations (Workover PEA), and site-specific EAs. This EIS will allow the BIA to streamline the NEPA review process by replacing the Leasing and Workover PEAs with a single NEPA document that provides comprehensive impacts analysis and reducing the size and cost of site-specific EAs. The efficiencies gained by streamlining the NEPA review process will expedite lease and permit processing.

ES.3 EIS Decision Framework

The EIS will replace the Leasing and Workover PEAs and serve as the sole NEPA review for leases and workover operations that do not require new ground disturbance. Site-specific EAs will be required for all drilling, workover, and other operations involving new ground disturbance, but lessees will be able to tier to the comprehensive impacts analysis in the EIS. The EIS does not impose restrictions on how large an area a site-specific environmental assessment may cover. Lessees may prepare a site-specific environmental assessment for 1 individual well, a "batched" group of wells that will be located within the same area, an entire lease, a quarter-section, a section, or any larger area that they so choose. The location of wells, well pads, access roads, rights-of-way, and other surface facilities will be determined at the permitting stage.

The Record of Decision associated with this EIS will approve a plan for the development of the Osage Mineral Estate. The Record of Decision could approve 1 of the alternatives or a combination of the alternatives.

ES.4 Public Involvement, Cooperating Agencies, and Consultation

ES.4.1 Public Involvement

Public involvement is a critical component of the NEPA process. In accordance with BIA and Council on Environmental Quality regulations and guidance, the BIA conducted 2 formal scoping periods to identify significant issues associated with the agency's proposed land and resource management issues. The scoping periods presented individuals from federal, state, and local agencies; Tribes; interest groups; and the general public with opportunities to provide meaningful input via in-person participation at public scoping meetings and the submission of written comments by comment card, email, or letter.

The final scoping report for the first scoping period is available online at https://eplanning.blm.gov/epl-front-office/eplanning/planAndProjectSite.do?methodName=renderDefaultPlanOrProjectSite&projectId=72142. The final scoping report for the second scoping period is available online at https://www.bia.gov/regional-offices/eastern-oklahoma/osage-agency/osage-oil-and-gas-eis.

ES.4.2 Cooperating Agencies

The Osage Nation, Osage Minerals Council, US Environmental Protection Agency (EPA), and US Geological Survey are cooperating agencies for this EIS.

ES.4.3 Consultation

The BIA initiated government-to-government consultation with the Osage Nation in November 2014 and continued to engage in consultation throughout the EIS process.

The BIA conducted consultation with the United States Fish and Wildlife Service (USFWS) under Section 7 of the Endangered Species Act of 1973 (ESA). The USFWS biological opinion and BIA biological assessment associated with that consultation are included in the EIS as **Appendix B**, Osage County Oil and Gas Biological Opinion and Biological Assessment.

The BIA conducted consultation with the Tribal Historic Preservation Officer, State Historic Preservation Officer, and Oklahoma Archaeological Survey under Section 106 of the National Historic Preservation Act of 1966 (NHPA) for this EIS. Section 106 consultation on site-specific oil and gas activities covered by the EIS will be conducted upon receipt of such proposals, as appropriate.

ES.5 Summary of the Reasonably Foreseeable Development Scenario and Development Projections

For purposes of the analysis in this EIS, the BIA prepared a reasonably foreseeable development scenario (RFD) of potential oil and gas development activity in the planning area. The RFD indicates that the number of annual wells drilled is expected to increase over the current rate during the next 20 years (2018–2037). During that time, the RFD estimates that up to 4,761 may be drilled: 3,208 oil wells, 1,369 gas wells, and 184 injection, disposal, or service wells. Most new wells are expected to be drilled vertically, due to the lack of unconventional oil and gas reservoirs in the planning area and poor results from existing horizontal wells.

ES.6 Alternatives

The BIA identified a reasonable range of alternatives that are based on management decisions the BIA can make regarding oil and gas development in Osage County. The alternatives were developed through public and internal scoping, interdisciplinary interaction between resource professionals, and collaboration with cooperating agencies.

The EIS analyzes 4 alternatives in detail: the No Action Alternative (required by 43 CFR 1502.14) and 3 action alternatives. Under all alternatives, lessees must obtain and comply with any necessary permits or authorizations required by federal law, such as the Clean Water Act of 1972, Clean Air Act of 1963, Safe Drinking Water Act of 1974, the ESA, and the NHPA. Determinations pursuant to the NHPA will be made in consultation with interested Tribes.

Lessees must also comply with the terms and conditions of the lease, the regulations in 25 CFR 226, and any orders, notices to lessees, and other guidance issued by the BIA Osage Agency Superintendent.

ES.6.1 Alternative 1—No Action

Under Alternative 1, No Action, the BIA would continue the current management direction for development of the Osage Mineral Estate. Accordingly, the BIA would approve ground-disturbing activities throughout all of Osage County, allowing for the permitting of up to 4,671 new wells by 2037. Conditions of approval (COAs) would be applied based on the Osage Agency's standard list.

ES.6.2 Alternative 2—Emphasize Oil and Gas Development

Alternative 2 emphasizes oil and gas development. Under this alternative, the BIA would publish a list of best management practices for all operations on leases in Osage County; however, it would not mandate compliance with best management practices or prescribe specific actions that lessees must take in order to comply with applicable laws and regulations (specific actions may still be required at the site-specific level). In addition, the BIA would waive many of the COAs for drilling and workover operations.

ES.6.3 Alternative 3—Hybrid Development

Alternative 3 represents a hybrid approach to development, blending management concepts from Alternatives 2 and 4. Under Alternative 3, the BIA would not approve permits for new ground-disturbing activities in certain sensitive areas (see **Figure 2-2** in **Appendix E**, Figures). Outside of those sensitive areas, the BIA would apply COAs based on the density of wells within each Public Land Survey System section. In "high-density" sections where there has been substantial historical development, the BIA would apply the same minimal COAs as Alternative 2. In "low-density" sections where there is little historical development, the BIA would apply the same protective COAs as Alternative 4 (see **Figure 2-3** in **Appendix E**).

ES.6.4 Alternative 4—Enhanced Resource Protection

Alternative 4 emphasizes resource conservation. Under Alternative 4, the BIA would not approve permits for new ground-disturbing activities in the areas listed under Alternative 3, plus additional sensitive areas (see **Figure 2-2** in **Appendix E**). The BIA would apply the COAs from Alternative 1 as well as additional protective COAs throughout the planning area. The BIA would also implement well-spacing requirements in order to manage well density.

ES.7 Alternatives Considered but Eliminated from Detailed Analysis

Nine alternatives were eliminated from detailed study because they would not meet the stated purpose of, and need for, the BIA's action (see **Section 1.3**, Purpose of and Need for the BIA Action) or because they would not be technically, economically, or legally feasible. These alternatives are described in detail in **Section 2.5**, Alternatives Considered but Eliminated from Detailed Analysis.

- No leasing alternative (eliminated because it does not meet the purpose of and need for the EIS)
- Leasing with no constraints (eliminated because it is not legally viable, since the BIA is required to comply with laws and regulations such as the ESA and NHPA)
- Transfer the BIA's management authority to another agency (eliminated because delegations of authority are out of the scope of this EIS)
- Alternatives based on oil price (eliminated because the BIA does not have control over oil prices)
- Alternatives based on total lease acreage (eliminated because placing a cap on the total acreage of the Osage Mineral Estate that can be leased at one time does not meet the purpose of and need for the EIS)
- Alternatives based on the total number of active leases (eliminated because the approval of a lease does not guarantee future development of the lease acreage)
- Reduce the royalty or annual rental rate in the planning area (eliminated because the BIA does not have the authority to lower royalty or rental rates)
- Increasingly stringent COAs as the number of leases and permits increases (eliminated because this wouldn't consider the impacts on sensitive areas)
- Close Greater Prairie-Chicken Habitat to New Oil and Gas Development (eliminated because the greater prairie-chicken is not a threatened or endangered species and therefore does not warrant this level of protection).

ES.8 Summary of Environmental Consequences

The BIA identified key resource issues during public and internal scoping and meetings with cooperating agencies. The potential environmental impacts associated with the alternatives are summarized below for key resources identified during scoping. **Chapter 3**, Affected Environment, provides a detailed description of the affected environment, and **Chapter 4**, Environmental Consequences, provides a comprehensive analysis of environmental consequences and other resource issues.

ES.8.1 Topography, Geology, Paleontology, and Soils

Under all alternatives, oil and gas development would continue to affect topography, geology, paleontology, and soils in the planning area. Under all alternatives, the risk of induced seismicity from injection of wastewater would continue, as would damage to soils due to spills. Alternatives that reduce surface disturbance would reduce some adverse impacts.

ES.8.2 Water Resources

Under all alternatives, water resources, including surface water and Waters of the United States, groundwater, and aquatic environments, are susceptible to depletion or contamination by oil and gas development. Alternatives 3 and 4 would reduce the risk of spills or surface disposal of wastewater compared with Alternative 1 (No Action), by preventing new drilling in the sensitive areas identified in **Chapter 2**, Alternatives, and applying additional COAs designed to protect water resources.

ES.8.3 Special Status Species

Under all alternatives, special status species would continue to be affected by habitat loss and fragmentation and disruption from noise and traffic. Under all alternatives, requirements to comply with the ESA and USFWS guidelines would mitigate or reduce impacts. Alternatives 3 and 4 would reduce the risk of habitat loss and species takes compared with Alternative 1 (No Action), since they would prevent new drilling near some lakes and rivers, and apply COAs designed to minimize surface disturbance, which would incidentally protect species habitat.

ES.8.4 Cultural Resources

Under all alternatives, cultural resources may be incidentally lost or damaged. Compliance with Section 106 of the NHPA (including the implementing regulations in 36 CFR 800) would minimize and mitigate any such impacts. The BIA would conduct Section 106 consultation with the Tribal Historic Preservation Officer, State Historic Preservation Officer, and any other interested parties, as required.

ES.8.5 Socioeconomics and Environmental Justice

Oil and gas operations in Osage County will continue to provide employment and income. Only gradual changes are expected in employment levels and area population as a result of oil and gas development; therefore, a population change or strain on public services and housing are minimal. Under all alternatives, due to the lack of significant disproportionate adverse impacts on low-income or minority populations, environmental justice impacts from proposed management would be negligible at the county level.

ES.8.6 Mineral Extraction

Under all alternatives, mineral extraction would continue to occur over the next 20 years, with this document supporting the drilling of up to 4,761 new wells. Oil and gas development would have a beneficial impact on royalty revenues and the availability of these resources for human use. Oil and gas development has the potential to conflict with future development of sand, gravel, sandstone, limestone, dolomite, and other salable mineral development within the planning area.

ES.8.7 Trust Assets and Osage Nation Interests

Under all alternatives, oil and gas leasing and development would continue. The production of oil and gas from the Osage Mineral Estate would result in the collection of rental and royalties that would be distributed to Osage headright holders on a quarterly, pro rata basis, with interest. Market forces, whether positive or negative, would affect royalty revenues and, therefore, the amount of quarterly Osage headright payments. The BIA would continue to comply with NHPA Section 106. The Osage Nation Tribal Historic Preservation Officer would review projects for effects on locations, sacred sites, resources, and settings that are traditionally important to the Osage Nation.

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Chapter 1. Introduction and Purpose and Need

1.1 Introduction

The Bureau of Indian Affairs (BIA) Eastern Oklahoma Regional Office is preparing an environmental impact statement (EIS) in accordance with the National Environmental Policy Act of 1969 (NEPA). The BIA will use this EIS to guide the management of oil and gas resources within the planning area, which is Osage County, Oklahoma. The oil, gas, and other subsurface minerals in Osage County, commonly referred to as the Osage Mineral Estate, are held in trust by the United States (US) for the benefit of the Osage Nation. The EIS is a programmatic document that will allow the BIA to streamline the NEPA review process by replacing the existing 2014 Programmatic Environmental Assessment for Leasing Activities and the 2015 Programmatic Environmental Assessment for the Approval of Workover Operations (Leasing and Workover PEAs) with a single NEPA document that provides comprehensive impacts analysis and reduces the size and cost of site-specific environmental assessments (EAs).

In 1872, Congress established a reservation for the Osage Nation in what is now Oklahoma. Upon statehood, Oklahoma was divided into 56 districts, and the Osage Indian Reservation became Osage County, Oklahoma. Congress enacted the Osage Allotment Act of 1906 (1906 Act), providing for the disposition of the Osage Nation's lands to its members. The 1906 Act, as amended, severed the Osage Mineral Estate from the surface estate, reserving all mineral rights to the Osage Nation in perpetuity. Accordingly, Osage County is a "split-estate," with separate surface and mineral ownership.

The 1906 Act required that royalty income derived from the Osage Mineral Estate be distributed to Osage headright holders on a quarterly, pro rata basis. The 1906 Act authorizes the Osage Nation to lease the Osage Mineral Estate for oil and gas exploration and development subject to the approval of the Secretary of the Interior and under such rules and regulations as he/she may prescribe.

The Secretary delegated the authority for management of the Osage Mineral Estate to the BIA Osage Agency Superintendent. Under such delegation, the BIA Osage Agency Superintendent manages not only the mining of oil and gas, but also the mining of sandstone, gravel, clay, sand, limestone, and other minerals. The regulations governing leasing of the Osage Mineral Estate for oil and gas mining are set forth in 25 Code of Federal Regulations (CFR) 226. The regulations governing all other mining of the Osage Mineral Estate are set forth in 25 CFR 214.

This EIS analyzes impacts on both the surface estate and subsurface mineral estate in the planning area and examines 4 alternatives (including the No Action Alternative) for the BIA's management of oil and gas development.

1.2 Project Background

In July 2013, the Bureau of Land Management (BLM), Oklahoma Field Office, published a Notice of Intent (NOI) to work with the BIA to prepare the Oklahoma, Kansas, and Texas (OKT) Joint EIS/BLM Resource Management Plan (RMP)/BIA Integrated RMP. Osage County is within the planning area for that project; however, the BIA is the sole federal agency with jurisdiction over management of the Osage Mineral Estate. This contrasts with the rest of the planning area for the OKT Joint EIS/BLM RMP/BIA Integrated RMP, where the BLM and BIA share jurisdiction over minerals management.

When scoping for the OKT Joint EIS/BLM RMP/BIA Integrated RMP began, the BLM and BIA intended to include analysis of the Osage oil and gas leasing program. In response to issues raised during scoping, and at the request of the Osage Minerals Council, the BIA determined that analysis of the Osage oil and gas leasing program needed to be expedited. Accordingly, the 2 agencies decided that the Osage County Oil and Gas EIS would be removed from the OKT Joint EIS/BLM RMP/BIA Integrated RMP; instead, it would be prepared as a separate document.

The scope of the Osage County Oil and Gas EIS is limited to the impacts of oil and gas leasing and development in Osage County. The BIA addressed Osage County planning issues that are not related to oil and gas leasing and development in the OKT Joint EIS/BLM RMP/BIA Integrated RMP.

In November 2015, the BIA published the Osage County Oil and Gas Draft EIS. Following the public comment period, the BIA determined that the 2015 Draft EIS should be revised in order to address comments received and to take additional information into consideration. On April 11, 2016, the BIA published the NOI to revise the 2015 Draft EIS. The agency held 1 additional public scoping meeting in Pawhuska, Oklahoma, on April 28, 2016.

With the help of the Indian Energy Service Center, the BIA has prepared a reasonably foreseeable development scenario (RFD) for the planning area for the period from 2018 through 2037. For the RFD, the BIA uses a data-driven approach to project the maximum future development of oil and gas resources in Osage County under the various alternatives. The complete RFD can be found in **Appendix A**, Reasonably Foreseeable Development Scenario.

The Draft EIS was released to the public on November 22, 2019, for a public comment period, which ended on February 21, 2020. The BIA held a public meeting to receive comments on the Draft EIS on December 12, 2019, from 6:00 to 8:00 p.m. at the Wahzhazhe Cultural Center at 220 Main Street, Pawhuska, Oklahoma. Thirty-one people signed in and attended the meeting, and 10 speakers signed up to provide oral comments. Public comments and responses are included in **Appendix J**, Comment Summary and Response Report.

Prior to releasing the Final EIS, the BIA revised the document to address all public comments received on the Draft EIS. The revisions include removing conditions of approval (COAs) that are duplicative of existing regulations, moving information on resource trends from **Chapter 3**, Affected Environment, to **Chapter 4**, Environmental Consequences, and updating information and analyses.

1.3 PURPOSE OF AND NEED FOR THE BIA ACTION

The 1906 Act, as amended, reserved all rights to the Osage Mineral Estate to the Osage Nation. Pursuant to the 1906 Act, the Osage Mineral Estate is held in trust by the United States for the benefit of the Osage Nation. All leases, applications for permits to drill (APDs), and other site-specific permit applications in Osage County are approved under the authority of the 1906 Act, as amended, and 25 CFR 226, Leasing of Osage Reservation Lands for Oil and Gas Mining.

The purpose of the BIA's action is to promote leasing and development of the Osage Mineral Estate in the best interest of the Osage Nation pursuant to the 1906 Act, as amended, balancing resource conservation and maximization of oil and gas production in the long term. In addition, the BIA is required, under more generally applicable statutes, to include in the best interest calculation, protection of the environment in Osage County in order to enhance conservation of resources and protection of the health and safety of the Osage people. Based on those considerations, the BIA's action will promote the maximization of oil and gas production from the Osage Mineral Estate in a manner that is economic, efficient, and safe; prevents pollution; and is consistent with the mandates of federal law.

The federal actions analyzed in the EIS are the approval of leases, drilling permits, and workover permits. The BIA needs this EIS in order to fulfill its trust responsibility under the 1906 Act to administer leasing and development of the Osage Mineral Estate. In the Hayes I litigation, the US District Court for the

Northern District of Oklahoma ruled that the 1979 EA was no longer valid. Accordingly, the BIA may not rely on the 1979 EA to review and approve oil and gas leases and permits. The BIA's current NEPA review process utilizes 3 separate NEPA documents: the Leasing PEA, Workover PEA, and site-specific EAs. This EIS will supersede the Leasing and Workover PEAs, streamline the NEPA review process by having 1 programmatic NEPA document covering all oil and gas development activities that do not require new ground disturbance, provide a comprehensive impacts analysis, and reduce the size and cost of site-specific EAs by allowing for tiering. The efficiencies gained by streamlining the NEPA review process will expedite lease and permit processing.

1.4 EIS FRAMEWORK

This EIS is prepared in accordance with NEPA and in compliance with the Council on Environmental Quality (CEQ) regulations, 40 CFR 1500–1508, the US Department of the Interior (DOI) regulations implementing NEPA, 40 CFR 36, and the guidelines set forth in the Indian Affairs NEPA Guidebook, 59 Indian Affairs Manual 3-H (BIA 2012). The BIA is the lead federal agency tasked with preparing the EIS. The EIS fulfills the BIA's NEPA obligations with respect to the approval of oil and gas leases, workover permits that do not require additional ground disturbance, and plugging permits.[1]

1.5 DECISION TO BE MADE

The EIS evaluates 4 alternatives for management of the Osage Mineral Estate: Alternative 1—No Action; Alternative 2—Emphasize Oil and Gas Development; Alternative 3—Hybrid Development; and Alternative 4—Enhanced Resource Conservation. The BIA does not know what lands may be leased or the location of well pads, roads, pipelines, and other facilities associated with future drilling and workover operations under the alternatives. Accordingly, this EIS is programmatic in nature, providing comprehensive analysis of the entire planning area as opposed to evaluating a particular project.

The Record of Decision (ROD) associated with this EIS will approve a plan for continued development of the Osage Mineral Estate. In the ROD, the BIA may approve 1 of the above alternatives or some combination thereof. The ROD will not constitute the final approval for all actions. The EIS will, however, provide the BIA with information and analysis that can be used to inform final approvals.

Future on-the-ground actions requiring BIA approval would require additional NEPA analysis based on the site-specific proposal. For example, prior to commencing drilling or workover operations that require new ground disturbance, lessees must submit an APD. That APD would require an appropriate NEPA analysis prior to the BIA Osage Agency Superintendent's approval, including an inspection of the proposed locations for well pads, roads, pipelines, and facilities. The BIA would document NEPA compliance for such proposals by completing a site-specific EA tiered to this EIS,[2] a determination of NEPA adequacy (DNA), or another type of appropriate review. The BIA Osage Agency Superintendent may require additional site-specific terms and conditions before authorizing any proposed operations based on the site-specific NEPA analysis.

Figure 1-1 and **Figure 1-2** in **Appendix E**, Figures, show the current leasing process and the streamlined process enabled by this EIS. Significant staff time would be saved by tiering future NEPA analysis to this EIS.

[1] Additional NEPA analysis may be needed for workovers involving additional surface disturbance or other impacts beyond the scope of this EIS analysis.

[2] The CEQ regulations implementing NEPA encourage tiering, which is the process of referencing information presented in other NEPA documents, such as an EIS, to promote efficiency and minimize repetition.

1.6 DESCRIPTION OF THE PLANNING AREA

Figure 1-3 in **Appendix E** represents the area subject to environmental analysis in this EIS. The planning area is Osage County, Oklahoma, which comprises approximately 1,474,500 acres.

Osage County is in northeast Oklahoma, bordering Kansas. The BIA's Eastern Oklahoma Regional Office manages all of the subsurface mineral estate in the county. **Table 1-1**, below, and **Figure 1-4** in **Appendix E** show the acreage for each type of surface ownership in the planning area.

Table 1-1
Planning Area Surface Ownership

Surface Owner/Surface Management Agency	Acres	Percentage of Total
Private, city, county, or other[1]	1,217,382	83
Restricted lands	122,361	8
State	14,500	1
The Nature Conservancy (TNC)	35,200	2
Tribal trust lands	14,357	1
US Army Corps of Engineers (includes water)	70,700	5
Total	**1,474,500**	**100**

Sources: BIA geographic information system (GIS) 2020; OK GAP GIS 2008
[1] Lands not identified as state, TNC, US Army Corps of Engineers, allotted, or Tribal were included in this category.

1.7 ORGANIZATION OF THIS EIS

This EIS describes the components of, reasonable alternatives to, and environmental consequences associated with managing the development of oil and gas resources in Osage County. Chapters in the EIS are as follows:

- **Chapter 1**, Introduction and Purpose and Need, describes the purpose of and need for action, authorizing actions, and public participation in the EIS process. The BIA collaborated with the Osage Nation, Osage Minerals Council, and other cooperating agencies with jurisdiction or expertise in the county to develop the alternatives.
- **Chapter 2**, Alternatives, describes the alternatives considered for detailed analysis and those considered but eliminated from further analysis.
- **Chapter 3**, Affected Environment, describes the existing social and environmental conditions in the planning area.
- **Chapter 4**, Environmental Consequences, details potential direct and indirect impacts associated with the alternatives. Potential cumulative impacts of the alternatives, as they relate to other projects in the region, are also discussed.
- **Chapter 5**, Consultation and Coordination, lists the state and federal agencies, Tribes, and other entities that the BIA consulted and coordinated with during preparation of this EIS; it also lists authorized users who were notified.

1.8 PUBLIC INVOLVEMENT

Figure 1-5 in **Appendix E** illustrates the major steps the BIA is taking in developing this EIS. Throughout the process, the agency is following the public involvement requirements documented in CEQ regulations implementing NEPA (40 CFR 1501.7 for scoping, and 1506.6 for public involvement) and Section 8.3 of the Indian Affairs NEPA Guidebook (59 Indian Affairs Manual 3-H; BIA 2012).

In accordance with BIA and CEQ regulations and guidance, the BIA provided opportunities for meaningful participation in the EIS process, inviting input from the Osage Nation, general public, other federal agencies and bureaus, state and local governments, surface owners, affected Tribes, and other interested groups. Details regarding public and stakeholder involvement are described in **Chapter 5**.

1.9 Relationship to Programs, Policies, and Plans

1.9.1 Federal Laws and Regulations

The BIA's proposed action is analyzed under NEPA and is consistent with federal guidelines for NEPA implementation, including the CEQ regulations set forth in 40 CFR 1500–1508, departmental regulations set forth in 43 CFR 36, and the Indian Affairs NEPA Guidebook, 59 Indian Affairs Manual 3-H (BIA 2012).

Under Section 7 of the Endangered Species Act of 1973 (ESA), the BIA is required to consult with the US Fish and Wildlife Service (USFWS) when any action the agency carries out, funds, or authorizes may affect a listed endangered or threatened species. If the BIA determines that its action is likely to adversely affect a listed species, it must formally consult with the USFWS. Formal consultation may result in the BIA adopting reasonable and prudent measures recommended by the USFWS in order to implement the proposed action.

Section 106 of the National Historic Preservation Act of 1966 (NHPA), as implemented at 36 CFR 800, requires the BIA to take into account the impacts of its undertakings on historic properties; it must afford the Advisory Council on Historic Preservation and any applicable State Historic Preservation Officer (SHPO), Tribal Historic Preservation Officer (THPO), and interested Tribes, reasonable opportunity to comment. Consultation under Section 106 may result in a memorandum that outlines agreed on measures that the BIA will take to avoid, minimize, or mitigate any adverse impacts on identified historic properties.

1.9.2 Related Land Use Plans

This EIS is not in conflict with any federal, local, county, or state laws or plans. The analysis in this EIS will replace the analyses in the Leasing PEA and the Workover PEA (BIA 2014 and 2015a). Other relevant land use plans considered during development of the EIS are listed below.

Other Federal Plans

Osage County is in the planning area for the OKT Joint EIS/BLM RMP/BIA Integrated RMP. That document covers all lands and minerals administered by the BLM and all Tribal and restricted lands and minerals administered by the BIA in Oklahoma, Kansas, and Texas, with the exception of oil and gas resources in Osage County. The RODs, Approved BLM RMP, and the 2 Approved BIA Integrated RMPs were published on March 11, 2020.

The following federal plans were also considered during the Draft EIS development:

- Lakeshore Management Plan, Hulah Lake, Oklahoma and Kansas (USACE 1996)
- Oil and Gas Industry Conservation Plan Associated with Issuance of ESA Section 10(a)(1)(B) Permits for the American Burying Beetle in Oklahoma (USFWS 2014a)

Local Government Plans

The local government plan considered during the Draft EIS development was the 2030 Osage County Comprehensive Plan (Osage County 2011).

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Chapter 2. Alternatives

2.1 INTRODUCTION

This chapter describes the alternatives considered in this EIS for oil and gas development in Osage County. A detailed comparison of the alternatives is presented in **Table 2-1** and **Table 2-3**.

2.2 ALTERNATIVES DEVELOPMENT

The CEQ regulations implementing NEPA require that federal agencies explore and evaluate all reasonable alternatives that meet the purpose of and need for the Proposed Action (**Section 1.3**, Purpose of and Need for the BIA Action; 40 CFR 1502.14).

In the alternatives, the preparers evaluate a reasonable range of management scenarios that cover the full spectrum of issues to be considered and compared. Alternatives analyzed in detail by the BIA in the EIS must be rigorously explored and objectively evaluated. The BIA must also identify any alternatives that were considered but eliminated from detailed analysis in the EIS, briefly discussing the basis for such elimination.

The alternatives development process for this EIS included 2 public scoping periods, alternatives development workshops (both internally and with cooperating agencies), and 2 public listening sessions to present draft alternatives concepts and receive public feedback thereon. See **Section 1.8**, Scoping, Public Involvement, and Relevant Issues Identified, for a description of these processes. The alternatives development process for the 2015 Draft EIS included public scoping, an alternatives development workshop, and a draft alternatives concepts public listening session. However, this chapter focuses on the alternatives developed subsequent to the second scoping period for this EIS.

Following the second scoping period for the EIS, the BIA convened a series of 4 alternatives development workshops with cooperating agencies. The workshops were held between August 2016 and February 2017. The BIA and cooperating agencies developed preliminary draft alternatives based on the feedback received during public scoping and the issues raised at the development workshops. The BIA presented these alternatives in a newsletter that was mailed to persons on the project mailing list as of March 29, 2017.

A public listening session on the alternatives was held on April 6, 2017, in Pawhuska, Oklahoma. The BIA advertised that listening session in the newsletter and the following local newspapers: *Fairfax Chief*, *Hominy News Progress*, *Pawhuska Journal Capital*, *Tulsa World*, *The Bigheart Times*, *Skiatook Journal*, and *Barnsdall Times*. During the listening session, the BIA provided background information regarding the EIS process, explained the alternatives development process, presented the preliminary draft alternatives, and offered the public the opportunity to provide comments orally or in writing. The BIA accepted written comments on the alternatives until May 8, 2017. Following the public comment period, the BIA revised and refined the preliminary draft alternatives.

The alternatives presented in this chapter represent the reasonable range of alternatives arising from internal and public scoping, cooperating agency development workshops, and the public comment periods for the preliminary draft alternatives and Draft EIS. These alternatives include the No Action Alternative and 3 action alternatives. All alternatives were evaluated for their ability to meet the purpose of and need for the EIS. In accordance with the CEQ regulations in 40 CFR 1500–1508, the potential impacts associated with the alternatives are analyzed in **Chapter 4**, Environmental Consequences.

Alternative 3, Hybrid Development, is the BIA's preferred alternative. Alternative 3 represents a hybrid approach to the alternatives, balancing resource protection while allowing for the potential permitting of up to 4,761 new wells by 2037. The BIA selected Alternative 3 as the preferred alternative based on consideration of the issues raised during internal and external scoping, input from cooperating agencies, government-to-government consultation, and public comments received on the DEIS.

The Act of March 2, 1929 (Section 1, 45 Stat. 1478; "1929 Act") directs the Secretary of the Interior and the Osage Nation to offer for lease "any unleased portion of [the Osage Mineral Estate] in such quantities and at such times as may be deemed in the best interest of the Osage [Nation], Provided, That not less than twenty-five thousand acres shall be offered for lease for oil and gas mining purposes during any one year." Alternative 3 is consistent with this statutory mandate.

Alternative 3 does not alter or amend a lessee's right, title, or interest in an existing lease; lessees holding record title to existing leases remain authorized and obligated to develop the Osage Mineral Estate in accordance with the terms and conditions of the lease and the regulations in 25 CFR 226. While Alternative 3 does not allow for the permitting of new ground-disturbing activities in certain sensitive areas, it does allow for the use of directional drilling to access oil and gas located in those areas. As set forth in **Section 2.3.4**, Alternative 3—Hybrid Development, the BIA Osage Agency Superintendent may approve variances from these restrictions where all, or some portion, of a lease approved prior to publication of the Final EIS is within a sensitive area and directional drilling is not feasible.

Table 2-3 identifies conditions of approval that would apply in high- and low-density sections within the planning area under Alternative 3. If the BIA chooses Alternative 3 in the ROD, it may add or remove COAs from the list for high- and low-density sections. For Alternative 3, and all alternatives in this EIS, the BIA may also apply additional COAs to protect resources, including sensitive areas, based on site-specific determinations made during project-level review.

2.3 ALTERNATIVES CONSIDERED FOR DETAILED ANALYSIS

The EIS analyzes 4 alternatives in detail, including the No Action Alternative, for managing oil and gas development in Osage County. These alternatives represent a reasonable range of management decisions that satisfy the purpose of and need for the BIA's action.

The alternatives include different combinations of acreage available for development and COAs containing measures to avoid or minimize the potential adverse impacts associated with oil and gas development. The methods of compliance with the ESA and NHPA also vary by alternative.

Table 2-1 provides a comparison of the 4 alternatives analyzed in this chapter. **Table 2-3** provides a comparison of the application of COAs under each of the alternatives.

2.3.1 Management Common to All Alternatives

Under all alternatives, lessees must obtain and comply with any permits or authorizations required by federal law including, but not limited to, the Clean Water Act of 1972 (CWA), Clean Air Act of 1963 (CAA), Safe Drinking Water Act of 1974, ESA, and NHPA. Lessees are also required to comply with the terms and conditions of the lease, the regulations in 25 CFR 226, and instructions, orders, and notices to lessees (NTLs) issued by the BIA Osage Agency Superintendent.

The alternatives were analyzed based on the version of 25 CFR 226 in effect at the time this Final EIS was published. In the event that the regulations are revised following publication of the Final EIS, should any COAs, best management practices (BMPs), or mitigation measures identified in the EIS conflict with the regulations, the regulations will govern. If a species present in Osage County is added to, or removed from, the lists of threatened and endangered species under the ESA, this EIS would need to be updated or supplemented.

The list of COAs in the EIS is not a fixed set of conditions that will apply to every permit issued under an alternative. Under all alternatives, the BIA may waive COAs or apply additional COAs based on site-specific considerations. COAs 1, 2, 7, 16, 19, 21, and 23 are analyzed for each alternative in the EIS (see **Table 2-3** for the full text of all COAs).

The EIS will supersede the Leasing and Workover PEAs and become the basis of the BIA's NEPA review for the approval of oil and gas leases and workover permits that do not require new ground disturbance. The BIA reserves the right to require preparation of a site-specific EA for any lease or workover operations if it determines, in its discretion, that the circumstances warrant additional analysis.

The EIS will provide the BIA and lessees with a programmatic analysis of the cumulative impacts of oil and gas development that they can tier from in any site-specific EAs for leases, drilling permits, or workover permits. Summarizing the analysis in the EIS and incorporating it into site-specific EAs by reference allows the BIA and lessees to focus on issues specific to the lease or permit. Accordingly, tiering will reduce the time and cost required to prepare site-specific EAs as well as the length of the documents.

Table 2-1
Alternatives Summary

Alternatives Component	Alternative 1—No Action	Alternative 2—Emphasize Oil and Gas Development	Alternative 3—Hybrid Development	Alternative 4—Enhanced Resource Protection
Leases	New Programmatic EIS: BMPs from the Leasing PEA (BIA 2014) The lessee would be required to comply with COAs, attached to approved permits, during oil and gas operations.	New Programmatic EIS: new BMPs provided at time of lease approval BMPs would be recommended general standards, intended to lessen the impacts of oil and gas development on the environment (*e.g.*, prevention of erosion) but would not dictate specific measures to be taken. If the measures the lessee takes to follow a BMP are insufficient to address the intent of that BMP, then interim mitigation measures may be required. Limited COAs attached to approved permits: COAs would be conditions the lessee is required to comply with during oil and gas operations.	New Programmatic EIS: new BMPs provided at time of lease approval for leases in high-density sections. BMPs would be recommended general standards, intended to lessen the impacts of oil and gas development on the environment (*e.g.*, prevention of erosion) but would not dictate specific measures to be taken. If the measures the lessee takes to follow a BMP are insufficient to address the intent of that BMP, interim mitigation measures may be required. COAs attached to approved permits: the lessee would be required to comply with COAs during oil and gas operations. In low-density sections, there would be additional protective COAs for cultural and environmental resources.	New Programmatic EIS: The lessee would be required to comply with COAs, attached to approved permits, during oil and gas operations. There would be additional protective COAs for cultural and environmental resources.
Workover Approvals	New Programmatic EIS: BMPs from the Workover PEA (BIA 2015) as enforceable COAs.	New Programmatic EIS	New Programmatic EIS: additional protective COAs for sensitive cultural and environmental resources in low-density development sections	New Programmatic EIS: additional protective COAs for sensitive cultural and environmental resources

Alternatives Component	Alternative 1—No Action	Alternative 2—Emphasize Oil and Gas Development	Alternative 3—Hybrid Development	Alternative 4—Enhanced Resource Protection
Drilling Permits	New Programmatic EIS: tiered EAs	New Programmatic EIS: tiered EAs	New Programmatic EIS: tiered EAs; implement spacing requirements, limiting well pad density in low-density sections. The BIA would not approve permits for new ground-disturbing activities in the following areas: • Municipalities • Sensitive water supplies (designated in Appendix A of the federally approved Oklahoma Water Quality Standards [Oklahoma Administrative Code 785:45]) • Public water supply wells and wellhead protection areas (defined by the Oklahoma Department of Environmental Quality) • Areas of Class I Special Source Groundwater or areas designated as high vulnerability by the Oklahoma Water Resources Board	New Programmatic EIS: tiered EAs; implement spacing requirements, limiting well pad density. The BIA would not approve permits for new ground-disturbing activities in the following areas: • Tallgrass Prairie Preserve • State parks • State wildlife management areas (WMAs) • US Army Corps of Engineers lakes • Municipalities • Sensitive water supplies (designated in Appendix A of the federally approved Oklahoma Water Quality Standards [Oklahoma Administrative Code 785:45]) • Public water supply wells and wellhead protection areas (defined by the Oklahoma Department of Environmental Quality) • Areas of Class I

Alternatives Component	Alternative 1—No Action	Alternative 2—Emphasize Oil and Gas Development	Alternative 3—Hybrid Development	Alternative 4—Enhanced Resource Protection
				Special Source Groundwater or areas designated as high vulnerability by the Oklahoma Water Resources Board • BLM wild horse and burrow pasture facilities
General COAs	Include all standard BMPs as COAs; add special conditions if necessary, based on site-specific EA	Minimize or waive most BMPs and COAs	For high-density sections, apply same COAs as under Alternative 2; for low-density sections, apply same COAs as under Alternative 4.	Same as Alternative 1 (No Action), plus additional protective COAs for sensitive areas and cultural and environmental resources
ESA	For American Burying Beetle (ABB) compliance, the BIA has prepared a biological assessment (BA), and the USFWS has issued a biological opinion (BO) describing the total amount of acreage in the county where incidental take of ABB can occur. The BIA would allow activities to proceed without a 45-day wait period where the ABB survey is negative, as long as appropriate COAs are applied. For other threatened and endangered species, the BA and the concurrence letter issued by the USFWS establish parameters for improved efficiency of BIA consultation on other threatened and	Without the appropriate COAs identified in the current BA, the BIA would likely need to revise the BA and reinitiate formal consultation under Section 7 of the ESA for ABB compliance. Until the new BO is issued, lessees would be solely responsible for documenting compliance under Section 10 of the ESA. Where the ABB survey is negative, activities could proceed without a 45-day wait period only where the BIA can justify a "no effect" determination. For other threatened and endangered species, there would be no agreed on parameters for consultation. The BA would be revised, and informal consultation	Request new BO that incorporates the hybrid approach. Without the appropriate COAs identified in the current BA, the BIA may need to revise the BA and to reinitiate formal consultation under Section 7 of the ESA for ABB compliance. Until the new BO is issued, lessees may be solely responsible for documenting compliance under Section 10 of the ESA. Where the ABB survey is negative, activities could proceed without a 45-day wait period only where the BIA could justify a "no effect" determination. For other threatened and	Same as Alternative 1 (No Action)

Alternatives Component	Alternative 1—No Action	Alternative 2—Emphasize Oil and Gas Development	Alternative 3—Hybrid Development	Alternative 4—Enhanced Resource Protection
	endangered species with preliminary determinations of "no effect" or "may affect/not likely to affect."	would be reinitiated.	endangered species, there would be no agreed on parameters for consultation on other threatened and endangered species. The BA would be revised, and informal consultation would be reinitiated.	
NHPA	Standard NHPA procedures apply. Add special COAs if necessary, based on site-specific EA.	Same as Alternative 1 (No Action)	Same as Alternative 1 (No Action), plus apply buffers around identified cultural sites; additional COAs would be applied. Ensure compliance with Section 106 of the NHPA on a case-by-case basis.	Same as Alternative 3

2.3.2 Alternative 1—No Action

The CEQ regulations in 40 CFR 1502.14(d) and Indian Affairs NEPA Guidebook (59 IAM 3-H, BIA 2012) require the BIA to analyze a "No Action" alternative as part of the reasonable range of alternatives in the EIS. The No Action Alternative is the only alternative that is not required to conform to the purpose of and need for the BIA's action. The EIS analyzes the No Action Alternative in detail to provide a baseline for evaluation of the action alternatives.

Under Alternative I, No Action, the BIA would continue the current Osage oil and gas program without modifying management direction or practices. Accordingly, the BIA would approve ground-disturbing activities throughout all of Osage County, allowing for the permitting of up to 4,671 new wells by 2037. The EIS would serve as the NEPA review for the approval of oil and gas leases and workover permits that do not require new ground disturbance. A determination of NEPA adequacy (DNA), or another appropriate process, would continue being used to document NEPA review for those actions. Site-specific EAs would still be required for drilling permits and workover permits requiring new ground disturbance. Site-specific EAs would be tiered to the analysis in the EIS. COAs would be applied to drilling and workover permits as appropriate.

National Historic Preservation Act Compliance

The BIA would ensure compliance with the NHPA regulations, 36 CFR 800, on a case-by-case basis in consultation with the THPO, SHPO, Oklahoma Archeological Survey (OAS), interested Tribes, and other parties, as appropriate. The BIA would apply special buffers or COAs for historic or cultural resources if such protections are determined to be warranted based on site-specific conditions.

Endangered Species Act Compliance

The BIA prepared a BA, based on the current Osage oil and gas program described above in this No Action alternative. The BA assesses all threatened and endangered species in the planning area, including the ABB. The USFWS issued a BO and letter of concurrence based on the BA. The BO identifies measures required for complying with the ESA at the time of lease application.

For ABB compliance, the BO describes the total amount of acreage in the county where incidental take of ABB can occur. The BIA would track the total incidental take acreage remaining, as leases are developed. Lessees would work with the BIA, using a simplified process to document ESA compliance.

Minimization and mitigation measures from the Oil and Gas Industry Conservation Plan (USFWS 2014a) for the ABB are proposed in the BA, and the BO discusses these measures and additional minimization and mitigation measures. The measures outlined in these documents would be applied as COAs to covered activities in areas with a positive ABB survey or presumed ABB presence. The measures in the BA and BO based on the Industry Conservation Plan would continue to apply, regardless of the status of the plan itself. Where the pre-development ABB survey is negative, the BIA would allow activities to proceed without a 45-day waiting period, as long as appropriate COAs are applied.

For threatened and endangered species other than the ABB, the USFWS issued a concurrence letter approving the minimization and mitigation measures outlined in the BA. This allows the BIA to issue "no effect" or "may affect/not likely to affect" determinations without the need for additional consultation.

Conditions of Approval

In addition to the COAs analyzed under all alternatives (COAs 1, 2, 7, 16, 19, 21, and 23), the following COAs are analyzed under Alternative 1 (No Action): 3, 4, 5, 6, 8, 9, 10, 11, 12,13, 14, 15, 17, 18, 20, and 22 (see **Table 2-3** for full text of COAs).

2.3.3 Alternative 2—Emphasize Oil and Gas Development

Under Alternative 2, management direction would emphasize oil and gas development. The BIA would continue to approve ground-disturbing activities throughout all of Osage County, allowing for the potential permitting of up to 4,671 new wells by 2037. The BIA would issue a list of standard BMPs that apply to all oil and gas development operations within the planning area.

The EIS would serve as the NEPA review for the approval of oil and gas leases and workover permits that do not require new ground disturbance. A DNA, or another appropriate process, would be used to document NEPA review for those actions. Site-specific EAs would still be required for drilling permits and workover permits requiring new ground disturbance. Site-specific EAs would be tiered to the analysis in the EIS. The BIA would minimize the number of COAs applied to drilling and workover permits and would not prescribe the specific methods operators must use to comply with the COAs or other applicable laws and regulations.

National Historic Preservation Act Compliance

The BIA would ensure compliance with the NHPA regulations, 36 CFR 800, on a case-by-case basis in consultation with the THPO, SHPO, OAS, interested Tribes, and other parties, as appropriate. The BIA would apply special buffers or COAs for historic or cultural resources if such protections are determined to be warranted based on site-specific conditions.

Endangered Species Act Compliance

The minimization of COAs under Alternative 2 would likely require the BIA to obtain a new BO from the USFWS. The USFWS issued the existing BO for the ABB subject to the BIA's implementation and enforcement of COAs listed in the BA. The BIA incorporated those COAs into the EIS. Under Alternative 2, some of those COAs would be waived. As a result, the BIA would need to revise the BA and reinitiate formal programmatic consultation under Section 7 of the ESA for ABB compliance. Until such time as the USFWS issued a new BO, lessees would be responsible for documenting compliance with ABB guidance in accordance with Section 10 of the ESA. In addition, the 45-day waiting period required by the ESA would be reinstated. Accordingly, even where there is a negative ABB survey, permitted activities would not be able to proceed prior to expiration of the 45-day waiting period unless the BIA is able to justify issuance of a "no effect" determination based on a lack of suitable habitat.

The BIA would also be required to revise the portions of the BA addressing the mitigation and minimization measures adopted for other threatened and endangered species and reinitiate informal consultation with the USFWS regarding the ability to issue "no effect" or "may affect/not likely to affect" determinations for those species.

Conditions of Approval

In addition to the COAs analyzed under all alternatives (COAs 1, 2, 7, 16, 19, 21, and 23), COAs 24 and 27 are analyzed under Alternative 2. See **Table 2-3** for full text of COAs.

2.3.4 Alternative 3—Hybrid Development

Alternative 3, Hybrid Development, blends the management concepts from Alternatives 2 and 4, allowing for the potential permitting of up to 4,011 new wells by 2037. The EIS would serve as the NEPA review for the approval of oil and gas leases and workover permits that do not require new ground disturbance. A DNA, or another appropriate process, would be used to document NEPA review for those actions. Site-specific EAs would be required for drilling permits and workover permits requiring new ground disturbance. Site-specific EAs would be tiered to the analysis in the EIS.

Under Alternative 3, the BIA would not approve new ground-disturbing activities in the following sensitive areas (see **Figure 2-2** in **Appendix E**, Figures):

- Municipalities
- Sensitive water supplies (designated in Appendix A of the federally approved Oklahoma Water Quality Standards [Oklahoma Administrative Code 785:45])
- Public water supply wells and wellhead protection areas (defined by the Oklahoma Department of Environmental Quality)
- Areas of Class I Special Source Groundwater or areas designated as high vulnerability by the Oklahoma Water Resources Board

In order to extract oil and gas from sensitive areas, lessees would be required to use directional drilling. The BIA Osage Agency Superintendent may approve variances from these restrictions where all, or some portion, of a lease approved prior to publication of the Final EIS is located in a sensitive area and directional drilling is not feasible.

Outside of sensitive areas, the BIA would apply COAs based on the well density in the Public Land Survey System (PLSS) section where the subject well(s) would be located. The PLSS is a method of subdividing and describing land in the United States. The PLSS typically divides land into 6-square-mile townships that are subdivided into 36 sections, with each section consisting of 1 square mile (640 acres). Under Alternative 3, each section in Osage County would be designated as either "high density" or "low density" based on the number of wells that had been drilled at the time the EIS was developed. There is an average of 17 wells per section in Osage County. Accordingly, the BIA can use that number as a threshold for identifying above- and below-average well density within a given section. High-density sections would be those in which 17 or more wells have been drilled, and low-density sections would be those in which less than 17 wells have been drilled. According to the Osage RFD (**Appendix A**), future development is largely expected to occur in the same general areas as historical development; thus, most of the new wells drilled are projected to be in high-density sections.

In high-density sections where there has been substantial historical development, the BIA would apply the same minimal COAs as Alternative 2. In low-density sections where there has been little historical development and the landscape remains relatively pristine, the BIA would apply the more protective COAs and well-spacing requirements from Alternative 4. Low-density sections will not be converted to high-density sections due to development. If a section is identified as low density in the EIS, it will continue being managed as a low-density section regardless of the number of wells drilled. **Figure 2-1** in **Appendix E** identifies the high- and low-density section designations for Osage County. The BIA may apply additional COAs in both high- and low-density sections where development will occur on lands enrolled in federal conservation programs, such as the US Department of Agriculture (USDA) Natural Resource Conservation Service (NRCS) Wetlands Reserve program, and where necessary to protect resources based on site-specific considerations.

National Historic Preservation Act Compliance

Under Alternative 3, in addition to standard NHPA procedures, the BIA would apply buffers around identified cultural sites in low-density sections. **Table 2-2** describes the distance that any surface disturbance on an oil and gas lease would have to be from cultural sites. In high-density sections, the BIA would ensure compliance with the NHPA regulations, 36 CFR 800, on a case-by-case basis in consultation with the THPO, SHPO, OAS, interested Tribes, and other parties, as appropriate. The BIA would apply special buffers or COAs for historic or cultural resources in high-density sections if such protections are determined to be warranted based on site-specific conditions.

Table 2-2
Cultural Site Buffers

Site Type	Buffer	Reason
Camps and villages (prehistoric and historic)	Minimum buffer zone of 160 feet around waterbodies: The buffer would be extended up to 500 feet in the presence of higher ground near undulating streams.	This site type is frequently close to water sources, such as creeks. The cultural resources are often buried and are frequently found within 160 feet of the water's edge. Sites can extend 500 to 650 feet, particularly in the presence of ridges, terraces, knolls, and other areas of higher ground; some areas exhibiting erosion have deeply buried deposits.
Graves, rock cairns, and cemeteries (prehistoric and historic)	Minimum buffer zone of 330 feet from graves, rock cairns, and family plots. Minimum buffer zone of 160 feet from cemeteries.	Buffer zones are required for all graves, family plots, and cemeteries. Historic cemeteries are often close to roads, in which case, buffer zones of this width may not be possible.
Historic bridges and other structures, such as barns	No buffer is required, unless the site is eligible for listing or is listed on the National Register of Historic Places. In that case, the BIA would determine buffer size, in consultation with the Osage Nation THPO and SHPO.	The need for a buffer would be specific to the site and undertaking.
Historic farmsteads or building complexes	No buffer would be required, unless the site is eligible for listing on or is listed on the National Register of Historic Places or if the household is occupied. In that case, the BIA would determine the buffer size, in consultation with the Osage Nation THPO, SHPO, and the resident of the building.	The need for a buffer would be specific to the site and undertaking.
Lithic scatter	No buffer required, except at the discretion of the BIA in consultation with the THPO, SHPO, and OAS.	The need for a buffer would be specific to the site and undertaking.
Native American churches	Minimum buffer zone of 650 feet	Frequently located near other cultural sites. Oil and gas development activities and related traffic on access roads may have auditory and visual impacts on cultural practices.
Rock art	Minimum buffer zone of 650 feet	Frequently located near other cultural sites. Oil and gas development activities and related traffic on access roads may have auditory and visual impacts on cultural practices.
Rock shelters and caves	Minimum buffer zone of 330 feet	Potentially located near, or associated with, other cultural sites.
Traditional cultural properties	Minimum buffer zone of 650 feet	Frequently located near other cultural sites. Oil and gas development activities and related traffic on access roads may have auditory and visual impacts on cultural practices.
Trails	Minimum buffer zone of 160 feet	Until the Osage Nation THPO creates a GIS predictive model for the Osage Indian Trail, the need for a buffer zone larger than 160 feet would be specific to the location and undertaking.

Site Type	Buffer	Reason
Waterways and springs	Minimum buffer zone of 160 feet from the edge of the ordinary high water mark or water source	Many types of cultural sites are located close to waterways or springs. This buffer will protect sites located on sand and gravel bars.

Note: All site buffers were developed in consultation with the Osage Nation.

Endangered Species Act Compliance

The hybrid approach to management under Alternative 3 would likely require the BIA to obtain a new BO from the USFWS. The USFWS issued the existing BO for the ABB subject to the BIA's implementation and enforcement of COAs listed in the BA. The BIA incorporated those COAs into the EIS. Under Alternative 3, low density, some of those COAs would be waived. As a result, the BIA would need to revise the BA and reinitiate formal programmatic consultation under Section 7 of the ESA for ABB compliance. Until such time as the USFWS issued a new BO, lessees would be responsible for documenting compliance with ABB guidance in accordance with Section 10 of the ESA. In addition, the 45-day waiting period required by the ESA would be reinstated. Accordingly, even where there is a negative ABB survey, permitted activities would not be able to proceed prior to expiration of the 45-day waiting period unless the BIA is able to justify issuance of a "no effect" determination based on a lack of suitable habitat.

The BIA would also be required to revise the portions of the BA addressing the mitigation and minimization measures adopted for other threatened and endangered species and reinitiate informal consultation with the USFWS regarding the ability to issue "no effect" or "may affect/not likely to affect" determinations for those species.

Conditions of Approval

In addition to the COAs analyzed under all alternatives (COAs 1, 2, 7, 16, 19, 21, and 23), COAs 3–6, 8–15, 17–18, 20, 22, and 24–31 are analyzed under Alternative 3 low density; COAs 24 and 27 are analyzed under Alternative 3 high density. See **Table 2-3** for the full text of the COAs.

Lessees would also be required to comply with any site-specific COAs the BIA determines to be necessary for the protection of sensitive areas. Examples of such potential site-specific COAs include, but are not limited to:

- Revegetate with native tallgrass seed in the Tallgrass Prairie
- Confine activities to locations outside designated state park picnic or camping areas
- Restrict wildlife from accessing any area of contamination until it is appropriately remediated
- Comply with established infrastructure setbacks at US Army Corps of Engineers lakes and conduct activities outside of established picnic, playground, and camping areas
- Observe reasonable setbacks requested by municipalities
- Allow no surface waste pits or disposal near a public water supply well
- Create an emergency plan to supply drinking water in the event that a sensitive public water supply is contaminated by a lessee's activities

2.3.5 Alternative 4—Enhanced Resource Protection

Under Alternative 4, management direction would focus on enhanced resource protection, allowing for the potential permitting of up to 3,095 new wells by 2037. The EIS would serve as the NEPA review for the approval of oil and gas leases and workover permits that do not require new ground disturbance. A DNA, or another appropriate process, would be used to document NEPA review for those actions. Site-specific EAs would be required for drilling permits and workover permits requiring new ground disturbance. Site-specific EAs would be tiered to the analysis in the EIS.

Under Alternative 4, the BIA would not approve new ground-disturbing activities in the following sensitive areas (see **Figure 2-2** in **Appendix E**):

- Tallgrass Prairie Preserve
- State parks
- State WMAs
- US Army Corps of Engineers lakes
- Municipalities
- Sensitive water supplies (designated in Appendix A of the federally approved Oklahoma Water Quality Standards [Oklahoma Administrative Code 785:45])
- Public water supply wells and wellhead protection areas (defined by the Oklahoma Department of Environmental Quality)
- Areas of Class I Special Source Groundwater or areas designated as high vulnerability by the Oklahoma Water Resources Board
- BLM Wild Horse and Burro Program rangelands

In order to extract oil and gas from sensitive areas, lessees would be required to use directional drilling. The BIA Osage Agency Superintendent may approve variances from these restrictions where all, or some portion, of a lease approved prior to publication of the Final EIS is located in a sensitive area and directional drilling is not feasible. In all locations, the BIA would implement well spacing requirements to limit well density.

Outside of sensitive areas, the BIA would apply the same COAs as Alternative 1 plus additional protective COAs for sensitive cultural and environmental resources. The BIA may also apply additional COAs where development will occur on lands enrolled in federal conservation programs, such as the USDA Natural Resource Conservation Service Wetlands Reserve program, and where necessary to protect resources based on site-specific considerations.

National Historic Preservation Act Compliance

Under Alternative 4, in addition to standard NHPA procedures, the BIA would apply the same cultural site buffers applied in low-density sections under Alternative 3. **Table 2-2** describes the distance that any surface disturbance on an oil and gas lease would have to be from cultural sites. The BIA would ensure compliance with the NHPA regulations, 36 CFR 800, on a case-by-case basis in consultation with the THPO, SHPO, OAS, interested Tribes, and other parties, as appropriate. The BIA would apply special buffers or COAs for historic or cultural resources if such protections are determined to be warranted based on site-specific conditions.

Endangered Species Act Compliance

Under Alternative 4, ESA compliance would be the same as under Alternative 1, No Action.

Conditions of Approval

All COAs presented in the EIS are analyzed under Alternative 4 (COAs 1–31). See **Table 2-3** for the full text of COAs.

Lessees would also be required to comply with any site-specific COAs the BIA determines to be necessary for the protection of sensitive areas. Examples of such potential site-specific COAs include, but are not limited to:

- Revegetate with native tallgrass seed in the Tallgrass Prairie
- Confine activities to outside designated state park picnic or camping areas
- Restrict wildlife from accessing any area of contamination until it is appropriately remediated

- Comply with established infrastructure setbacks at US Army Corps of Engineers lakes and conduct activities outside of established picnic, playground, and camping areas
- Observe reasonable setbacks requested by municipalities
- Allow no surface waste pits or disposal near a public water supply well
- Create an emergency plan to supply drinking water if a sensitive public water supply is contaminated by a lessee's activities

2.4 Summary Comparison of Conditions of Approval

Table 2-3, below, summarizes the different COAs that would apply under each alternative. (The table does not list the exact set of COAs that would be applied to each permit under an alternative.) Under all alternatives, the BIA may waive COAs or apply additional COAs, based on site-specific determinations.

Table 2-3
Summary Comparison of Conditions of Approval[1]

No.	Condition of Approval (Source)[2]	Alt. 1—No Action	Alt. 2—Emphasize Oil and Gas Development	Alt. 3—Hybrid Alternative[3]	Alt. 4—Enhanced Resource Protection
1.	Avoid impacts on National Register-eligible or unevaluated cultural resources. If cultural resources or human remains are discovered during construction or operations, stop work immediately, secure the affected site, and notify the BIA, Osage Nation THPO, and, in case of the discovery of human remains, law enforcement. In the event of a discovery, halt work in the approved project area until the BIA has issued a written authorization to proceed (BIA 2014, 2015, 2017a).	X	X	H L	X
2.	Keep all surface disturbance within the proposed ground-disturbance area described in the approved site-specific EA for the project. Well pads and access roads may not be expanded or relocated, and activities outside the scope of the approved EA may not be conducted, without the submission and approval of a cultural resource survey and the issuance of any necessary permits. The BIA Osage Agency will review and approve any such cultural resource surveys in consultation with the Osage Nation THPO, SHPO, and other appropriate parties (BIA 2014, 2015, 2017a).	X	X	H L	X
3.	Avoid or minimize soil and vegetation disturbance. Do not remove or damage trees, shrubs, and groundcover, to the extent possible (BIA 2014, 2015, 2017a).	X		L	X
4.	Avoid or minimize alteration of the natural topography and limit activities on steep slopes (BIA 2014, 2015, 2017a).	X		L	X
5.	Implement erosion control measures during the construction, drilling, and completion phases of the project. Such measures must effectively minimize the movement of soil, debris, and/or contaminants from the well site to adjacent lands and waterways (BIA 2014, 2015, 2017a).	X		L	X
6.	Confine all vehicles and equipment to new and preexisting roads described in the approved site-specific EA unless off-road travel is required to respond to a blowout, fire, spill, personal injury, or fatality. All other off-road travel requires the BIA Osage Agency Superintendent's prior written approval. Maintain and upgrade roads as directed by the BIA Osage Agency or in accordance with any agreements between the lessee and surface owner(s) (BIA 2014, 2015, 2017a).	X		L	X
7.	Do not vent or flare gas without the BIA Osage Agency Superintendent's prior approval (BIA 2014, 2015, 2017a).	X	X	H L	X
8.	Store and label chemicals properly, including secondary containment. Do not store equipment or chemicals on-site if they are not being used. Do not leave open containers of chemicals or wastes on-site (BIA 2014, 2015, 2017a).	X		L	X

No.	Condition of Approval (Source)[2]	Alt. 1—No Action	Alt. 2—Emphasize Oil and Gas Development	Alt. 3—Hybrid Alternative[3]	Alt. 4—Enhanced Resource Protection
9.	Keep sites clean and free of any litter, trash, old equipment, contaminated soil, or unused containers. Promptly dispose of any waste at an appropriate recycling facility, approved landfill, or other approved location, based on the type of waste. Remove any unused equipment not necessary to the operation of the lease after drilling has been completed (BIA 2014, 2015, 2017a).	X		L	X
10.	Properly enclose all production equipment, facilities, and tanks, including wellhead and aboveground piping and equipment, to exclude livestock, if present (BIA 2014, 2015, 2017a).	X		L	X
11.	A spill prevention, control, and countermeasures plan must be developed and complied with, in compliance with EPA regulations under 40 CFR 112, when using Tank Batteries. Construct a sufficiently fluid-impermeable secondary containment dike/berm around any tank battery and facilities, according to 40 CFR 112.7. Cover the dike/berm and entire containment area with gravel. Do not discharge water collected in the secondary containment. In accordance with the spill prevention, control, and countermeasures plan and BIA regulations, immediately notify the BIA of all spill incidents (BIA 2014, 2015, 2017).	X		L	X
12.	Empty and close all pits utilized for drilling a new well with mud rotary equipment within 3 months of the date the well is completed. Empty and close all pits utilized for drilling a new well with an air rig or cable tools within 1 month of the date the well is completed. Empty and level all pits used during workover and plugging operations immediately following completion of operations unless otherwise directed by the surface owner(s) (BIA 2002, 2014, 2015, 2017a).	X		L	X
13.	Minimize the disturbance to surface owners, wildlife, and natural resources caused by noise, excessive traffic, dust, and other impacts associated with operations, to the extent possible (BIA 2014, 2015, 2017a).	X		L	X
14.	Do not conduct activities within aquatic environments, as defined in the glossary, without proper authorization. Avoid discharging soil or contaminants or removing stream water that could result in a violation of applicable, federally approved, water quality standards (BIA 2014, 2015, 2017a).	X		L	X
15.	If drilling and completion operations result in a producing well, promptly remediate areas of surface disturbance that are not necessary for production or operation of the well (*i.e.*, well pad, access roads, and pipelines) in accordance with the approved EA and APD or such alternative agreement as may be reached with the surface owner. If drilling and completion operations result in a dry hole or a completed well is no longer in production, return surface lands to the original contour and revegetate with seed or sod unless an alternative agreement is reached with the surface owner. For dry holes and nonproducing wells, complete surface recontouring and revegetation within 90 days of final plugging and abandonment. Do not use noxious or invasive species for revegetation under any circumstances (BIA 2014, 2015, 2017a).	X		L	X

No.	Condition of Approval (Source)[2]	Alt. 1—No Action	Alt. 2—Emphasize Oil and Gas Development	Alt. 3—Hybrid Alternative[3]	Alt. 4—Enhanced Resource Protection
16.	Conduct activities in a manner that avoids potential incidental take or harm to federally listed threatened or endangered species in compliance with the BO for the Osage County Oil and Gas Program issued July 27, 2018. Follow the USFWS Impact Avoidance guidance (USFWS 2014b; BIA 2014, 2015, 2017a).	X	X	H L	X
17.	Follow USFWS-established protocol in areas where the ABB is known or suspected to exist (see http://www.fws.gov/southwest/es/oklahoma/ABBICP.htm). Conduct an ABB presence/absence survey prior to commencing ground-disturbing activities, including construction of a drilling pit or other excavation activity using heavy equipment, within the ABB's range unless the USFWS has characterized the habitat as being an area unfavorable for the ABB. If the proposed ground-disturbing activities do not commence prior to the start of the next ABB active season, the lessee must perform a new ABB presence/absence survey and submit the results to the Osage Agency. If subsequent surveys for the presence of the ABB are positive, the lessee must conduct additional consultation with the Osage Agency before beginning operations. If appropriate, the Osage Agency will issue incidental take to the lessee in accordance with the BO for the Osage County Oil and Gas Program issued by the USFWS on July 27, 2018 (BIA 2014, 2015, 2017a).[4]	X		L	X
18.	Implement the air quality BMPs listed in the approved site-specific EA, incorporated here by reference, when proposed drilling operations will penetrate formations having zones suspected of containing, or known to contain, hydrogen sulfide (H_2S) of 100 parts per million (ppm) or greater in the gas stream (BIA 2014, 2017a).	X		L	X
19.	Obtain EPA approval prior to commencing workover operations related to underground injection, construction, or the conversion of saltwater injection or disposal wells (BIA 2015, 2017a).[5]	X	X	H L	X
20.	Suitable habitat for the ABB is present on portions of the existing well pad where vegetation height currently exceeds 8 inches. Construct all pits required for the proposed operations in areas of the well pad where vegetation height is below 8 inches. Maintain vegetation height until the proposed operations are complete (BIA 2015, 2017a).	X		L	X
21.	Suitable ABB habitat is present at the site of the proposed workover operations. No ground-disturbing activities may occur during the conduct of such operations. Do not excavate any soil. If the operation requires wastewater containment, use a temporary aboveground storage tank instead of a pit or take such other actions as the BIA Osage Agency Superintendent may approve to avoid ground disturbance. Remove any temporary storage tanks immediately following completion of workover operations (BIA 2015, 2017a).	X	X	H L	X
22.	Screen, net, cover, or otherwise render harmless to birds, all open-top tanks and pits (standard operating procedure).	X		L	X

No.	Condition of Approval (Source)[2]	Alt. 1—No Action	Alt. 2—Emphasize Oil and Gas Development	Alt. 3—Hybrid Alternative[3]	Alt. 4—Enhanced Resource Protection
23.	Do not commence any new ground-disturbing activities or operations that were not specifically addressed and approved as part of the APD without the BIA Osage Agency Superintendent's prior approval. Submit a written request for new ground-disturbing activities to the BIA Osage Agency Superintendent together with documentation demonstrating compliance with NEPA, ESA, NHPA, and other applicable laws (standard operating procedure).	X	X	H L	X
24.	Conduct operations in a manner that minimizes disturbance due to noise levels or adverse visual impacts that may constitute a public nuisance that is harmful to people or sensitive environmental receptors (25 CFR 226).		X	H L	X
25.	Conduct an initial test of the H_2S concentration of the gas stream for each well or production facility. If a well or facility has an H_2S concentration of 100 ppm or more in the gas stream, determine the 100 ppm and 500 ppm radius of exposure. Post danger or caution signs warning of the presence of H_2S gas and take appropriate measures to ensure the safety of personnel and the general public (Oklahoma Corporation Commission [OCC] 2014).			L	X
26.	Do not locate well sites or pits in areas subject to frequent flooding, according to the NRCS Soil Survey.			L	X
27.	Do not apply waste oil, wastewater, contaminated soil, or similar substances to the land without the BIA Osage Agency Superintendent's prior approval. Submit a written request for land-based application of waste oil or other substances to the BIA Osage Agency Superintendent together with documentation demonstrating compliance with the ESA, NHPA, and other applicable laws (OCC 2014).		X	H L	X
28.	Locate drilling pits at least 200 feet from streams and waterways, including reservoirs, lakes, wetlands, natural perennial or seasonally flowing streams or rivers, ponds, and aquatic environments (OCC 2014).			L	X
29.	Avoid new road and pipeline crossings of aquatic environments and alterations to hydrology (the surface and subsurface flow of water) to the extent practicable. Where crossing cannot be avoided, design and construct crossings to minimize impacts on riparian and aquatic habitats.			L	X
30.	Bury pipelines to protect important aquatic environments or sensitive areas,[6] when appropriate (new requirement).			L	X
31.	Collocate new and existing facilities (e.g., roads and pipelines) when feasible.			L	X

[1] The BIA may apply additional COAs to protect resources, including sensitive areas, based on site-specific determinations. Additional COAs may be applied to development on lands enrolled in federal conservation programs, such as the NRCS Wetlands Reserve program, consistent with the protection of the relevant resources.
[2] Sources for each COA are provided in parentheses. In some cases, the BIA modified the COA from the original source, but the general concept and objective remain the same.
[3] An "X" in a column indicates that the COA would apply to that alternative. Under Alternative 3, letters are used to indicate which areas a COA applies to.
L = low-density sections; H = high-density sections.

[4] Under Alternative 2 and in high-density sections under Alternative 3, lessees would still be required to comply with the ESA; however, the BIA would not apply specific COAs dictating the manner in which lessees must comply.
[5] In high-density sections under Alternative 3, lessees would still be required to comply with underground injection control provisions of the CWA; however, the BIA would not apply specific COAs dictating the manner in which lessees must comply.
[6] Sensitive areas include the Tallgrass Prairie Preserve; state parks; state WMAs; US Army Corps of Engineers lakes; municipalities; sensitive water supplies; public water supply wells and wellhead protection areas; Class I Special Source Groundwater areas; areas designated as high vulnerability; and BLM Wild Horse and Burro Program rangelands.

2.5 ALTERNATIVES CONSIDERED BUT ELIMINATED FROM DETAILED ANALYSIS

Federal agencies are required to rigorously explore and objectively evaluate all reasonable alternatives and briefly discuss the reasons for eliminating any alternatives that were not developed in detail (40 CFR 1502.14).

Before impact analysis begins, any action alternatives that do not comport with the purpose of and need for the proposed action, in whole or in part, should be eliminated. Alternatives eliminated from detailed analysis may include those that are unreasonably expensive, cannot be implemented for technical or logistical reasons, do not satisfy BIA mandates, or have significant environmental impacts or impacts for which adequate mitigation is not possible.

Nine alternatives were eliminated from detailed study because they would not meet the stated purpose of and need for the BIA's action (see **Section 1.3**, Purpose of and Need for the BIA Action) or because they would not be technically, economically, or legally feasible. These alternatives are summarized below.

2.5.1 No Leasing Alternative

The BIA considered an alternative under which it would not approve any new oil or gas leases in Osage County. While the 1906 Act and 25 CFR 226 vest the BIA with the authority to approve or deny leases of the Osage Mineral Estate, this alternative would not meet the purpose of and need for the BIA's action. As previously noted, the purpose of the BIA's action is to promote leasing and development of the Osage Mineral Estate in the best interest of the Osage Nation, while balancing resource conservation and the maximization of production from the Osage Mineral Estate in the long term.

2.5.2 Leasing with No Constraints

During alternatives development, the BIA considered an alternative under which it would approve oil and gas leases and permits without any conditions or constraints. This would not be legally viable, because the BIA would not be able to ensure compliance with applicable laws and regulations, such as the ESA and NHPA.

2.5.3 Transfer the BIA's Management Authority to Another Agency

Several public commenters suggested that the BIA transfer its management authority over oil and gas leasing and development in Osage County to another agency, such as the OCC or the BLM. The 1906 Act authorizes the Secretary of the Interior to manage oil and gas development in Osage County. This authority cannot be transferred to a state agency, such as the OCC, without an act of Congress.

Further, the BIA cannot delegate its management of the Osage Mineral Estate to the BLM without the BLM's consent. In addition, because the statutes under which the BLM operates explicitly exclude the Osage Nation from the BLM's jurisdiction, legislative amendments may also be required to achieve such an action. The enactment or amendment of legislation and implementation of delegations of authority are outside the scope of this EIS. Accordingly, this alternative was eliminated from consideration.

2.5.4 Alternatives Based on Oil Price

During alternatives development, the BIA considered developing a range of alternatives based on varying levels of development in relation to oil prices. For example, 1 alternative with oil prices between $40 and $60 per barrel would involve secondary recovery technologies to increase oil development in the planning area. Alternatives with increased development would have increased mitigation measures; however, because the BIA does not have control over oil prices or the technologies used by developers to extract oil in the planning areas, selecting an alternative based on price and development technologies would be outside of the BIA's authority.

This alternative would also require the BIA to continuously supplement the EIS for changes in commodity prices in order to select the applicable alternative. This would result in significant administrative costs and burden; therefore, this alternative concept was eliminated from further consideration.

2.5.5 Alternatives Based on Total Lease Acreage

The BIA considered developing a range of alternatives that placed varying caps on the total number of acres that could be leased at any given point in time. The 1906 Act, as amended, vests the BIA with broad authority over leasing of the Osage Mineral Estate, subject to the requirement that a minimum of 25,000 acres of land must be offered for lease during any 1 year. While the 1906 Act would allow the BIA to set a cap on the number of acres of the Osage Mineral Estate that can be leased, this alternative would not meet the purpose of and need for the BIA's action.

2.5.6 Alternatives Based on a Total Number of Active Leases

The BIA considered developing a range of alternatives in which the total number of active leases in the planning area would vary under each alternative. While the 1906 Act and 25 CFR 226 vest the BIA with broad authority over the approval or denial of leases, the fact that a lease is approved does not mean that it will ultimately be placed into production, nor does it dictate the type or amount of future development that may occur. Due to these uncertainties, this alternative was eliminated from further consideration.

2.5.7 Reduce the Royalty or Annual Rental Rate in the Planning Area

The BIA considered reducing the royalty rate or annual rental for leases within the planning area in order to encourage oil and gas development. The 1906 Act authorizes the BIA to approve or deny leases of the Osage Mineral Estate and to prescribe the rules and regulations applicable thereto.

The regulations in 25 CFR 226 contain provisions setting forth the minimum royalty rates for oil and gas, as well as annual rental for leases. The BIA cannot lower royalty or rental rates outside the regulatory process. Further, while the regulations in 25 CFR 226 set forth the minimum royalty rates for oil and gas, the negotiation of royalty rates above those minimums is at the discretion of the Osage Minerals Council. Amending regulations is outside the scope of this EIS; accordingly, this alternative was eliminated from consideration.

2.5.8 Increasingly Stringent Conditions of Approval as the Number of Leases and Permits Increases

During alternatives development, an alternative was proposed for the BIA to administer leasing and development at 3 different tiers, based on the number of wells drilled in a given year. As the number of wells drilled increased beyond a certain threshold during the year, additional permits issued in that year would be subject to increasingly stringent COAs.

This proposed alternative would not distinguish between sensitive areas in the different tiers. A well drilled in a sensitive area could be subject to minimal restrictions if it were 1 of the first wells permitted in a given year. Conversely, wells drilled in areas without resource conflicts could be subject to increased restrictions, simply because they were approved later in the year than others; therefore, the alternative proposing increasingly stringent COAs as the number of leases and permits increases was eliminated from further consideration

2.5.9 Close Greater Prairie-Chicken Habitat to New Oil and Gas Development

A commenter on the Draft EIS proposed an alternative to excluding further oil and gas development in areas of highest important habitat for the greater prairie-chicken. Specifically, the commenter proposed that any area of greater prairie-chicken habitat with a habitat importance rank of 6 or higher from **Figure 3-9** be excluded from any further development of oil and gas production to aid in preserving habitat for greater prairie-chickens.

The proposed alternative was eliminated from further consideration because the greater prairie-chicken is not a threatened or endangered species and therefore does not warrant this level of protection in the alternatives.

2.6 SUMMARY COMPARISON OF ENVIRONMENTAL CONSEQUENCES

Table 2-4 in **Appendix D**, Table 2-4: Summary Comparison of Environmental Consequences of the Alternatives, briefly describes and compares the impacts of the proposed action on resources and resource uses for each alternative, including the Alternative 1 (No Action). For detailed analysis of the impacts under each alternative, see **Chapter 4**, Environmental Consequences.

Chapter 3. Affected Environment

3.1 Introduction

The purpose of this chapter is to describe the existing biological, physical, and socioeconomic characteristics of the planning area, Osage County, Oklahoma. The planning area includes the Osage Mineral Estate. The affected environment descriptions for individual resources provide a baseline for comparing potential environmental impacts under each alternative analyzed in **Chapter 2**, Alternatives. The resources analyzed are based on federal regulatory requirements and policies, as well as issues identified by the BIA through internal and external scoping.

The level of information presented in this chapter is commensurate with, and sufficient to assess, the potential impacts discussed in **Chapter 4**, Environmental Consequences, based on the alternatives presented in **Chapter 2**.

The acreages and other figures used in Chapter 3 are approximations based on available data. Many acreages were calculated using GIS technology. As a result, there may be slight variations in total acreage amounts between resources.

There are no lands in the planning area that are designated wilderness under the Wilderness Act of 1964, 16 US Code (USC) 1131–1136. Accordingly, that topic is not discussed in this EIS.

In recent years plugging permits have outpaced drilling permits in Osage County. However, for purposes of analysis, it is assumed that the number of wells in the county will grow over time in order to provide maximal coverage for future development under NEPA, should that trend reverse.

3.2 Topography, Geology, Paleontology, and Soils

Topography is the degree of slope, contours of the land, and ranges in elevation. Just as knowledge of area drainage basins, watersheds, and soils is important to planning, so too is the knowledge of slope and contour. Such knowledge aids site planning, site preparation, and final construction by determining the different gradients and contours of a particular area or site (Osage County 2011).

Geologic resources are defined through descriptions of the geology of the planning area and identification of geologic hazards. Geologic hazards are adverse geologic conditions that are capable of causing damage to, or loss of, property and life. Geologic information is used to evaluate the potential development of mineral resources and to regulate land uses, based on slope stability and accessibility. Mineral occurrence and management are discussed in detail in **Section 3.16**, Mineral Extraction.

Paleontological resources are any fossilized remains or traces of organisms that are preserved in or on the earth's crust. They include invertebrate, plant, trace, or vertebrate fossils, which constitute a fragile and nonrenewable record of the history of life. The BIA may consult with, or request technical advice from, federal entities inside and outside the DOI that have subject matter expertise relating to paleontological resources on a case-by-case basis, as necessary.

Soil resources are described using the characteristics and distribution of soil types in the planning area that may affect the use and management of the land and the quality of surface water, air, forage, and tree growth. Soil characteristics are important to consider when siting construction activities associated with oil and gas development, including the construction and installation of well pads, roads, pipelines, and other facilities. They are also important considerations when planning rangeland and timber stand improvements.

3.2.1 Regulatory Framework

Topography

There are no specific regulations and guidelines for topography critical for NEPA compliance. Topography is listed as a topic for discussion, in accordance with the BIA NEPA guidebook.

Geology

There are no specific regulations and guidelines for geology or geologic hazards critical for NEPA compliance. Geology is listed as a topic for discussion in accordance with the BIA NEPA guidebook.

Paleontology

The Indian Affairs Manual, Part 59, Chapter 7, Paleontological Resources, establishes policy on the specific requirements and responsibility of Indian Affairs headquarters and field staff for protecting and managing paleontological resources on Indian lands (BIA 2012).

Soils

The following statutes, regulations, and policies govern soil resources:

- 25 CFR 225–226, Energy and Minerals
- Soil Conservation and Domestic Allotment Act of 1935, as amended
- Soil and Water Resources Conservation Act of 1977
- The American Indian Agricultural Resource Management Act, Public Law 103-177

3.2.2 Current Conditions

Topography

Osage County's terrain is characterized by gently rolling rocky hills, bisected by the lowlands of the Arkansas River and its major tributaries. The average elevation of the county is about 860 feet and ranges from around 590 feet in the lowlands to a maximum of 1,407 feet northeast of Foraker (BIA 1979). Northwest Osage County has most of the highest elevation areas, at 1,116 feet or higher. This portion of the county stretches along State Highway 18 from north of US Highway 60 and includes the Kaw WMA, the John Dahl WMA, and the towns of Webb City, Shidler, and Grainola. The range of 985 to 1,115 feet of elevation is commonly found along the ridgelines of the drainage basins of the major creeks that begin in the northwest portion of the county and flow southeasterly (Osage County 2011).

The degree of slope in Osage County is shown in **Figure 3-1** in **Appendix E**, Figures, and the acres by slope gradient are shown on **Table 3-1**. In general, the county is flat, with mostly 0- to 15-degree slopes, but in some of these areas the land slopes in the upper end of the slope gradient range. This can be considered severely sloping for purposes of construction, without incorporating specific site planning measures (Osage County 2011).

Table 3-1
Slope Gradient

Percent Slope	Acres
0–5	881,900
5.1–10	441,400
10.1–20	109,500
20.1–30	41,700

Source: NRCS GIS 2015

A slope of 5 to 10 percent presents moderate constraints to nonresidential land development (Osage County 2011). Slopes of 11 to 20 percent may be impracticable for uses other than lower density residential development, parks, and open space activities. Development in these areas requires careful engineering and construction techniques to ensure that the development constraints are properly addressed (Osage County 2011).

Geology

A geomorphic province is part of the earth's surface where a suite of rocks with similar geologic character and structure underwent similar geologic history and where present-day character and landforms differ significantly from adjacent provinces (Johnson 2008). Osage County is in the Interior Plain division of the Central Lowlands physiographic/geomorphic province. This area is characterized by low-relief plains, punctuated by east-facing escarpments formed by cuestas, with mixed-grass prairie in the west, transitioning to mixed tall grass savannahs and woodlands in the east (USGS 2014).

The northwestern part of the county is in the Northern Limestone Cuesta Plains subdivision, characterized by thin, Permian limestone-capped, west-dipping cuestas rising above broad shale plains (Johnson 2008). The southeastern portion is in the Eastern Cuesta Plains subdivision, characterized by west-dipping, Pennsylvanian sandstone-formed cuestas that overlook broad shale plains (Johnson 2008). The bedrock formations in this area are stereotypically intermixed with layers of sandstone, shale, and thin limestone outcrops, and the bedrock outcrop formations are mainly of the Upper Pennsylvanian and Lower Permian age structures (BIA 2014).

Surface geologic strata (see **Figure 3-2** in **Appendix E** and **Table 3-2**) consist primarily of Quaternary (0.005–2.5 millions of years ago [Ma]), Permian (252–298 Ma), and Pennsylvanian (298–323Ma; USGS 2003a) age stratigraphic units. Details on the formations underlying the planning area were obtained from the US Geological Survey Mineral Resources On-Line Spatial Data database (USGS 2015a). The most westerly formation is Quaternary Alluvium (loose gravel, sand, or clay deposited by streams) along the Arkansas River and around Kaw Lake (Osage County 2011). This formation is overlain with a large area of the Oscar Group (shale with many layers of limestone with sandstone) and patches of terrace deposits (alluvial deposits on 1 or more terrace levels of unconsolidated gravels, sand, silt, and clay).

To the east of the Oscar Group is the Vanoss Group (alternating layers of limestone and shale) and then the Ada Group (orange-brown fine-grained sandstone and red-brown to gray shale). The Ada Group is bounded on the east by a wide band of the Vamoosa Formation (alternating layers of shale and fine- to coarse-grained sandstone, with some limestone). East of the Vamoosa Group is a narrow band of the Tallant Formation (alternating layers of shale and sandstone), followed by a similar narrow band of the Barnsdall Formation (fine- to medium-grained sandstone, overlain by shale). The Barnsdall Formation is bordered on the east by Wann limestone (shale and fine- to medium-grained sandstone, with many thin layers of fossiliferous limestone) and Iola limestone (limestone, calcareous sandstone, shale, and underlying Wann).

The southeast areas of the county are underlain by the Nellie Bly Formation (shale with a few layers of fine- to medium-grained sandstone), Hogshooter limestone (crinoidal limestone underlying Nellie Bly), and the Coffeyville Formation (shale interbedded with fine- to medium-grained sandstone). **Table 3-2** gives additional details of the stratigraphy in the planning area.

Mineral Resources

Oil and gas production in the county comes mainly from formations at depths of between 200 and 3,000 feet. The Burbank and Bartlesville Sands, Mississippi Chat, and Arbuckle Group are among the formations where oil and gas have been produced. The Burbank and Bartlesville Sands are Pennsylvanian or younger sandstone bodies that are up to 15 miles long, several miles wide, and 200 feet thick. Both of these sands occur in the Cherokee Group, which includes several other sands, limestones, and coal beds (Thorman and Hibpshman 1979).

Table 3-2
Major Surface Stratigraphic Units in Osage County, Northeastern Oklahoma

Time-Stratigraphic Unit	Group	Surficial Deposits and Formations	Lithology	Thickness (Feet)
Quaternary		Alluvium	Gravel to clay	0–80
		Terrace	Gravel to clay	0–95
Permian	Summer Group	Wellington Formation	Shale, sandstone	0–850
Pennsylvanian	Oscar Group	Numerous	Shale, limestone, sandstone	0–400
	Vanoss Group	Numerous	Limestone, shale, sandstone	0–500
	Ada Group	Numerous	Shale, limestone, sandstone	0–300
		Vamoosa Formation	Shale, sandstone, limestone	0–500
		Tallant Formation	Shale, sandstone	75–250
		Barnsdall Formation	Sandstone, shake	45–200
		Wann Formation	Shale, sandstone, limestone	50–400
		Iola Limestone	Limestone, sandstone, shale	4–100
		Chanute Formation	Sandstone, shale	10–150
		Dewy Limestone	Limestone, shale	0–60
		Nelly Bly Formation	Shale, sandstone	80–550
		Hogshooter Limestone	Limestone	1–50
		Coffeyville Formation	Shale, sandstone	175–470
		Checkerboard Limestone	Limestone	2–15
		Upper Holdenville Formation	Shale, sandstone, limestone	40–250
Mississippian		Pitkin Limestone	Limestone	—
		Fayetteville Shale	Shale	—
		Batesville Formation	Sandstone	—
		Hindsville Limestone	Limestone	—
		Moorefield Formation	Shale	—
		Koekuk Limestone	Limestone	—
		Reeds spring Formation	Limestone	0–100
		St. Joe Formation	Limestone	0–50
Mississippian/ Devonian		Chattanooga Shale	Shale	0–30
Ordovician	Simpson Group	Bromide Formation	Shale	0–30
		Tulip Creek Formation	Limestone, shale, sandstone	—
		McLish Formation		—
		Oil Creek Formation		—
		Joins Formation		—
		West Spring Creek Formation	Dolomite	200–1,500
		Kindblade Formation	Dolomite	
		Cool Creek Formation	Dolomite	
		McKenzie Hill Formation	Dolomite	

Table 3-2
Major Surface Stratigraphic Units in Osage County, Northeastern Oklahoma (cont.)

Time-Stratigraphic Unit	Group	Surficial Deposits and Formations	Lithology	Thickness (Feet)
Upper Cambrian	Arbuckle Group	Butterfly Formation	Dolomite	
		Signal Mountain Formation	Dolomite	
		Royer Dolomite	Dolomite	
		Fort Sill Limestone	Dolomite	

Source: USGS 2014

The Bartlesville Sand occurs at 1,400 feet in depth, and the Burbank sand occurs at 3,100 feet (Jordan 1957). The Mississippi Chat is a Pennsylvanian or younger basal unit. It consists mainly of conglomerate derived from underlying Mississippi lime, with an irregular channel of siliceous deposits that vary rapidly in thickness from 0 to 100 feet and from 3,000 to 6,000 feet below the surface (Thorman and Hibpshman 1979; IPPA 2015). The Arbuckle Group ranges in age from the Late Cambrian to Early Ordovician and is composed of interbedded limestone, dolomite, and sandstone units, up to 1,200 feet thick.

In addition to oil and gas, Osage County has shale, limestone, sand, and gravel that are quarried or extracted for sale.

Geologic Hazards

Faults and Earthquakes

Faults are discontinuous features in a volume of rock, typically expressed as a fracture or break, with a surficial expression fault line. Faults are rarely individual occurrences; they are more typically formed in a fault zone and result when a body of rock breaks or shifts under stress, which causes an earthquake.

Earthquakes are ground-shaking events that occur at various magnitudes as a result of movement within the earth's crust that releases seismic waves. Earthquakes can vary from slight tremors to building-collapsing events, as shown in **Table 3-3**. Fault lines and recorded earthquakes in and around the planning area are shown on **Figure 3-2** in **Appendix E**.

Earthquakes are either induced through human activities or occur naturally. Since the mid-1960s, oil and gas development, specifically the injection of fluids into the subsurface, has been known to induce earthquakes (Weingarten et al. 2015). The hazard from these earthquakes was traditionally considered small due to their infrequency and small magnitude, but several damaging earthquakes have occurred in the Unites States since 2011 (Weingarten et al. 2015).

Earthquake activity has increased in the central US, rising from an average of 24 earthquakes per year, with a magnitude of 3 or greater from 1973 to 2008, to an average of 193 magnitude 3 or greater earthquakes per year, from 2009 to 2014 (Rubinstein and Mahani 2015). In Oklahoma in 2016 there were 623 earthquakes with a magnitude of 3 or greater, down from a high of 903 in 2015 (Oklahoma Office of the Secretary of Energy and Environment 2017). Many of those earthquakes are believed to have been induced by fluids injected by wastewater disposal wells, particularly those in the Arbuckle formation (Rubinstein and Mahani 2015; Weingarten et al. 2015). Disposal wells are used to inject wastewater from oil and gas wells back into non-productive formations.

According to the Oklahoma Geological Survey (OGS), there were 1,865 earthquakes in Oklahoma from 1970 to 2009; only 5 had an epicenter in Osage County (OGS 2020). The seismicity rate in 2013 was 70 times greater than the background seismicity rate observed in Oklahoma before 2008. The 2015 seismicity

Table 3-3
Modified Mercalli Intensity Scale

Value	Summary Damage Description Used on Maps	Description of Shaking Severity	Full Description (Shortened from *Elementary Seismology*)
I	Not mapped	Not mapped	Not felt.
II	Not mapped	Not mapped	Felt by people seated or those on the upper floors of buildings.
III	Not mapped	Not mapped	Felt by almost all people indoors. Hanging objects swing. Vibration is like that of a passing light truck. It may not be recognized as an earthquake.
IV	Not mapped	Not mapped	Vibration feels like a passing heavy truck. Stopped cars rock; hanging objects swing; windows, dishes, and doors rattle and glasses clink. In the upper range of IV, wooden walls and frames creak.
V	Light	Pictures move	Felt outdoors. Sleepers are wakened. Liquids are disturbed, some spilled. Small unstable objects are displaced or upset. Doors swing; pictures move; pendulum clocks stop.
VI	Moderate	Objects fall	Felt by all. People walk unsteadily. Many become frightened. Windows crack; dishes, glassware, knickknacks, and books fall off shelves; pictures fall off walls; furniture is moved or overturned. Weak plaster, adobe buildings, and some poorly built masonry buildings crack. Trees and bushes shake visibly.
VII	Strong	Nonstructural damage	Difficult to stand or walk. Noticed by drivers. Furniture is broken. Poorly built masonry buildings are damaged. Weak chimneys break at the roof line. Plaster, bricks, stones, tiles, cornices, unbraced parapets, and porches fall. Some cracks appear in better masonry buildings. Waves are generated on ponds.
VIII	Very strong	Moderate damage	Drivers' ability to steer is affected. Extensive damage to unreinforced masonry buildings, including partial collapse, and some masonry walls fall. Chimneys and monuments are twisted and fall. Wood-frame houses move on foundations if not bolted; loose partition walls are thrown out. Tree branches break.
IX	Violent	Heavy damage	General panic. Damage to masonry buildings ranges from collapse to severe damage, unless buildings are of modern design. Wood-frame structures rack and, if not bolted, shift off foundations. Underground pipes break.
X	Very violent	Extreme damage	Poorly built structures are destroyed with their foundations. Even some well-built wooden structures and bridges are heavily damaged and need to be replaced. Water is thrown on waterbody banks.
XI	Not mapped because these intensities are typically limited to areas with ground failure.		Rails are bent greatly. Underground pipelines are completely out of service.
XII	Not mapped because these intensities are typically limited to areas with ground failure.		Damage is nearly total. Large rock masses are displaced. Lines of sight and level are distorted. Objects are thrown into the air.

Source: Richter 1958

rate was approximately 600 times greater than the background rate prior to 2008 (OGS 2015). According to the OGS, it is very unlikely that this increase in seismicity is due to natural processes. The OGS considers it very likely that "the majority of recent earthquakes, particularly those in central and north-central Oklahoma, are triggered by the injection of produced water in disposal wells" (OGS 2015).

In September 2016, a magnitude 5.8 earthquake occurred near Pawnee, Oklahoma, a few miles from the border of Osage County (USGS 2016). In response to seismicity in the area, the Environmental Protection Agency (EPA), which administers the Underground Injection Control (UIC) program for Class II injection wells in Osage County, ordered the shut-in of 5 saltwater disposal wells located in the southwest portion of the county. The agency also ordered volume reductions at 15 other wells in the county. The EPA indicated that it would continue to follow the guidance of the OCC, regarding restrictions on Osage County disposal wells in the Arbuckle Group (*The Oklahoman* 2016).

Soon thereafter, the EPA instituted a moratorium on issuing new permits for Arbuckle disposal wells in Osage County. The moratorium remains in place as of April 2020. In lieu of injection into the Arbuckle, the EPA has been encouraging operators to use shallower zones for disposal wells to mitigate seismicity. This strategy has been successful. The EPA also permitted 1 operator to drill a disposal well into the Mississippi Lime Formation after a pressure demonstration that the Arbuckle and Mississippi Formations were not in hydraulic communication.[1]

Hydrogen Sulfide

Hydrogen sulfide (H_2S) is a gas that may be released from geologic formations during oil and gas development activities. H_2S is colorless, corrosive, flammable, explosive, and poisonous. H_2S is heavier than air and has the characteristic odor of rotten eggs. H_2S is known to occur in Osage County, and oil and gas operators have encountered it at varying concentrations (Osage Nation 2017a). See **Section 3.11**, Public Health and Safety, for further discussion of H_2S.

Paleontology

During the Early and Middle Paleozoic, a shallow sea covered the planning area and supported small marine animals, such as brachiopods, trilobites, mollusks, and crinoids. Late in the Paleozoic (Carboniferous/Pennsylvanian), vast swampy deltas were deposited by rivers, supporting amphibians and early reptiles and developing a rich growth of vegetation that would later become coal seams. Periodically, the sea would alternately return and retreat, resulting in the cyclic deposition pattern of shales, limestones, and sandstones. Rare fossils of insects, amphibians, and reptiles and vertebrate footprints have been collected from Late Paleozoic rocks in Oklahoma (The Paleontology Portal 2015).

During the Mesozoic, Oklahoma lay above sea level, with the western and southeastern portions being covered again by the sea during the Late Mesozoic. Fossils from these marine deposits include oysters, ammonites, sand dollars, and shark teeth.

During the Early Cenozoic (Tertiary), the Rocky Mountains were being pushed up to the west, causing a period of broad gentle uplift in Oklahoma and surrounding areas. Rivers draining off the rising mountains carried extensive sand and gravel deposits and filled wide shallow valleys. These sediments and rocks contain a rich vertebrate fossil record, including a large assortment of fossilized mammals and petrified wood. Quaternary fossils in the planning area are clams and snails and the teeth and bones of horses, camels, bison, and mammoths (The Paleontology Portal 2015).

[1] Philip Dellinger, Chief, Groundwater/Underground Injection Control Section, EPA Region 6, personal communication to Mosby Halterman, Regional Environmental Specialist, BIA Eastern Oklahoma Region, April 6, 2020.

Potential fossil yield classification maps have not been completed for the planning area. The BIA has not done a paleontological investigation in the planning area because of the limited area subject to BIA surface management and the types of activities that this management typically permits. There is a geological potential for fossils, especially for Pennsylvanian epoch fossils, but there has been relatively little formal investigation.

Soils

Soils are grouped on the basis of their characteristics: permeability, percolation, ponding, drainage conditions, shrink-swell potential, depth to cemented pan, depth to hard/soft bedrock, soil texture, flooding frequency, filtering capacity, topography, seepage, subsistence, and organic content. These characteristics also influence soils' adaptation to non-agricultural uses for roads, residences, and small commercial structures and septic tank absorption. Soils are considered healthy when they are able to support region-specific vegetation communities (*i.e.*, appropriate drainage, porosity, and salinity) and are not eroding at rates above what is considered natural for that specific soil type.

Map units are identified during soil surveys at the county level, which can be used for management of activities involving site-specific disturbance. Soil map units may be designated based on the soil's series, slope, aspect, or texture. Soil series are 2 or more geographically associated soils that have similar formation, chemistry, or physical properties (NRCS 2017). Examples of soil series properties are runoff capabilities, erosion hazards, associated native vegetation, wildlife habitat, and suitability for community development.

In 2012, the US Department of Agriculture, NRCS conducted a complete and detailed soil survey of Osage County. There are 71 soil map units in the planning area, but only 8 that cover 3 percent or more of the planning area; when the 8 soil units are combined they account for 66 percent of the planning area (NRCS GIS 2015). These 8 dominant soil map units, along with a brief description of their characteristics, are listed in **Table 3-4** and are shown in **Figure 3-3** in **Appendix E**.

The characteristics and distribution of soil types in the planning area affect the use and management of the land and the quality of surface water, air, forage, and tree growth. Soil characteristics are important to consider when siting construction locations, such as those for oil and gas well development, roads, and buildings.

Sensitive soils are those with characteristics that make them more susceptible to impacts or that make them more difficult than healthy soils to restore or reclaim after disturbance. Sensitive soils in the planning area are susceptible to increased erosion rates. Steep slopes are discussed under *Topography*, above.

Accelerated erosion is usually in response to a land use practice that causes excessive runoff from even normal intensity storms. This type of erosion persists and worsens until the land use practice is corrected or mitigated. Any land use activity that leads to bare soil or increased impervious areas can cause erosion to accelerate. Soils that are susceptible to erosion may require the addition of protective measures to prevent excessive erosion.

Table 3-5 shows the acres of soils susceptible to natural erosion in the planning area. Soils assigned to Group 1 are most susceptible to erosion, and those assigned to Group 8 are least susceptible.

Table 3-6 shows the relative potential erosion hazard for the map unit when used as a site for unimproved roads and trails. The erosion hazard is expressed as the rating class for the dominant component in the map unit, based on composition percentage of each map unit component. Map units with moderate or severe ratings would need additional management to prevent excessive erosion.

Table 3-4
Dominant Soil Map Units

Map Unit Name	Description	Acres	Percent of Planning Area
Niotaze-Bigheart-Rock outcrop complex, 3 to 45 percent slope	Niotaze—Loamy colluvium derived from sandstone over clayey residuum weathered from shale; depth to bedrock: 20–40 inches (densic) or 31–79 inches (paralithic); somewhat poorly drained Bigheart—Residuum weathered from sandstone; depth to bedrock: 10–20 inches; well drained	229,900	15.9
Bigheart-Niotaze-Rock outcrop complex, 1 to 8 percent slopes	Niotaze—Loamy colluvium derived from sandstone over clayey residuum weathered from shale; depth to bedrock: 20–40 inches (densic) or 31–79 inches (paralithic); somewhat poorly drained Bigheart—Residuum weathered from sandstone; depth to bedrock:10–20 inches; well drained	178,900	12.3
Steedman-Lucien complex, 3 to 25 percent slopes	Steedman—Clayey residuum weathered from sandstone and shale; depth to bedrock: 20-40 inches; moderately well drained Lucien—Loamy residuum weathered from sandstone and shale; depth to bedrock: 10-20 inches; well drained	146,600	10.1
Goodnight loamy fine sand, fine sand, and loamy fine sand, 3 to 15 percent slopes	Reworked stabilized dunes adjacent to floodplains of major streams in the Central Rolling Red Prairie; depth to bedrock: greater than 80 inches; excessively drained	99,300	6.9
Westsum-Shidler-Apperson complex, 3 to 12 percent slopes	Westsum—Calcareous clayey residuum weathered from shale; depth to bedrock: greater than 60 inches; well drained Shidler—Loamy residuum weathered from cherty limestone; depth to bedrock: 4–20 inches; well drained Apperson—Calcareous clayey residuum weathered from limestone; depth to bedrock: 40–60 inches; somewhat poorly drained	96,800	6.7
Verdigris silt or clay loam, 0 to 1 percent slopes, frequently or occasionally flooded	Very deep soils that formed in silty alluvium on floodplains in the Cherokee Prairies; depth to redox concentrations where present: 20 to more than 60 inches; well drained	88,700	6.1
Grant silt loam, 1 to 5 percent slopes, (some eroded)	Deep, moderately permeable soils that formed in material weathered predominantly from siltstone or silty shale of Permian age; depth to paralithic contact: 40–60 inches; well drained	77,600	5.4
Bartlesville-Bigheart complex, 1 to 5 percent slopes, very rocky	Bartlesville—Loamy residuum weathered from sandstone; depth to bedrock (paralithic): 20–29 inches; well drained Bigheart—Residuum weathered from sandstone; depth to bedrock: 10–20 inches; well drained	43,800	3.0

Source: NRCS GIS 2015

Table 3-5
Wind Erodibility Group

Group	Acres
1: Very fine sand, fine sand, sand, or coarse sand	0
2: Loamy very fine sand, loamy fine sand, loamy sand, and loamy coarse sand; very fine sandy loam and silt loam, with 5 percent or less clay and 25 percent or less very fine sand and sapric soil materials, except folists	34,500
3: Very fine sandy loam (but does not meet wind erodibility group criterion 2), fine sandy loam, sandy loam, and coarse sandy loam; noncalcareous silt loam that has greater than or equal to 20 to less than 50 percent very fine sand and greater than or equal to 5 percent to less than 12 percent clay	308,500
4: Clay, silty clay, noncalcareous clay loam that has more than 35 percent clay and noncalcareous silty clay loam that has more than 35 percent clay; none of these have sesquic, parasesquic, ferritic, ferruginous, or kaolinitic mineralogy (high iron oxide content)	24,900
5: Noncalcareous loam that has less than 20 percent clay; noncalcareous silt loam with greater than or equal to 5 percent to less than 20 percent clay (but does not meet wind erodibility group criterion 3); noncalcareous sandy clay loam; noncalcareous sandy clay; and hemic soil materials	133,500
6: Noncalcareous loam and silt loam that have greater than or equal to 20 percent clay; noncalcareous clay loam and noncalcareous silty clay loam that have less than or equal to 35 percent clay; silt loam that has parasesquic, ferritic, or kaolinitic mineralogy	586,800
7: Noncalcareous silt; noncalcareous silty clay, noncalcareous silty clay loam, and noncalcareous clay that have sesquic, parasesquic, ferritic, ferruginous, or kaolinitic mineralogy and are oxisols or ultisols; and fibric soil materials	339,400
8: Soils not susceptible to wind erosion due to rock and pararock fragments at the surface or wetness and folists	43,800

Source: NRCS GIS 2015

Table 3-6
Erosion Hazard Ratings for Roads

Rating	Acres
Not rated	40,600
Slight	499,500
Moderate	776,100
Severe	158,300

Source: NRCS GIS 2015

Soils in the planning area have been affected by oil and gas leasing for the past 100 years. Impacts are as follows (USGS 2003b):

- Surface disturbance and soil compaction related to the construction of oil and gas operations and ancillary facilities
- Salt scarring and soil salinization; elevated sodium concentrations in soil kill vegetation and break down cohesion of soil particles, both of which enhance soil erosion
- Tree kills
- Brine and oil contamination from improper disposal or accidental release of large volumes of saline water produced in association with oil and gas production

Before federal laws and regulations were instituted in the 1970s, produced waters were often discharged into streams, creeks, and unlined evaporation ponds, causing salt scars and surface water and groundwater pollution (USGS 2003b). These waters are highly saline (total dissolved solids may exceed 350,000 milligrams per liter) and may contain toxic metals, organic and inorganic components, and radium-226/228 and other naturally occurring radioactive isotopes.

As documented in a 2003 study in Osage County performed by the US Geological Survey, contaminated water generally comes from accidental hydrocarbon and produced water releases and from incorrectly sealed abandoned wells (USGS 2003b). Areas with salt scarring or oil contamination are unable to support vegetation, leaving the soils susceptible to erosion.

To gauge the potential success of restoration, the soil salt content, nutrients, organic matter, petroleum hydrocarbons, and bacterial activity at individual sites would need to be measured. **Figure 3-4** in **Appendix E** shows a typical salt-scarred site, with exposed soil and damaged vegetation.

3.3 WATER RESOURCES

3.3.1 Regulatory Framework

The following federal laws, statutes, mandates, and authorities govern water resources:

- Appropriations Act of 1952, McCarran Amendment
- Federal Water Pollution Control Act (commonly referred to as the CWA), as amended (33 USC 1251–1387)
- Safe Drinking Water Act of 1974 (42 USC 201)
- Watershed Protection and Flood Prevention Act of 1954, as amended
- Water Resources Development Act of 1974
- Water Resources Planning Act of 1965, as amended
- Water Resources Research Act of 1954, as amended
- Soil and Water Resources Conservation Act of 1977
- Executive Order (EO) 11988, as amended by EO 12148, Floodplain Management, May 24, 1977
- EO 11990, Protection of Wetlands, May 24, 1977
- EO 12088, Federal Compliance with Pollution Control Standards, October 13, 1978
- EO 12322, Water Resources Projects, September 17, 1981
- President's Letter of May 26, 1974 (created the Interagency Committee on Water Resources and established interagency participation in river basin planning)
- The Unified Federal Policy for a Watershed Approach to Federal Land and Resource Management (*65 Federal Register* 62565, [October 18, 2000])

3.3.2 Current Conditions

Surface Water

The climate of the planning area is temperate, with annual precipitation of approximately 36 inches in the northeastern and western parts of the county and approximately 45 inches in the southeastern part of the county. May and September are typically the wettest months of the year. Snowfall ranges from 1 to over 10 inches per year (USGS 2014).

The US Geological Survey delineated watersheds in the United States using a national standard hierarchical system. This system classifies surface hydrologic features into hydrologic units: region (first field), subregion (second field), accounting unit (third field), and cataloging unit (fourth field). Each hydrologic unit is identified by a unique hydrologic unit code: region (2-digit), subregion (4-digit), accounting unit (6-digit), and cataloging unit (8-digit).

A cataloging unit is a geographic area representing part or all of a surface drainage basin, a combination of drainage basins, or a distinct hydrologic feature (USGS 2015d). Cataloging units, sometimes called watersheds, are the most widely used hydrological units in water resource planning, management, and policy (Daniels et al. undated). **Table 3-7** shows the cataloging units in the planning area.

Table 3-7
Hydrologic Cataloging Units

Cataloging Unit Name	Total Acres	Acres in Planning Area
Bird	727,904	574,400
Black Bear-Red Rock	1,366,773	432,900
Caney	1,340,509	365,000
Kaw Lake	609,945	76,800
Polecat-Snake	846,226	25,400

Source: NHD GIS 2015

The planning area is drained by the Caney River in the northeast, Bird Creek in the southeast, and Salt Creek in the west. The Arkansas River borders the western and southwestern portions of the planning area for 123 miles (USGS 2014).

There are 69 lakes in the planning area, ranging from 2-acre ponds to the 10,400-acre Skiatook Lake and portions of the larger Keystone and Kaw Lakes along the planning area boundary. Hulah Lake (2,640 acres) near Bowring is the major lake in the Caney River basin, in the northeastern portion of the planning area. The major reservoirs in the Bird Creek basin are Bluestem Lake (860 acres) near Pawhuska, Birch Lake (1,040 acres) near Barnsdall, and Skiatook Lake (10,400 acres) near Skiatook (OWRB GIS 2015; USGS 2002). Approximately 2,180 miles of rivers and creeks traverse the planning area (OWRB GIS 2015). **Figure 3-7** in **Appendix E** shows streams, rivers, and lakes in the planning area.

Water quality standards consist of the designation of beneficial uses, water quality criteria to protect the designated uses, and antidegradation policies. Under Section 303(d) of the CWA, states, territories, and authorized Tribes are required to develop lists of impaired waters that do not meet water quality standards set by states, territories, or authorized Tribes. The law requires that these jurisdictions establish priority rankings for waters on the lists and develop their total maximum daily loads. This is a calculation of the maximum amount of a pollutant that a waterbody can receive and still safely meet water quality standards (EPA 2015c). Two of the 18 waterbodies shown in **Figure 3-7** in **Appendix E** are no longer on the 303(d) list as of 2018: Pawhuska Lake and Hominy Lake.

As shown in **Table 3-8**, oil and natural gas activities are considered unconfirmed potential sources in 4 out of the 18 impaired waterbodies in the planning area: Delaware Creek, Hominy Creek, Bigheart Creek, and Harlow Creek. No total maximum daily load has been established for the pollutants that could be related to oil and natural gas activities on these waterbodies (EPA 2015d). It should be noted that the potential sources of impairment for Delaware Creek, Hominy Creek, Bigheart Creek, and Harlow Creek are not limited to oil and gas activities. To the contrary, oil and gas activities are just 1 of multiple potential sources of impairment for those waterbodies including, but not limited to, urban runoff, grazing, septic systems, residential districts, wildlife, pet waste, municipal point source discharges, and crop production.

Chloride is 1 of the pollutants causing impairment in Hominy Creek and Delaware Creek (OK DEQ 2018). In the planning area, chloride in surface water can come from natural upward seepage of brines underlying fresh groundwater and from brines pumped to the surface and reinjected or otherwise disposed of as a byproduct of oil and natural gas extraction. Chloride concentrations measured in surface water in 1999 at sites distributed throughout much of the planning area were generally greatest in the southern and eastern parts of the county, where the greatest density of oil wells had been drilled (Abbott

Table 3-8
Waterbodies on the 303(d) List of Impaired Waters

Waterbody	Waterbody ID	Miles Impaired in Planning Area	Oil/Natural Gas Activities a Probable Contributor?
Delaware Creek	OK121300010150_00	21.84	Yes
Bluestem Lake	OK121300030300_00	6.35	Unknown
Hominy Creek	OK121300040280_00	39.42	Yes
Keystone Lake, Arkansas River Arm	OK621200010050_00	24.21	Unknown
Keystone Lake	OK621200010020_00	3.62	Unknown
Arkansas River	OK621200010200_00	25.33	No
Kaw Lake, Lower	OK621210000020_00	5.68	Unknown
Kaw Lake, Upper	OK621210000040_00	0.15	Unknown
Bigheart Creek	OK120420010140_00	2.40	Yes
Harlow Creek	OK120420010170_00	4.29	Yes
Shell Lake	OK120420010250_00	5.47	Unknown
Flat Rock Creek	OK121300010120_00	3.89	Unknown
Birch Lake	OK121300030040_00	9.44	Unknown
Mission Creek	OK121400020190_00	18.63	No
Hulah Lake	OK121400030020_00	14.59	Unknown
Buck Creek	OK121400030170_00	25.36	No

Sources: EPA GIS 2015; OK DEQ 2018

and Tortorelli 2002). Chloride levels measured at Little Hominy Creek, a small watershed in the Bird Creek basin, were relatively high between 1999 to 2012, as compared with other watersheds sampled. Accordingly, the US Geological Survey determined that there is a particularly large seepage of saline groundwater at the surface or leaks of brines associated with petroleum extraction in that watershed (USGS 2014).

Floodplains

A floodplain is a geographic area of relatively level land that is occasionally inundated by surface water from rivers or streams. A floodplain would be covered by water in the event of a 100-year flood. This is a flood that has a 1 percent chance of being equaled or exceeded in magnitude in any given year. Areas in the 100-year floodplain are considered special flood hazard areas, and special insurance and construction requirements apply.

The Federal Emergency Management Agency (FEMA) has different requirements for different types of areas, or flood zones, in the 100-year floodplain. The planning area contains acreage in 3 different flood zones:

- Zone A is subject to inundation by a 100-year flood but has not had detailed hydraulic analyses completed
- Zone AE is subject to inundation by a 100-year flood and has been the subject of more detailed analysis on flood elevations
- Zone AO is subject to inundation by 100-year shallow flooding (usually sheet flow on sloping terrain) and has been the subject of detailed analysis on average flood depths

The number of acres in each of these flood zones in the planning area is shown in **Table 3-9**; **Figure 3-7** in **Appendix E** shows the locations of these zones.

Table 3-9
FEMA Flood Zones

Flood Zone	Acres in Planning Area
A	107,100
AE	41,300
AO	100

Source: FEMA GIS 2013

Groundwater

There are 3 major aquifers in the planning area (see **Figure 3-5** in **Appendix E**). The first is composed of alluvial and terrace aquifers (hereinafter referred to as alluvial), made up of unconsolidated sands, silts, clays, and gravels deposited along streams and rivers in the Quaternary. The second is the Vamoosa-Ada aquifer, consisting of a sequence of sandstones, siltstones, shales, conglomerates, and limestones deposited in marine environments in the Pennsylvanian. The third is a series of minor bedrock aquifers associated with 8 sedimentary rock formations deposited in the Pennsylvanian for the eastern part of Osage County and the Permian for the western part of Osage County, where the Vamoosa-Ada aquifer is absent (USGS 2014).

Alluvial aquifers adjoining rivers and streams in Osage County consist of unconsolidated lens-shaped beds of sand, silt, clay, and gravel. Alluvium underlies river valleys and adjoins active stream channels, whereas terrace aquifers are at higher elevations and were deposited when the riverbed was at a higher elevation. Alluvial aquifers underlie approximately 186,800 acres of the planning area and range in thickness from 0 to 80 feet (Bingham and Bergman 1980; Abbott 2000; USGS GIS 2014). Terrace aquifers near the Arkansas River, which are grouped with alluvial aquifers in this section, range in thickness from 0 to about 95 feet (Mashburn et al. 2003).

The Vamoosa-Ada aquifer underlies approximately 667,100 acres of the planning area (USGS GIS 2014). It consists of stacked sequences of fine-grained to very fine-grained sandstone, siltstone, shale, and conglomerates that are interbedded with very thin limestones (D'Lugosz et al. 1986).

The supply of potable groundwater in the alluvial aquifers and the Vamoosa-Ada aquifer is adequate for current domestic and other purposes. Approximately 48 percent of the water pumped from the alluvial aquifers is used for public water supply, about 13 percent is used for livestock and agriculture, and about 39 percent is used for domestic and commercial purposes (Stephens, Daniel B. and Associates, Inc. 2016).

In areas where these aquifers are absent, groundwater must be pumped from minor bedrock aquifers that generally produce smaller volumes of water (Bingham and Bergman 1980). In these areas surface water is sometimes used for non-potable uses.

Domestic uses of water by individuals and families in the planning area include the use of water for household purposes, agricultural purposes, farm and domestic animals up to the normal grazing capacity of the land, irrigation of gardens that are 3 acres or less in size, and fire protection. Domestic uses of water also include the use of water by non-household entities for drinking water, restrooms, and watering lawns, provided that the amount of stream water used for any such purposes does not exceed 5 acre-feet per year (OWRB 2016).

Private wells do not serve public water supply systems and have fewer regulations than public supply wells. **Figure 3-6** in **Appendix E** shows the high density of domestic water wells in the planning area. In general, domestic wells can be subject to groundwater contamination from seepage through landfills, failed septic tanks, underground storage tanks, fertilizers and pesticides, and runoff from urban areas (EPA 2015b).

In parts of the planning area without the alluvial or Vamoosa-Ada aquifers, wells produce water from permeable rocks that occur intermittently in the subsurface. Wells completed in these minor aquifers typically produce less than 25 gallons per minute and underlie approximately 540,800 acres of the planning area (Bingham and Bergman 1980; Abbott 2000).

The US Geological Survey analyzed groundwater quality in the planning area in 2014 (USGS 2014). Groundwater is in constant contact with minerals in rocks and sediments. As a result, it gradually dissolves those minerals and, with time, becomes saline. The entire planning area is underlain by brines containing large concentrations of sodium and chloride and total dissolved solids concentration as large as 200,000 milligrams per liter (D'Lugosz et al. 1986). Chloride, a component of total dissolved solids, is a conservative element in hydrologic systems. Chloride can indicate sources and movement of groundwater, such as upward discharge of saline groundwater to springs and streams or the effects of disposal or leakage of brines brought to the surface during oil and natural gas extraction.

Chloride concentrations were significantly greater in water samples collected from wells completed in the Vamoosa-Ada aquifer than in water samples collected from wells in alluvial aquifers in the planning area. Chloride concentrations in the few water samples collected from wells completed in minor aquifers were not significantly different from those in water samples collected from wells completed in alluvial and the Vamoosa-Ada aquifers in the planning area. Water sampled from wells completed in alluvial, the Vamoosa-Ada, and minor bedrock aquifers generally contained smaller concentrations of dissolved chloride than water samples collected at Hominy Creek (USGS 2014). Groundwater samples collected from 32 wells completed in alluvial and terrace aquifers contained dissolved chloride concentrations similar to those in water samples collected from Bitter Creek and Bird Creek (USGS 2014).

General decreases in dissolved chloride concentration with larger streamflows at 5 surface water sites in the planning area indicate that base flow (derived from groundwater seepage) tended to contain larger dissolved chloride concentrations than were measured in runoff (associated with high flows) in those streams. Larger concentrations of dissolved chloride in base flow may have been caused by upward seepage of saline groundwater along stream channels or by increased dissolved chloride concentration in shallow groundwater near petroleum-gathering structures (USGS 2014).

Local effects may cause the substantial variations in dissolved chloride concentration in groundwater in the planning area (USGS 2014). These effects can be caused by brines seeping into shallow groundwater or by leaks and spills from oil and natural gas extraction near the land surface. No general geographic patterns of dissolved chloride concentration are apparent in groundwater samples collected in the planning area (USGS 2014).

Water Use

Water Use for Oil and Gas Extraction

Industrial use of surface water and groundwater in the planning area is primarily for oil and gas development activities. This industrial water is supplied by the water user and does not impact water rights in the planning area.

Water is used throughout well drilling, completion, and production processes. To conduct these operations, lessees extract water from surface water or groundwater sources, haul water in by truck, or reuse/recycle produced water. The quantity of water used per well is dependent upon the geology of the targeted reservoir, well type, total well depth, operator preference, drilling technique, and other operational factors (Nicot and Scanlon 2012).

Vertical (conventional) drilling, as opposed to horizontal or directional (unconventional) drilling, is the predominant method of oil and gas extraction in the planning area; of the more than 40,000 wells drilled in

Osage County since 1897, just 228 have been horizontal or directional wells. See **Table 3-44** for further information regarding the total number of wells drilled in Osage County. Today, 45 of the approximately 14,599 active oil, gas, oil and gas, and injection/disposal/service wells within the planning area are horizontal or directional wells. See **Table 3-43** for additional information regarding active wells in Osage County.

Vertical drilling and completion use an estimated 65,000 to 690,000 gallons of water per well, with an assumed average of 250,000 gallons per completion (Gallegos et al. 2015). Air drilling, or pneumatic percussion drilling, a technique commonly used to drill vertical wells in Osage County, reduces the amount of water required by using air to cool the drill bit instead of liquids. Horizontal drilling and completion in tight oil or shale gas uses an estimated 65,000 to over 1 million gallons of water per well, plus an additional 2 to 6 million gallons of water for any associated hydraulic fracturing (Koplos 2014).

Hydraulic fracturing, also referred to as hydrofracking, hydrofracturing, and fracking, is a process used to increase oil and gas flow to a well from petroleum-bearing rock formations, thereby increasing the volumes of oil and gas recovered (USGS 2015c). The process involves the injection of hydraulic fracturing fluid (*e.g.*, water, proppant, and chemical additives) down a wellbore and into a target bedrock formation under high pressure, creating fractures in the formation. Freshwater or produced water are typically used for hydraulic fracturing. While both vertical and horizontal wells can be fracked, hydraulic fracturing has not been prevalent within the planning area, where lessees have found the cost of fracking operations to exceed improvements in recovery.

In contrast to hydraulic fracturing, waterflooding is common within the planning area. Waterflooding is an enhanced oil recovery method in which water is injected into petroleum-producing zones in rock formations to displace residual oil. In Osage County, these petroleum-producing zones are located below drinking water aquifers (USGS 2014). Waterflooding operations within the planning area rely heavily on the extraction and reinjection of saline groundwater; however, produced water may also be reused.

Data regarding the volumes of surface water and groundwater used for oil and gas extraction in Osage County were not available as of the time this EIS was being prepared.

Lessees in Osage County must obtain a CWA Section 401 certification to determine whether a proposed discharge to surface waters under a federal permit (*e.g.*, CWA Section 402 or Section 404) will comply with water quality standards. The Oklahoma Department of Environmental Quality administers the CWA Section 401 water quality certification program in Oklahoma for projects on state lands. However, on Tribal land when a Tribe has not received treatment in the same manner as a state for the CWA Section 401 program, the EPA retains responsibility for CWA 401 certification reviews. For the 2017 nationwide permits under CWA Section 404, EPA Region 6 did not certify the use of the 2017 nationwide permits for use in the Tulsa District. Rather, in accordance with US Army Corps of Engineers regulations at 33 CFR 330.4(c), anyone wanting to perform an activity subject to the nationwide permits (or under an individual CWA Section 404 permit) on Tribal land is required to obtain an activity-specific water quality certification, or waiver, from the EPA before proceeding under the nationwide permit.

Other Water Use

The primary water sources in the planning area are surface water withdrawn from Skiatook Lake and groundwater withdrawn from alluvial aquifers. In 2015, approximately 99 percent of the water withdrawn by public suppliers in the planning area was from surface water sources (USGS 2018). Skiatook Lake is the primary source of water for public suppliers in the planning area and for cities in adjoining counties. Surface water is also withdrawn from other lakes, ponds, creeks, and streams in the planning area. Planning area residents living outside public water supply service areas typically rely on private wells.

There are no large industries in the planning area using water from public suppliers; therefore, the volume of water withdrawn by cities, towns, rural water districts, and small communities is likely to vary in response to population changes (USGS 2014). Surface water in the planning area is also used for livestock and irrigation. Livestock is the second-highest water use in the planning area, behind public water suppliers (USGS 2014).

3.4 AIR QUALITY AND CLIMATE

Air Quality

Air quality is influenced by a combination of factors: climate, weather, the magnitude and distribution of pollution sources, and the chemical properties of emitted pollutants. Air quality is a component of air resources that may be affected by oil and gas development in the planning area.

Climate

Climate analysis has 2 components to be considered in a NEPA analysis. The first is the impact that climate change has on the resources and resource uses in the planning area; the second is the impact that activities and management actions authorized by the NEPA document have on greenhouse gas (GHG) emission levels that contribute to climate change.

This EIS provides an overview of climate and climate change in the region and the sources and levels of GHG emissions at a state and national scale. More information on how climate change is affecting specific resources and resource uses in the planning area is described in the individual resource sections in this chapter.

Climate is the generally prevailing weather conditions of a particular region throughout the year, averaged over a series of years (National Climate Assessment 2014). Climate is both a driving force and a limiting factor for biological, ecological, and hydrological processes. Climate change represents a deviation from the average climate, whether warming or cooling, over an extended period (IPCC 2013); such change has been happening continuously since the formation of the earth and its early atmosphere, billions of years ago. Climate change occurs as a result of a change in the earth's overall energy balance, or a difference in the amount of energy it receives and emits back into space (EPA 2016b).

The earth has a natural greenhouse effect, wherein naturally occurring GHGs, such as water vapor, carbon dioxide, methane, and nitrous oxide, absorb and retain heat. GHGs are efficient in absorbing short-wave radiation emitted by the earth, effectively trapping the heat that would otherwise be lost into space. Also known as the greenhouse effect, this warms the earth and its atmosphere. Increased levels of GHGs trap more heat in the atmosphere (EPA 2016c).

In its Fifth Assessment Report, the International Panel on Climate Change (IPCC 2014) states that the atmospheric concentrations of well-mixed, long-lived GHGs, such as carbon dioxide, methane, and nitrous oxide, have increased to levels unprecedented in at least the last 800,000 years. Globally, atmospheric carbon dioxide concentrations have increased from an estimated 277 ppm before 1750 to approximately 395 ppm in 2013 (Global Carbon Project 2014). From pre-industrial times until 2013, the global average concentration of carbon dioxide in the atmosphere increased by over 40 percent, methane increased by over 150 percent, and nitrous oxide increased by over 20 percent (IPCC 2014).

Following decades of extensive and focused research and a growing body of evidence, the scientific community has reached a consensus that climate change is occurring (NASA 2016). Research indicates that natural causes do not explain most observed warming, especially warming since the mid-twentieth century; rather, it is extremely likely that human activities have been the dominant cause of that warming (IPCC 2013).

3.4.1 Regulatory Framework

Air Quality

The CAA (42 USC 7401–7642) established the principal framework for national, state, and local air quality protection. The EPA prescribes regulations and standards implementing the requirements of the CAA. While the EPA retains authority for certain air quality rules, including most pertaining to emission standards for mobile sources, it may authorize states and, in some cases, Tribal governments to implement portions of the CAA.

Under the 1990 amendments to the CAA, Tribal governments are to be treated as states; however, unlike states, Tribes are not required to implement all CAA requirements. Instead, they are authorized to develop and implement CAA requirements that they deem appropriate. In the event that a Tribe does not have the desire or capability to administer CAA programs, the EPA generally oversees the implementation of the CAA on Tribal lands.

In Oklahoma, the EPA has delegated responsibility for implementing the CAA to the Oklahoma Department of Environmental Quality. In parts of Osage County that are not considered Indian country, the Oklahoma Department of Environmental Quality is responsible for most permitting under the CAA; however, the EPA retains responsibility for some parts of the CAA.

Ambient Air Quality Standards

Under the authority of the CAA, the EPA has established nationwide air quality standards, known as the National Ambient Air Quality Standards (NAAQS; **Table 3-10**). These standards represent the maximum allowable atmospheric concentration of the 6 criteria pollutants that are considered to be key indicators of air quality: carbon monoxide, nitrogen dioxide, ozone, sulfur dioxide, lead, and 2 categories of particulate matter (less than 10 microns in diameter [PM_{10}] and less than 2.5 microns in diameter [$PM_{2.5}$]).

There are primary and secondary standards for these pollutants. Primary standards set limits to protect public health, including the health of sensitive populations, such as asthmatics, children, and the elderly. Secondary standards set limits to protect public welfare, including against decreased visibility and damage to animals, crops, vegetation, and buildings. Averaging periods vary by pollutant, based on the potential health and welfare impacts of each pollutant. Individual states must meet the NAAQS but have the option of adopting their own standards that are at least as stringent at the NAAQS.

The EPA periodically reviews the standards and the science that they are based on. The existing standards can be revised, or new standards can be introduced, to ensure that they provide adequate health and environmental protection.

Clean Air Act General Conformity

Section 176(c) of the CAA requires that federal actions conform to the appropriate state implementation plan. The EPA has promulgated rules establishing conformity analysis procedures for transportation-related actions and for other general federal agency actions (40 CFR 6, 51, and 93).

The EPA general conformity rule requires a formal conformity determination document for federal agency actions that are undertaken, approved, or funded in federal nonattainment or maintenance areas. This rule applies when the total net change in direct and indirect emissions of nonattainment pollutants (or their precursors) exceeds specified thresholds. Osage County is not in a nonattainment or maintenance area; therefore, CAA conformity does not apply to federal actions in the planning area.

Table 3-10
National Ambient Air Quality Standards

Pollutant	Averaging Time	National Standards		
		Primary	Secondary	Form
Ozone	8-hour	0.070 ppm*	Same as primary	Annual 4th-highest daily maximum 8-hour concentration, averaged over 3 years
Carbon monoxide	8-hour	9 ppm	—	Not to be exceeded more than once a year
	1-hour	35 ppm	—	
Nitrogen dioxide	Annual (arithmetic mean)	0.053 ppm	Same as primary	Annual mean
	1-hour	100 ppb	—	98th percentile, averaged over 3 years
Sulfur dioxide	3-hour	—	0.5 ppm	Not to be exceeded more than once a year
	1-hour	75 ppb**	—	99th percentile of 1-hour daily maximum concentrations, averaged over 3 years
PM_{10}	24-hour	150 µg/m^3***	Same as primary	Not to be exceeded more than once a year, on average, over 3 years
$PM_{2.5}$	Annual (arithmetic mean)	12 µg/m^3	15 µg/m^3	Annual mean, averaged over 3 years
	24-hour	35 µg/m^3	Same as primary	98th percentile, averaged over 3 years
Lead[3]	Rolling 3-month average	0.15 µg/m^3	Same as primary	Not to be exceeded

Source: EPA 2017a
***ppm**—parts per million. Final rule signed October 1, 2015, and effective December 28, 2015. The previous (2008) ozone standards also remain in effect in some areas. Revocation of the 2008 ozone standards and a transition to the 2015 standards will be addressed in the implementation rule for the current standards.
****ppb**—parts per billion. Final rule signed June 2, 2010. The 1971 annual and 24-hour sulfur dioxide standards (0.03 ppm annual and 0.14 ppm 24-hour) were revoked in that same rulemaking; however, these standards remain in effect until 1 year after an area is designated for the 2010 standard. One exception is in areas designated as nonattainment for the 1971 standards; in such cases the 1971 standards remain in effect until implementation plans to attain or maintain the 2010 standard are approved.
*****µg/m³**—micrograms per cubic meter. Final rule signed October 15, 2008. The 1978 lead standard (1.5 µg/m^3) remains in effect until 1 year after an area is designated for the 2008 standard. The one exception is in areas designated as nonattainment for the 1978 standard; in such cases the 1978 standard remains in effect until implementation plans to attain or maintain the 2008 standard are approved.

Prevention of Significant Deterioration

In addition to the NAAQS, the CAA also has prevention of significant deterioration (PSD) provisions. They establish a permitting process intended to limit incremental increases of specific pollutant concentrations above a legally defined baseline level. They apply to new or modified major stationary sources in attainment or unclassified areas.

The purpose of the program is to protect public health and welfare. It also preserves, protects, and enhances the air quality of national parks and wilderness areas, national monuments, seashores, and other areas of recreational, scenic, or historic value.

The PSD regulations prevent areas that are in attainment of the NAAQS from being polluted, up to the level of the standards. The CAA directs the EPA to classify areas of the US as PSD Class I, II, or III. Class I areas are national parks and wilderness areas of a certain size that existed before 1977 or additional areas that have since been designated by federal regulation. The PSD regulations place limits on the total incremental increase in ambient pollution levels above established baseline levels for sulfur dioxide, nitrogen dioxide, and PM_{10} that are allowed in these areas (see **Table 3-11**). Class II areas allow a greater

Table 3-11
PSD Class I and Class II Increments

Pollutant	Averaging Period	NAAQS (µg/m³)	PSD Class I Increment (µg/m³)	PSD Class II Increment (µg/m³)
Nitrogen dioxide	1-hour	188	—	—
	Annual	100	2.5	25
Ozone	8-hour	137	—	—
$PM_{2.5}$	24-hour	35	2	9
	Annual	12	1	4
PM_{10}	24-hour	150	8	30
	Annual	—	4	17
Sulfur dioxide	1-hour	196	—	—
	3-hour	1,3000	25	512
	24-hour	365	5	91
	Annual	80	2	20

Source: 40 CFR 52.21(c)

degree of degradation and comprise the remaining areas in the US (outside of nonattainment and maintenance areas). National Park System units over 10,000 acres are given more resource protection than other Class II areas. No Class III areas, which would allow the greatest level of degradation, have been designated.

There are 2 Class I airsheds in Oklahoma, but neither is in the planning area (National Park Service 2011). There are no Tribal Class I airsheds in the planning area (National Park Service 2011). Class II airsheds are the remaining areas outside nonattainment and maintenance areas, and these make up the entire planning area. No areas have been designated as Class III.

Hazardous Air Pollutants

Toxic air pollutants, also known as hazardous air pollutants, are those that are known to cause or are suspected to cause cancer or other serious health impacts. No ambient air quality standards exist for hazardous air pollutants; instead, emissions of these pollutants fall under a variety of regulations that target the specific source class and industrial sectors for stationary, mobile, and product use and formulations.

Sources of hazardous air pollutants from oil and gas operations are benzene, toluene, ethyl benzene, xylene, n-hexane, and formaldehyde from well sites and from compressor station and gas plant combustion. Oil and gas exploration and development can also release H_2S gas from geologic formations, which can be a public health and safety hazard. While H_2S has been removed from the CAA Section 112(b) list of hazardous air pollutants, it is subject to accidental release provisions under Section 112(r). For more discussion on H_2S in the planning area, see **Section 3.11**, Public Health and Safety.

Climate

In 2007, the US Supreme Court ruled in *Massachusetts v. EPA* that the EPA has the authority to regulate GHGs, such as methane and carbon dioxide, as air pollutants under the CAA. The ruling did not, however, require the EPA to create any emissions control standards or ambient air quality standards for GHGs. At present, there are no ambient air quality standards for GHGs.

3.4.2 Current Conditions

Air Quality

The planning area is Osage County, Oklahoma. The area of analysis for directly emitted pollutants (those other than ozone) is generally limited to a few miles downwind of a source. The area of analysis for ozone is larger; this is because ozone is formed by photochemical reactions of other pollutants in the atmosphere, primarily VOCs and nitrogen oxides. Ozone may form later and at a greater distance from the sources of precursor emissions.

The CAA requires each state to identify areas that have ambient air quality in violation of federal standards, using monitoring data collected through state monitoring networks, as follows:

- Areas that violate air quality standards are designated as nonattainment for the relevant criteria air pollutants.
- Areas that comply with air quality standards are designated as attainment for the relevant criteria air pollutants.
- Areas that have been redesignated from nonattainment to attainment are considered maintenance areas.
- Areas of uncertain status are generally designated as unclassifiable but are treated as attainment areas for regulatory purposes.

Osage County, like all of Oklahoma, is in attainment or is unclassified for all NAAQS (EPA 2017b). It is part of the Tulsa metropolitan statistical area, which includes Creek, Okmulgee, Osage, Pawnee, Rogers, Tulsa, and Wagoner Counties. This area is represented by the Indian Nations Council of Governments (INCOG), an association of local and Tribal governments in the Tulsa metropolitan area. INCOG is the Metropolitan Planning Organization for the Tulsa region and is responsible for regional transportation plans, in cooperation with the Oklahoma Department of Transportation (ODOT) and the Metropolitan Tulsa Transit Authority. It serves as the planning agency for air quality issues in the region (INCOG and OK DEQ 2017).

INCOG was accepted into the EPA Ozone Advance Program. This is a collaboration between the EPA, states, and local governments to enact expeditious emission reductions to help near-nonattainment areas to remain in attainment of the NAAQS (INCOG and OK DEQ 2017). Portions of the Tulsa Metropolitan Statistical Area are vulnerable to being designated as nonattainment for ozone, though it is not known how much of the statistical area would be included in a future nonattainment designation. There are 5 ozone monitors in the Tulsa Metropolitan Statistical Area, none of which are in Osage County; therefore, measured concentrations of ozone are not available for Osage County. The north monitor in the Tulsa Metropolitan Statistical Area is in Skiatook, near the border of Osage County with Tulsa County (INCOG and OK DEQ 2017). Data for the last 3 years for which monitoring data have been verified show some instances where the ozone standard has been exceeded; however, the 3-year average of the fourth highest daily maximum (on which the 8-hour ozone standard is based) is below the NAAQS for ozone (**Table 3-12**; EPA 2017c).

Table 3-12
Air Quality Monitoring Values Near the Planning Area

Pollutant	Averaging Time	2013 (ppm)	2014 (ppm)	2015 (ppm)	3-Year Average (ppm)	NAAQS (ppm)	Percent of NAAQS[1]
Site ID 401430137 (1100 South Osage Drive, Skiatook)							
Ozone	8-hour averaging end hour	0.071	0.065	0.066	0.067	0.070	96

Source: EPA 2017c
[1] In 2013 and 2014, the NAAQS for ozone was 0.075 ppm. It was lowered to 0.070 ppm in 2015. See **Table 3-11** for more detail.

The Oklahoma Department of Environmental Quality collects annual point source emissions from permitted sources. Emissions from reported sources in Osage County are shown in **Table 3-13**, below.

An emissions inventory was prepared as part of the air quality analysis for the OKT Joint EIS/BLM RMP/BIA Integrated RMP. That inventory estimated the annual oil and gas-related point and area source emissions in Osage County (Grant et al. 2016a). These emissions are shown in **Table 3-14**, below.

Table 3-13
Osage County Annual Point Sources Emissions, 2013–2015

Year	Emissions (Tons per Year)						
	Sulfur Dioxide	Nitrogen Dioxide	Carbon Monoxide	PM_{10}	$PM_{2.5}$	VOCs	Hazardous Air Pollutants
2013	11	558	575	64	30	1,051	245
2014	11	480	521	93	31	1,816	387
2015	Less than 1	428	466	104	29	1,511	373

Source: OK DEQ 2017

Table 3-14
2011 Area and Point Source Oil and Gas Emissions by Mineral Estate in Oklahoma

Mineral Estate Designation	Emissions (Tons)						
	Sulfur Dioxide	Nitrogen Dioxide	Carbon Monoxide	PM_{10}	$PM_{2.5}$	VOCs	Hazardous Air Pollutants
Osage Indian	**5**	**2,238**	**2,758**	**52**	**52**	**5,859**	**164**
Federal	3	577	552	18	18	872	39
State and private	916	123,070	117,224	3,370	3,365	201,092	7,782
Other Indian	6	1,664	1,712	48	48	2,975	122
Total Emissions	**930**	**127,549**	**122,246**	**3,488**	**3,483**	**210,798**	**8,107**
Percent of statewide emissions from Osage Indian sources	0.54	1.75	2.26	1.49	1.49	2.78	2.02

Source: Grant et al. 2016a
The method used for this baseline emissions inventory is detailed in Section 2.1 of Grant et al. 2016a. Area source emissions estimates were obtained from the Oklahoma Department of Environmental Quality, while point sources were obtained from the EPA's National Emissions Inventory.

As described under ***Current Conditions***, there are no permanent air quality monitoring stations in Osage County.

The 2016 Tulsa Area Ozone Advance Annual Update reported ozone trend data in the Tulsa Metropolitan Statistical Area from 1996 to 2016 (see **Figure 3-8** in **Appendix E**; INCOG and OK DEQ 2017). According to these data, ozone concentrations have decreased over time, with occasional spikes in ozone levels.

Forecast

While new sources of ozone precursor emissions will continue to be proposed in the planning area, federal, state, local, and Tribal jurisdictions continue to seek ways to reduce emissions through voluntary and regulatory mechanisms. Climate scientists have predicted that drought conditions and high temperatures will increase through 2050 in the Great Plains (National Climate Assessment 2014); this could contribute to an increase in the instances where the ozone standard is exceeded.

Climate

The planning area is classified as part of the Great Plains. The climate there tends to be characterized by long, hot summers and severe winters (National Climate Assessment 2014). The average temperature in Osage County is about 59 degrees Fahrenheit, with an average high temperature around 93 degrees and an average low temperature around 23 degrees. The annual mean temperature increased by about 1 degree Fahrenheit between 1970 and 2007, as measured at the National Weather Service field station in Pawhuska (USGS 2014).

Annual rainfall in Osage County ranges from about 36 inches in the west and northeast to 45 inches in the southeast, with May and September typically receiving the most precipitation (USGS 2014). The region tends to be susceptible to droughts (National Climate Assessment 2014).

Table 3-15 shows monthly climate normal data for 3 representative cities in and near the planning area, from 1981 to 2010. Climate normals are 3-decade averages of climatological variables produced every 10 years by the National Oceanic and Atmospheric Administration, National Climatic Data Center.

Table 3-15
Average Temperatures and Precipitation in and Near the Planning Area, 1981–2010

Location	Average Maximum Temperature (Degrees Fahrenheit)			Average Minimum Temperature (Degrees Fahrenheit)			Average Precipitation (Inches)		
	Jan.	July	Annual	Jan.	July	Annual	Jan.	July	Annual
Pawhuska	47.9	92.3	71.3	24.6	70.3	47.8	1.68	4.56	3.91
Ralston	47.6	93.1	71.5	22.5	69.3	46.1	1.31	3.39	3.28
Ponca City	45.7	92.7	70.1	24.0	70.6	47.4	1.00	3.33	2.90

Source: National Oceanic and Atmospheric Administration 2015

Climate change in the Great Plains is described on the National Climate Assessment website (National Climate Assessment 2014). This website provides an overview of how climate change is affecting the region in 5 key topic areas, as follows:

- Energy, water, and land use—Rising temperatures are increasing the demand for water and energy. In parts of the region, this will constrain development, stress natural resources, and increase competition for water among communities, agriculture, energy production, and ecological needs.
- Sustaining agriculture—Changes to crop growth cycles due to warming winters and alterations in the timing and magnitude of rainfall have already been observed; as these trends continue, they will require new agriculture and livestock management practices.
- Conservation and adaptation—Landscape fragmentation is increasing, for example, in the context of energy development in the northern Great Plains. A highly fragmented landscape will hinder adaptation of species when climate change alters habitat composition and timing of plant development cycles.
- Vulnerable communities—Communities that are already the most vulnerable to weather and climate extremes will be stressed even further by more frequent extreme events in an already highly variable climate system.
- Opportunities to build resilience—The magnitude of expected changes will exceed those experienced in the last century. Existing adaptation and planning are inadequate to respond to these projected impacts.

Greenhouse Gases

GHGs are chemical compounds in the earth's atmosphere. Some GHGs occur both naturally and through human activities, while others are created and emitted solely through human activities. Naturally occurring GHG compounds are carbon dioxide, methane, nitrous oxide, ozone, and water vapor. Carbon dioxide, methane, and nitrous oxide are produced naturally by the following processes:

- Respiration and other physiological processes of plants, animals, and microorganisms
- Decomposition of organic matter
- Volcanic and geothermal activity
- Naturally occurring wildfires
- Natural chemical reactions in soil and water

Ozone is not released directly by natural sources. It forms during complex chemical reactions in the atmosphere between organic compounds and nitrogen oxides in the presence of ultraviolet radiation. While water vapor is a strong GHG, its concentration in the atmosphere is primarily a result, and not a cause, of changes in temperatures on the surface and in the lower atmosphere.

Carbon dioxide, methane, and nitrous oxide are also produced by industrial processes, motor vehicles and other transportation sources, urban development, agricultural practices, and other human activities.

Global Emissions

The World Resources Institute's (WRI) Climate Analysis Indicators Tool provides data on GHG emissions from 186 countries and all 50 states (WRI 2016). In 2012, global GHG emissions were 46,049 million metric tons (MMT) of carbon dioxide equivalent (CO_2e).

US Emissions

The WRI's Climate Analysis Indicators Tool reports total US GHG emissions of 5,420.7 million MMT CO_2e in 2012 (WRI 2016); this represented nearly 12 percent of the total global emissions.

The WRI reports 2012 statewide GHG emissions in Oklahoma of 804.8 MMT CO_2e; this accounts for 2.2 percent of total US GHG emissions. Electricity generation, transportation, and industry were the largest sources of GHG emissions in Oklahoma, as follows:

- Electricity—34 percent
- Transportation—23 percent
- Industry—16 percent

County Emissions

There are no county-wide estimates of GHG emissions; however, the BLM and BIA developed a GHG emissions inventory for the oil and gas sector, as part of the air and climate analysis for the OKT Joint EIS/BLM RMP/BIA Integrated RMP (Cosic and Vijayaraghavan 2016). This inventory included upstream and midstream sources, including well sites, compressor stations, gas plants, and off-road equipment.

Table 3-16, below, shows total oil and gas GHG emissions in Oklahoma by mineral estate designation for the baseline year 2011. As shown in this table, Osage County oil and gas emissions represented 1.7 percent of state oil and gas emissions in 2011.

Table 3-16
2011 Oil and Gas-Related GHG Emissions in Oklahoma by Mineral Estate

Mineral Estate Designation	CO_2e (MMTs per Year)
Osage Indian	0.8
Federal	0.2
State and private	44.3
Other Indian	0.6
Total Emissions	**46.0**
Percentage of statewide oil and gas emissions from Osage Mineral Estate	1.7

Source: Cosic and Vijayaraghavan 2016

Climate History

Changes in climate over the past 100 years are well documented. The earth's surface has become incrementally warmer in the past 3 decades, compared with any preceding decade since 1850. There is a 95 to 100 percent certainty that the period from 1983 to 2012 was the warmest 30-year period of the last 800 years in the Northern Hemisphere. Moreover, this is likely the warmest 30 years of the last 1,400 years (IPCC 2014).

The global average of the combined land and ocean surface temperature data show a warming of 1.5 degrees Fahrenheit from 1880 to 2012. The increase between the average from 1850 to 1900 and from 2003 to 2012 is 1.4 degrees Fahrenheit. From 1901 to 2012, the longest period when calculation of regional trends is sufficiently complete, almost the entire globe experienced surface warming (IPCC 2014).

On a global scale, the ocean surface has warmed by 0.2 degrees Fahrenheit per decade from 1971 to 2010; since 1901, average sea level has increased by 7.5 inches. Late summer Arctic Ocean sea ice coverage has decreased by half since 1979, and glaciers have receded and lost significant mass since the 1970s (IPCC 2014).

Most of Oklahoma did not become warmer during the last 50 to 100 years, but soils became drier, annual rainfall increased, and more rain has been in the form of heavy downpours. While most of the earth warmed during the last century, natural cycles and sulfates in the air cooled eastern Oklahoma. This trend is not expected to continue. This is because sulfate emissions are declining and the factors that once prevented parts of the state from warming are unlikely to persist (EPA 2016d).

Greenhouse Gases History

From 1990 to 2010, global GHG emissions increased by 42 percent, or at an average annual rate of 1.9 percent. From 1970 to 2000, global GHG emissions increased at an average annual rate of 1.3 percent, while from 2000 to 2010 these emissions increased at an average annual rate of 2.2 percent. Between 2000 and 2010, GHG emissions increased in all sectors, except in agriculture, forestry, and other land use (IPCC 2014).

From 1990 to 2015, US GHG emissions increased by 3.5 percent, or at an average annual rate of 0.2 percent. Over this period, total emissions in the energy, industrial processes and product use, and agriculture sectors grew by 4.1 percent, 10.4 percent, and 5.5 percent, respectively (EPA 2017d).

Between 1990 and 2012, GHG emissions in Oklahoma increased by 18 percent. Over this period, total emissions in the energy and industrial processes sectors increased by 20 percent and 66 percent, while the agriculture sector decreased by 7 percent (WRI 2017).

Forecast

Climate

Climate models predict that annual temperatures will continue to increase through the twenty-first century. Extreme weather, such as severe drought and intense rainfall, is also expected to increase in frequency.

According to the EPA (EPA 2016b), the following conditions will apply:

- Increases in average global temperatures are expected to be within the range of 0.5 to 8.6 degrees Fahrenheit by 2100, with a likely increase of at least 2.7 degrees Fahrenheit for all scenarios, except the one representing the most aggressive mitigation of GHG emissions.
- By 2100, the average US temperature is projected to increase by about 3 to 12 degrees Fahrenheit, depending on emissions scenarios and climate models.
- Northern areas of the US are projected to become wetter, especially in the winter and spring. Southern areas, especially the Southwest, are projected to become drier.
- The proportion of precipitation falling as rain rather than snow is expected to increase, except in far northern areas of the country.

In the Great Plains, climate projections indicate that droughts, heat waves, and extreme rainfall will occur with greater frequency and intensity. Currently, the southern portion of the Great Plains, including the planning area, has an average of 7 days a year where maximum temperatures exceed 100 degrees Fahrenheit. Mid-century projections show the number of days with temperatures exceeding 100 degrees Fahrenheit will quadruple (National Climate Assessment 2014).

Changing extremes in precipitation are projected across all seasons, including higher likelihoods of both increasing heavy rain and snowstorms and more intense droughts. Osage County is likely to experience more severe and frequent heavy snowfalls than the rest of the state, aside from the panhandle (National Weather Service 2017). Projections show an increase in the length of dry spells in Oklahoma (National Climate Assessment 2014).

Greenhouse Gases

In its publication, What Climate Change Means for Oklahoma (EPA 2016d), the EPA identified the following:

- Precipitation and water sources—The demand for water will increase, but water will be less available. As rising temperatures increase evaporation and water use by plants, soils are likely to become drier. Increased evaporation and decreased rainfall are likely to reduce the average flow of rivers and streams. Conventional power plants need adequate water for cooling. Compounding the challenges for electric utilities, rising temperatures are expected to increase the demand for electricity for air conditioning.
- Agriculture—Increasing droughts and higher temperatures are likely to interfere with Oklahoma's farms and cattle ranches. Hot weather causes cows to eat less and grow more slowly, and it can threaten their health. Reduced water availability would create challenges for ranchers, as well as farmers who irrigate crops such as wheat. Yields are likely to decline by about 50 percent in fields that can no longer be irrigated. The early flowering of winter wheat could have negative repercussions on livestock farmers who depend on it for feed.
- Floods and tornadoes—Although summer droughts are likely to become more severe, floods may also intensify. Over the next several decades, the amount of rainfall during the wettest days of the year is likely to continue to increase, which would increase flooding. Scientists do not know how

the frequency and severity of tornadoes will change; rising levels of GHGs increase humidity and unstable conditions, but decreased wind shear discourages tornadoes.

- Wildfires and landscape change— Higher temperatures and droughts are likely to increase the severity, frequency, and extent of wildfires. The combination of more fires and drier conditions may change parts of Oklahoma's landscape.

3.5 Fish, Wildlife, and Migratory Birds

3.5.1 Regulatory Framework

Migratory Bird Treaty Act of 1918, as amended

The Migratory Bird Treaty Act of 1918 (MBTA; 16 USC 703–712) makes it unlawful to, among other things, pursue, hunt, take, capture, kill, or possess any migratory bird or part, nest, or egg of such bird listed in 4 separate wildlife protection treaties between the US, Great Britain, Mexico, Japan, and Russia. The MBTA covers 1,007 species, as specified in 50 CFR 10.13.

3.5.2 Current Conditions

Fisheries

Lands in the planning area contain ponds, lakes, and other waterways that provide habitat for a diverse assortment of game and nongame fish species. Many of the ponds and lakes are stocked with game fish; some of the most common species are bass (*Micropterus* spp.), crappie (*Pomoxis* spp.), and catfish (*Ictalurus* spp.). Other game species are paddlefish (*Polyodon spathula*), sauger (*Sander canadensis*), sunfish (*Mola mola*), rainbow and brown trout (*Oncorhynchus mykiss*, *Salmo trutta*), and walleye (*Sander* spp.).

A 1991 survey of the Sand Creek watershed and Hickory Creek in the Bird Creek system identified 23 species with representative characteristics of both Ozarkian and Osage Plains river systems; several of these species are intolerant of degraded habitat and water quality. The fish included suckers (family Catostomidae); topminnows (family Fundulidae); silversides (family Atherinopsidae); perches (family Moronidae); darters (family Percidae); sunfishes (family Centrarchidae); gars (family Lepisosteidae); catfishes (family Ictaluridae); and carps, stonerollers, and shiners (family Cyprinidae) (Stewart et al. 1991).

Some lakes in the planning area, such as Keystone, Skiatook, Hulah, and Kaw, have been combined with WMAs and waterfowl refuges. Approximately 2,080 miles of rivers and creeks and 25,230 acres of lakes are found in the planning area (OWRB GIS 2015).

River impoundments are common throughout the planning area and, in some instances, have changed downstream fish assemblages by altering flow regimes (Taylor et al. 2014). For example, higher flow conditions and loss of low- to no-flow periods associated with post-impoundment habitats at the Skiatook Lake area corresponded with increases in frequency and abundance of stream-dependent species (Taylor et al. 2014). The extent of impacts on stream species by altered habitat and deteriorated water quality in Osage County is unknown.

Wildlife

The Cross Timbers and Flint Hills Ecoregions dominate most of the planning area and provide habitat for an array of wildlife species.

Much of the tallgrass prairie has declined greatly in acreage due to agricultural conversion throughout the region, although large, intact tallgrass prairie landscapes still remain in Osage County (ODWC 2005a). Invasive species continue to threaten native habitat for wildlife by changing community structure in a way that is harmful to native wildlife species.

Five bat species are known to occur in Osage County: the big brown bat (*Eptesicus fuscus*), eastern red bat (*Lasiurus borealis*), hoary bat (*L. cinereus),* silver-haired bat (*Lasionycteris noctivagans*), and tri-colored bat

(*Perimyotis subflavus*). These species roost in a variety of habitats, such as caves, rock crevices, tree hollows and cracks, tree foliage, and buildings (ODWC 2013a).

White-nose syndrome is a disease affecting hibernating bats and is named for a white fungus that appears on the muzzle and other parts of infected bats. A newly discovered fungus, *Pseudogymnoascus* (formerly *Geomyces*) *destructans*, has been demonstrated to cause white-nose syndrome (Coleman 2014). The disease is responsible for extensive mortality of bats in eastern North America; while no incidents have been recorded in the planning area, white-nose syndrome has been confirmed in eastern Oklahoma (ODWC 2017a).

Other mammals found in the planning area are moles (*Scalopus aquaticus*), shrews (family Soricidae), opossums (*Didelphis virginiana*), rabbits (family Leporidae), armadillos (*Dasypus novemcinctus*), squirrels (family Sciuridae), beavers (*Castor canadensis*), gophers (family Geomyidae), mice (families Cricetidae and Zapodidae), raccoons (*Procyon lotor*), red foxes (*Vulpes Vulpes*), coyotes (*Canis latrans*), bobcats (*Lynx rufus*), and woodchucks (*Marmota monax*). Payne et al. (2001) conducted an inventory of the Tallgrass Prairie Preserve in Osage County between June 1991 and May 1992. They reviewed previous literature to determine historical accounts of mammals in the preserve. Based on the collected information, Payne et al. found 43 species of mammals in the preserve.

Big game species, such as white-tailed deer (*Odocoileus virginianus*), are common in the planning area. Deer harvest counts for Osage County in 2013 were 3,755, more than any other county in Oklahoma for that year (ODWC 2013b). Distribution and abundance of big game species vary by habitat type and ecoregion. White-tail deer are typically found at the edges of woodlands and forested areas (American Society of Mammalogists 2015).

Trends for all bird species in the region are unknown, although many species, such as Bell's vireo, northern bobwhite, and red-headed woodpecker, appear to be in decline (ODWC 2005a). Climate conditions play an important role in wildlife production and habitat quality and quantity. Persistent droughts have contributed to range-wide bobwhite quail population declines since the 1960s (ODWC 2016a). The Audubon Society identified 50 bird species that occur in Oklahoma that are threatened by climate change (National Audubon Society 2013). For other upland game species, such as wild turkey, long-term population trends have generally increased since the second half of the twentieth century, in part due to restocking and restoration.

Some reptiles, such as the alligator snapping turtle (*Macrochelys temminckii*) and Texas horned lizard (*Phrynosoma cornutum*), have declined in the planning area; these are both Oklahoma Natural Heritage species of concern. River channel manipulations and thermal alterations of aquatic environments have reduced populations of the alligator snapping turtle (Riedle et al. 2005). The spread of fire ants and use of insecticides to control them, heavy agricultural use, and other habitat alterations have contributed to a decline of the Texas horned lizard (Hammerson 2007).

A fungus known as *Batrachochytrium dendrobatidis* (also known as Bd or chytrid) is an amphibian infectious disease, which has increased in Osage County. Surveys in 2015 found that the prevalence of chytrid is more common than previously thought (Cameron Siler 2017).

Migratory Birds

Lands in the planning area are used for nesting and foraging grounds by large numbers of migratory birds, including songbirds, waterfowl, shorebirds, and raptors. Some species overwinter in the planning area, while others breed or reside there.

The 39,650-acre Tallgrass Prairie Preserve in northern Osage County is the sole location in the planning area important to migratory birds. It contains large tracts of grasslands that provide nesting, breeding, and migratory stopover habitat for a variety of bird species. According to eBird (2017), 236 species of birds have been observed in the Tallgrass Prairie Preserve. Species commonly associated with the preserve are Bell's vireo (*Vireo bellii*), greater prairie-chicken (*Tympanuchus cupido*), Henslow's sparrow (*Ammodramus henslowii*), northern bobwhite (*Colinus virginianus*), painted bunting (*Passerina ciris*), and the red-headed woodpecker (*Melanerpes erythrocephalus*).

The USFWS Wildlife Research Center in Patuxent, Maryland, collects migratory bird survey data and has identified 3 breeding bird survey routes in Osage County. Bird species that have been recorded at 1 or more of these routes are presented in **Table 3-17** species identified as Birds of Conservation Concern are also noted.

Table 3-17
Birds Recorded in Breeding Bird Survey Routes in Osage County

Scientific Name	Common Name	Bird of Conservation Concern
Empidonax virescens	Acadian flycatcher	X
Corvus brachyrhynchos	American crow	
Spinus tristis	American goldfinch	
Falco sparverius	American kestrel	X
Turdus migratorius	American robin	
Peucaea aestivalis	Bachman's sparrow	X
Icterus galbula	Baltimore oriole	
Hirundo rustica	Barn swallow	
Strix varia	Barred owl	
Vireo bellii	Bell's vireo	X
Megaceryle alcyon	Belted kingfisher	
Thryomanes bewickii	Bewick's wren	X
Coragyps atratus	Black vulture	
Mniotilta varia	Black-and-white warbler	
Coccyzus erythropthalmus	Black-billed cuckoo	X
Passerina caerulea	Blue grosbeak	
Cyanocitta cristata	Blue jay	
Polioptila caerulea	Blue-gray gnatcatcher	
Buteo platypterus	Broad-winged hawk	
Toxostoma rufum	Brown thrasher	X
Molothrus ater	Brown-headed cowbird	
Branta canadensis	Canada goose	
Poecile carolinensis	Carolina chickadee	
Thryothorus ludovicianus	Carolina wren	
Bubulcus ibis	Cattle egret	
Chaetura pelagica	Chimney swift	
Spizella passerina	Chipping sparrow	
Caprimulgus carolinensis	Chuck-will's-widow	X
Petrochelidon pyrrhonota	Cliff swallow	
Quiscalus quiscula	Common grackle	
Chordeiles minor	Common nighthawk	
Geothlypis trichas	Common yellowthroat	X
Accipiter cooperii	Cooper's hawk	
Spiza americana	Dickcissel	X
Picoides pubescens	Downy woodpecker	
Sialia sialis	Eastern bluebird	

Table 3-17 Birds Recorded in Breeding Bird Survey Routes in Osage County (cont.)

Scientific Name	Common Name	Bird of Conservation Concern
Tyrannus	Eastern kingbird	
Sturnella magna	Eastern meadowlark	
Sayornis phoebe	Eastern phoebe	
Caprimulgus vociferus	Eastern whip-poor-will	X
Contopus virens	Eastern wood-pewee	
Streptopelia decaocto	Eurasian collared-dove	
Sturnus vulgaris	European starling	
Spizella pusilla	Field sparrow	X
Corvus ossifragus	Fish crow	
Ammodramus savannarum	Grasshopper sparrow	X
Dumetella carolinensis	Gray catbird	
Ardea herodias	Great blue heron	
Myiarchus crinitus	Great crested flycatcher	
Ardea alba	Great egret	
Bubo virginianus	Great horned owl	
Tympanuchus cupido	Greater prairie-chicken	
Geococcyx californianus	Greater roadrunner	
Quiscalus mexicanus	Great-tailed grackle	
Butorides virescens	Green heron	
Picoides villosus	Hairy woodpecker	
Ammodramus henslowii	Henslow's sparrow	X
Eremophila alpestris	Horned lark	X
Carpodacus mexicanus	House finch	
Passer domesticus	House sparrow	
Troglodytes aedon	House wren	
Passerina cyanea	Indigo bunting	
Charadrius vociferus	Killdeer	
Chondestes grammacus	Lark sparrow	
Egretta caerulea	Little blue heron	X
Lanius ludovicianus	Loggerhead shrike	X
Anas platyrhynchos	Mallard	
Ictinia mississippiensis	Mississippi kite	X
Zenaida macroura	Mourning dove	
Colinus virginianus	Northern bobwhite	
Cardinalis	Northern cardinal	
Colaptes auratus	(Yellow-shafted flicker) Northern flicker	X
Circus cyaneus	Northern harrier	
Mimus polyglottos	Northern mockingbird	
Setophaga americana	Northern parula	
Stelgidopteryx serripennis	Northern rough-winged swallow	
Icterus spurius	Orchard oriole	X
Passerina ciris	Painted bunting	X
Dryocopus pileatus	Pileated woodpecker	
Protonotaria citrea	Prothonotary warbler	X
Progne subis	Purple martin	
Melanerpes carolinus	Red-bellied woodpecker	
Vireo olivaceus	Red-eyed vireo	

Table 3-17 Birds Recorded in Breeding Bird Survey Routes in Osage County (cont.)

Scientific Name	Common Name	Bird of Conservation Concern
Melanerpes erythrocephalus	Red-headed woodpecker	X
Buteo lineatus	Red-shouldered hawk	
B. jamaicensis	Red-tailed hawk	
Agelaius phoeniceus	Red-winged blackbird	
Phasianus colchicus	Ring-necked pheasant	
Columba livia	Rock pigeon	
Archilochus colubris	Ruby-throated hummingbird	
Tyrannus forficatus	Scissor-tailed flycatcher	X
Asio flammeus	Short-eared owl	X
Actitis macularius	Spotted sandpiper	
Piranga rubra	Summer tanager	X
Buteo swainsoni	Swainson's hawk	X
Baeolophus bicolor	Tufted titmouse	
Cathartes aura	Turkey vulture	
N/A	Unidentified buteo hawk	
Bartramia longicauda	Upland sandpiper	X
Vireo gilvus	Warbling vireo	
Tyrannus verticalis	Western kingbird	
Sturnella neglecta	Western meadowlark	
Sitta carolinensis	White-breasted nuthatch	
Vireo griseus	White-eyed vireo	
Meleagris gallopavo	Wild turkey	
Hylocichla mustelina	Wood thrush	X
Setophaga petechia	Yellow warbler	X
Coccyzus americanus	Yellow-billed cuckoo	X
Icteria virens	Yellow-breasted chat	
Nyctanassa violacea	Yellow-crowned night-heron	
Vireo flavifrons	Yellow-throated vireo	
Dendroica dominica	Yellow-throated warbler	

Sources: USFWS 2008; Pardieck et al. 2015

3.5.3 Greater Prairie-Chicken (*Tympanuchus cupido*)

The greater prairie-chicken is a chunky hen-like bird, barred with dark brown, cinnamon, and pale buff. It is slightly larger, darker, and more barred than the closely related lesser prairie-chicken, a federal threatened species. Its preferred habitat is grasslands with herbaceous cover; it may also be found in cultivated lands and pastures. Males gather in leks for communal courtship, and females nest in the vicinity, in a scrape on the ground lined with vegetation. Both sexes show site fidelity and most do not migrate. Ranges vary from 25 to 500 acres.

The diet of the greater prairie-chicken consists primarily of insects, especially grasshoppers in summer. At other times of the year it eats fruits, leaves, flowers, shoots, and grain. Formerly widespread in the grasslands of Canada and the western US, the greater prairie-chicken is now found locally in much reduced numbers in the Great Plains, south to Texas.

The species' decline is mainly the result of loss and fragmentation of tallgrass prairie from roads, infrastructure development, and incursion of trees, such as red cedar. The largest remaining populations are in Kansas, Nebraska, Oklahoma, and South Dakota. Northwestern Osage County is a stronghold for the species and contains 32,700 acres of highest importance habitat (see **Figure 3-9** in **Appendix E**).

The closely related lesser prairie-chicken is also diminished in range, and the subspecies *Tympanuchus cupido cupido* (heath hen) of the eastern seaboard has been extinct since the 1930s (NatureServe 2015).

3.6 Special Status Species

3.6.1 Regulatory Framework

Endangered Species Act of 1973

The ESA of 1973 (16 USC 1531 et seq.), as amended, provides for the conservation of federally listed plant and animal species and their habitats. The ESA directs federal agencies to conserve listed species. It imposes an affirmative duty on such agencies to ensure that any action authorized, funded, or implemented does not jeopardize the continued existence of any listed species or result in the destruction or adverse modification of a listed species' designated critical habitat.

Critical habitat is defined in the ESA as "the specific areas within the geographical area occupied by the species . . . on which are found those physical or biological features (I) essential to the conservation of the species, and (II) which may require special management considerations or protection; and . . . specific areas outside the geographical area occupied by the species . . . upon a determination by the Secretary [of the Interior] that such areas are essential for the conservation of the species" (16 USC 1532[5][A]).

Species proposed for listing are not protected by the ESA; however, the USFWS works with federal agencies, state, local, and Tribal governments, surface owners and others to implement conservation actions that prevent a proposed species further decline.

Under the ESA, Section 7 consultation is required when a federal action may affect a listed species or designated critical habitat. During this process, the federal action agency submits a BA to the USFWS or the National Marine Fisheries Service, which includes the following:

- A list of potentially and actually occurring listed species and designated critical habitat that may be affected by the project
- A description of the proposed project
- An evaluation of the potential impacts of the project on such species and habitat

During formal consultation, for actions that may affect or are likely to adversely affect listed species or designated critical habitat, the USFWS and the federal agency will exchange information and gather any necessary additional information. Section 7 consultation concludes with the USFWS issuing a BO detailing its determinations as to whether there is jeopardy to a species or adverse modification to critical habitat, or both. The BO contains all reasonable and prudent mitigation and minimization measures as well as any incidental take statements.

Biological Assessment and Opinion

The BIA submitted a BA to the USFWS in July 2017, requesting formal, programmatic Section 7 consultation regarding oil and gas development activities in Osage County. Section 7 consultation began in September 2017 upon the USFWS' acceptance of the BA and related addenda. The BIA submitted the BA for the purpose of obtaining a BO for all species as well as an incidental take statement for the ABB. The BIA also sought to assume certain USFWS responsibilities relating to the review of proposed oil and gas development activities within the ABB's range.

In July 2018, the USFWS issued a BO, including an incidental take statement for the ABB, and a letter of concurrence with the BIA's effects determinations for other special status species. The USFWS authorized the procedural changes set forth in the BO, incidental take statement, and letter of concurrence on the condition that the BIA would apply certain specified conservation measures to reduce or mitigate the potential impacts of oil and gas development activities.

The BA and BO are included in this EIS as **Appendix B**, Osage County Oil and Gas Biological Opinion and Biological Assessment.

Bald and Golden Eagle Protection Act

The Bald and Golden Eagle Protection Act (16 USC 668–668d) applies primarily to taking, hunting, and trading activities that involve bald or golden eagles. The act prohibits the taking of any individuals of these 2 species, as well as any part, nest, or egg.

Migratory Bird Treaty Act of 1918, as amended

The MBTA (16 USC 703–712) makes it unlawful to, among other things, pursue, hunt, take, capture, kill, or possess any migratory bird or part, nest, or egg of such bird listed in 4 separate wildlife protection treaties between the United States, Great Britain, Mexico, Japan, and Russia. The MBTA covers 1,007 species, as specified in 50 CFR 10.13.

3.6.2 Current Conditions

Osage County is characterized by rolling uplands bisected by drainages, with narrow floodplains in the south and level to rolling uplands in the north (BIA 2013). Elevation ranges from 750 feet to 1,000 feet above mean sea level. The highest elevation in Osage County is in the far northwestern portion of the county; the lowest elevation is found along the Caney and Arkansas Rivers.

Predominant vegetation cover is rangeland and native pastureland. Native grass meadows, prairie, and oak savannah also are found in Osage County (BIA 2013), along with bottomland forest along the Arkansas River (Hoagland 2000). TNC's Tallgrass Prairie Preserve (39,650 acres) in Osage County is part of the 3.8 million-acre Flint Hills, the largest remaining intact tallgrass prairie in North America. The preserve is a center for rangeland research, focusing on conserving and restoring prairie ecosystems.

*American Burying Beetle (***Nicrophorus americanus***), Endangered*

The ABB is a federally endangered species that occurs in 31 counties in Oklahoma, including Osage County (USFWS 2012a). The USFWS published the recovery plan for the ABB in 1991. On March 15, 2016, the USFWS announced its finding that a petition to delist the ABB has substantial information that the petitioned action may be warranted. The USFWS is now reviewing the status of the species. If the ABB is removed from the endangered species list, the BIA would update its required COAs, as appropriate.

This beetle is shiny black, and its most diagnostic feature is the large, orange-red markings on the raised portion of the pronotum (foremost 3 segments of the thorax, including the first pair of legs). The species is up to 1.5 inches long. The ABB has been frequently found in upland grasslands or near the edge of grassland/forest. Sandy/clay loam soils and food (carrion) availability are also important. The species appears to prefer loose soil in which carrion can be easily buried. It is a habitat generalist, and all vegetation types are considered habitat within its range, excluding developed areas, tilled lands, mowed grasslands, saturated soils, and unvegetated areas (USFWS 2014a).

This large, strikingly colored beetle is nocturnal and belongs to a small group of beetles known to bury small dead animals. It is threatened by disease, pesticides, habitat loss, competition for food, isolation and loss of genetic diversity, decrease in prey abundance, agriculture and grazing, and invasive species (USFWS 1991, 2014a). The ABB was once found in 35 eastern states but now occupies only the periphery of its former range. It has been documented in Rhode Island, South Dakota, Nebraska, Oklahoma, Arkansas, and Kansas, with reintroductions attempted in Massachusetts and Ohio (GPNC 2012; USFWS 2012b).

The ABB's presence in the planning area is established. Most of the planning area is within the potential range of the ABB, and the northeastern part of the county is considered an ABB conservation priority area (USFWS 2014a; see **Figure 3-10** in **Appendix E**).

*Whooping Crane (***Grus americana***), Endangered*

The whooping crane is a federal endangered species that has been observed in Osage County, Oklahoma. It is the tallest North American bird and is named for its whooping sound. The whooping crane and sandhill crane are the only 2 crane species found in North America (USFWS 2012c).

An adult whooping crane is white with a red crown and a long, dark, pointed bill. Immature whooping cranes are cinnamon brown. While in flight, their long necks are kept straight and their long dark legs trail behind. Adult whooping cranes' black wing tips are visible during flight.

The muskeg of the taiga in Wood Buffalo National Park, Alberta, Canada, and the surrounding area were the last remnant of the former nesting habitat of whooping crane summer range; however, with the advent of the Whooping Crane Eastern Partnership Reintroduction Project, for the first time in 100 years, whooping cranes are nesting naturally in the Necedah National Wildlife Refuge in central Wisconsin.

Whooping cranes nest on the ground, usually on a raised area in a marsh. The female lays 1 or 2 blotchy, olive green eggs, usually in late April to mid-May. The incubation period is 29 to 31 days. Both parents brood the young, although the female is more likely to directly tend to them. Usually no more than 1 young bird survives in a season. The whooping crane's lifespan is estimated to be 22 to 24 years in the wild.

Breeding populations winter along the Gulf Coast of Texas, near Corpus Christi on the Aransas National Wildlife Refuge, and along Sunset Lake, Matagorda Island, Isla San Jose, and portions of the Lamar Peninsula and Welder Point, on the east side of San Antonio Bay. The Salt Plains National Wildlife Refuge in Oklahoma is a major migratory stopover for the crane population; it hosts over 75 percent of the species annually.

Whooping cranes migrate through western Oklahoma during spring and fall. Osage County is on the eastern edge of this migration route, and whooping cranes may use the Arkansas River as a stopover area. While migrating, they are typically found in shallow wetlands, marshes, the margins of ponds and lakes, sandbars and shorelines of shallow rivers, wet prairies, and crop fields near wetlands (ODWC 2017b).

By 1941, the whooping crane was pushed to extinction by unregulated hunting and loss of habitat; just 21 wild and 2 captive whooping cranes were left. Conservation, however, has led to a limited recovery. As of 2011, there are an estimated 437 birds in the wild and more than 165 in captivity (**Appendix B**).

The nearest critical habitat for the whooping crane is the Salt Plains National Wildlife Preserve, approximately 60 miles west of Osage County. The species does not nest in or near Osage County but has been observed migrating in Osage County.

*Red Knot (***Calidris canutus rufa***), Threatened*

Calidris canutus rufa is a subspecies of red knot, a sandpiper-like shorebird with a round body, long legs, a small head, and tiny eyes. The beak tapers and is not much longer than its head. Males and females vary slightly in size and color. It migrates over long distances, breeding in Arctic tundra and wintering on sandy beaches and barren flats in the Americas (NatureServe 2015).

Although the breeding plumage of *C. c. rufa* is the dullest of all red knot subspecies, the face, chest, and belly remain a striking reddish brown. The head is dark gray, the eye stripe, back, and rump are rust, while the rear belly is white. The wing feathers are gray, with a pale edging and oblong rust-colored center.

When not breeding, the species has a white eye stripe; the head, back, and tail are a plain gray, while the face, chest, and belly are a dingy white. The upper chest has dark streaking that may extend down the flanks. In juveniles there is no distinction between male and female, which both have a dark gray head with a white eye stripe. The back and tail are gray, with distinct white outlines on the feathers, giving each feather a predominant shape. The chest and belly are white with light streaking (Harrington 2001; Niles et al. 2008).

Red knot populations have been in substantial decline from overharvesting of horseshoe crabs, whose eggs are a primary food source during migration. Although this species has been observed migrating in Osage County, it does not nest in the vicinity (NatureServe 2015).

*Interior Least Tern (***Sternula antillarum athalassos***), Endangered*

The interior least tern is a federal endangered species that has been observed in Osage, Pawnee, and Payne Counties, Oklahoma. The breeding season lasts from May through August. The terns gather at staging areas with high concentrations of fish, their primary prey, to rest and eat before the long flight to southern wintering grounds. Low wet sand or gravel bars at the mouths of tributary streams and floodplain wetlands are important staging areas. Interior least terns often return to the same breeding site, or one nearby, year after year.

Least terns nest in colonies, where nests can be as close as 10 feet but are often 30 feet or more apart. The nest is a shallow depression in an open, sandy area, a gravelly patch, or an exposed flat. Small twigs, pieces of wood, small stones, or other debris are usually found near the nest (KDWPT 2011; MDC 2011; USFWS 2011). Nesting habitat of the interior least tern is bare or sparsely vegetated sand, shell and gravel beaches, sandbars, islands, and salt flats associated with rivers and reservoirs. The birds prefer open habitat and tend to avoid thick vegetation and narrow beaches.

The interior least tern is migratory, breeding along inland river systems in the United States and wintering along the Central American coast and the northern coast of South America, from Venezuela to northeastern Brazil. Today, the interior least tern continues to breed on sandy flats in most of the major river systems, but its distribution is generally restricted to the less altered and more natural or little disturbed river segments. It has been observed migrating in Osage County and may breed along the Arkansas River in Osage County (USFWS 1990).

*Piping Plover (***Charadrius melodus***), Threatened*

The piping plover is a federal threatened species that has been observed in Osage, Pawnee, and Payne Counties, Oklahoma. It is a small, sand-colored, sparrow-sized shorebird that nests and feeds along coastal sand and gravel beaches in North America. The adult has yellow-orange legs, a black band across the forehead from eye to eye, and a black ring around the neck. This chest band is usually thicker in males during the breeding season, and it is the only reliable way to tell the sexes apart. The piping plover is difficult to see when standing still as it blends well with open, sandy beach habitats. It typically runs in short starts and stops (USFWS 2012d).

Its breeding habitat is beaches or sand flats on the Atlantic coast, the shores of the Great Lakes, and the Midwest of Canada and the United States. It nests on sandy or gravel beaches or shoals and forages for food on beaches, usually by sight, moving across the beaches in short bursts. Generally, piping plovers will forage for food around the high tide wrack zone and along the water's edge. It eats mainly insects, marine worms, and crustaceans (USFWS 2014c).

Piping plovers migrate north in the summer and winter to the south on the Gulf of Mexico, the southern Atlantic coast of the United States, and the Caribbean. They begin migrating north beginning in mid-March. Their breeding grounds extend from southern Newfoundland south to the northern parts of South

Carolina. Males begin claiming territories and pairing up in late March. They also perform elaborate courtship ceremonies, including stone tossing and courtship flights, featuring repeated dives. Piping plovers begin mating and nesting on the beach in mid-April.

Migration south begins in August for some adults and fledglings, and by mid-September most piping plovers have headed south for the winter. Although this species has been observed migrating in Osage County, it does not nest in the vicinity.

*Northern Long-Eared Bat (***Myotis septentrionalis***), Threatened*

A small insectivorous bat, the northern long-eared bat hibernates in winter and has a single pup in May or June. It forages primarily over springs and waterways and roosts in small colonies in mines, caves, or trees. This bat has a wide but scattered distribution in the eastern and north-central United States and southern Canada. It has suffered severe, recent declines in abundance associated with the fungal white-nose syndrome in eastern North America. The disease is expected to spread across the species' range.

The northern long-eared bat was listed as threatened on May 4, 2015. Threats to the northern long-eared bat include wind-energy development, habitat modification, destruction and disturbance (*e.g.*, hibernation site vandalism and roost tree removal), climate change, and contaminants, particularly for populations reduced by white-nose syndrome (NatureServe 2015). Osage County is on the edge of the range for this species (USFWS 2017).[2]

*Neosho Mucket Mussel (***Lampsilis rafinesqueana***), Endangered*

The Neosho mucket is a federal endangered species known to exist in Osage County. It is a medium to large mussel in the Lampsilinae subfamily. The shell of the Neosho mucket is relatively oblong, and the umbones[3] are low and project only slightly or not at all above the dorsal curvature of the shell (Shiver 2002).

The Neosho mucket is associated with shallow riffles and runs with gravel substrate and moderate to swift currents. Channel stability is an important factor determining the location of Neosho muckets. They need substrate loose enough to allow burrowing; typically they are deeply imbedded in the substrate in a variety of habitats in large streams and small rivers. The Neosho mucket spawns in late April and May and broods larvae from May through August (Shiver 2002; KDWPT 2012). The preferred habitat of this species is along rivers.

*Rattlesnake Master Borer Moth (***Papaipema eryngii***), Candidate*

The rattlesnake master borer moth has simple antennae and is generally characterized by a long thoracic tuft that often slants forward and ends abruptly at the far end. *P. eryngii* is a large chocolate-colored moth with bold white disk markings on the wings. Nearly all the larvae in the genus are purplish brown and have a pattern of longitudinal white stripes. They can be placed into 1 of 4 groups, based on stripe configurations. *P. eryngii* is a member of the group with zero stripes. The adult of the species is readily distinguished by male genitalia or external spots (Forbes 1954).

P. eryngii larvae rely on the rattlesnake master, which is the sole host plant for this species; a population of 100 to 1,000 rattlesnake master plants are needed for *P. eryngii* to persist. *P. silphii* and rarely *P. baptisiae* will also feed on rattlesnake master in June.

Mating and egg laying are strictly nocturnal. Females deposit 200 or more eggs in the duff on or near host plants. Larvae emerge from overwintered eggs in late May and immediately begin to bore into the

[2] Kevin Stubbs, USFWS biologist, phone conversation with Katie Patterson, EMPSi environmental planner, February 17, 2015.
[3] Rounded knobs or protuberances.

rattlesnake master host. Larvae enter stems near the ground and slowly eat their way into the root of the plant. Feeding continues through early August, at which time mature larvae cease all activity and lay dormant for approximately 1 week. Larvae pupate in late August, either in the root or in the soil, and emerge as adults roughly 18 to 21 days later (**Appendix B**).

The rattlesnake master borer moth is threatened by prairie habitat loss, fragmentation, degradation, modification, and illegal collections and population isolation (USFWS 2013).

Three populations of the species are known to occur in Osage County, in TNC's Tallgrass Prairie Preserve (USFWS 2013).

*Sprague's Pipit (***Anthus spragueii***), Candidate*

A pale, slender, sparrow-sized bird with white outer tail feathers and a heavily streaked back, Sprague's pipit is known for its jingling call and high flight. It feeds on insects and grains and nests in depressions in the ground, concealed in clumps of grass or other dense vegetation. Nests are difficult to find and females do not flush from the nest until they are almost stepped on. On the ground, the bird is extremely secretive and flies away in a long, undulating flight when approached. It walks instead of hops and usually lands only on the ground.

Its breeding habitat is short-grass plains, mixed grass prairie, alkaline meadows, and wet meadows. The breeding season extends from late April through early September. Sprague's pipits may raise 2 broods of young a year. Clutch size is usually 4 or 5 eggs. It breeds mainly on the northern Great Plains but has bred as far south as Osage County. Tallgrass prairie, particularly in northwestern Osage County, provides high value nesting habitat for Sprague's pipit. It winters from Texas to Arizona and in Mexico. It forms flocks for migration and typically occurs in Oklahoma for spring and fall migration (USFWS 2010).

The USFWS found the pipit's listing under the ESA to be warranted but precluded by higher priority species; thus, it is considered a candidate species. Its population has declined as a result of loss, degradation, and fragmentation of habitat due to cultivation, wetland drainage, overgrazing, and nonnative vegetation (NatureServe 2015; USFWS 2010).

*Bald Eagle (***Haliaeetus leucocephalus***), Bird of Conservation Concern*

The USFWS has identified the bald eagle as a Bird of Conservation Concern, meaning that it is a species that represents the agency's highest conservation priorities. In addition, the species is of cultural significance to the Osage Nation, as the feathers are highly valued.

The eagle has a distinctive white head and tail, bright yellow bill, and dark plumage; it occurs in Osage County throughout the year. It can be found along the Arkansas River, including Kaw and Keystone Lakes (ODWC 2017c). The species prefers areas near water for hunting fish or waterfowl. It also nests in tall trees or cliffs near water. Clutch size is 1 to 3 eggs. Defended territories are relatively small, from 27 to 279 acres, but feeding home ranges around active nests are larger, from 1,729 to 5,337 acres. Wintering eagles tend to avoid areas with high levels of nearby human activity and development (NatureServe 2015).

3.7 Vegetation, Wetlands, and Noxious Weeds

3.7.1 Regulatory Framework

Clean Water Act

The CWA, as amended in 1977, established the basic framework for regulating discharges of pollutants into the Waters of the United States, including wetlands. The US Army Corps of Engineers regulates the discharge of dredged and fill material into Waters of the United States, including wetlands, in accordance with Section 404 of the CWA.

The US Army Corps of Engineers describes wetlands as "those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas."

The US Army Corps of Engineers provides guidelines for determining the areas under Section 404 jurisdiction (Environmental Laboratory 1987). These guidelines require that at least 1 positive indicator for each of 3 criteria (hydrophytic vegetation, hydric soils, and wetland hydrology) exist for an area to be designated as a wetland. The numerous and varied indicators for each of the criteria are described in detail in the guidelines. If an area meets the criteria, certain activities, such as placing fill, would be subject to US Army Corps of Engineers regulation. The planning area is under the US Army Corps of Engineers Tulsa District.

Federal Noxious Weed Act

The Federal Noxious Weed Act of 1974 provides for the control and management of nonindigenous weeds that injure, or have the potential to injure, the interests of agriculture and commerce, wildlife resources, and public health. The Act prohibits importing or moving any noxious weeds identified by the regulations and allows for inspection and quarantine to prevent their spread.

Executive Order 13112, Invasive Species

Signed in 1999, EO 13112 directs federal agencies to prevent the introduction of invasive species, to provide for their control, and to minimize the economic, ecological, and human health impacts that invasive species cause.

Oklahoma Agricultural Code—Noxious Weeds

Title 2 of the Oklahoma Agricultural Code advises that controlling noxious weeds is the responsibility of every surface owner or occupant. According to the Noxious Weed Laws and Rules of Oklahoma (OSDA 2000), every surface owner and any public, private, or corporate entity that maintains ROWs in Oklahoma is responsible for removing any thistle infestation on their land. Noxious weeds in Oklahoma were listed by the passage of Oklahoma House Bill 2277 (NRCS 2012a).

Biological Assessment and Opinion

The BIA submitted a BA to the USFWS in July 2017, requesting formal, programmatic Section 7 consultation regarding oil and gas development activities within Osage County. Section 7 consultation began in September 2017 upon the USFWS's acceptance of the BA and related addenda. In the BA, the BIA discussed noxious weeds, including the potential for their establishment and spread, as part of its assessment of the potential impacts of oil and gas development on special species habitat.

In July 2018, the USFWS issued a BO and letter of concurrence with the BIA's effects determinations for special status species. The USFWS authorized the procedural changes set forth in the BO and letter of concurrence on the condition that the BIA would apply certain specified conservation measures to reduce or mitigate the potential impacts of oil and gas development activities. Those measures include COAs aimed at preventing the spread of noxious weeds.

The BA and BO are included in this EIS as **Appendix B**.

3.7.2 Current Conditions

Vegetation in Oklahoma is influenced by larger regional patterns of climate, particularly the precipitation gradient. Precipitation averages 55 inches in southeast Oklahoma, enough to support dense oak-pine forests. Shortgrass prairie grasslands are the predominant vegetation in the far western portion of the state, which receives only 13 inches of precipitation annually (Hoagland 2008). Vegetation in the planning area reflects its intermediate location along this precipitation gradient. It is also influenced by geology and soils, as well as disturbances from fires and grazing.

According to the Oklahoma Biological Survey, the planning area contains 3 potential vegetation types: post oak-blackjack forest, tallgrass prairie, and bottomland forest along the Arkansas River (Hoagland 2008). **Table 3-18** summarizes acreages of each potential vegetation type in the planning area. The potential vegetation types reflect the distribution of vegetation in the absence of human intervention and thus do not depict urban or agricultural areas.

Approximately 74,000 acres (5 percent) of the planning area is developed or barren. Developed areas consist of small cities and towns and the northwest edge of the Tulsa metropolitan area, near the southeast corner of the planning area (USGS 2014). Developed and barren areas are not included in the potential vegetation types in **Table 3-18**.

Table 3-18
Potential Vegetation Types

Vegetation Type	Acres
Post oak-blackjack forest	772,700
Tallgrass prairie	656,700
Bottomland forest	41,400
Total[1]	**1,470,800**

Source: OK Biological Survey GIS 1943
[1] The BIA reconciled the Oklahoma Biological Survey dataset with contemporary DOI data for the planning area boundary. Due to a data discrepancy, likely based on water surface not being included in the Oklahoma Biological Survey data, the potential vegetation type total acres do not precisely match the planning area total acres. The discrepancy is approximately 4,100 acres, which equates to 0.27 percent of the planning area.

Post Oak-Blackjack Forest

Post oak-blackjack forest, also locally known as the cross timbers, is characterized by a mix of forest, woodland, and grassland vegetation. Common woody species are post oak (*Quercus stellata*), blackjack oak (*Q. marilandica*), black oak (*Q. velutina*), blackhaw (*Viburnum prunifolium*), black hickory (*Carya texana*), gum bumelia (*Sideroxylon lanuginosum*), Mexican plum (*Prunus mexicana*), redbud (*Cercis* spp.), roughleaf dogwood (*Cornus drummondii*), and sumac (*Rhus* spp.).

The understory is made up of little bluestem (*Schizachyrium scoparium*), big bluestem (*Andropogon gerardii*), and other species, depending on the site (Hoagland 2008; Duck and Fletcher 1943), though understory and regeneration are limited where cattle graze in this vegetation type (ONENRD 2006). Between 1910 and 1980, post oak-blackjack forests in the planning area approximately doubled in size due to fire suppression (ONRNRD 2006).

Post oak-blackjack forest is commercially managed, in part to produce harvestable wood products under the Osage Nation Forest Management Plan (ONENRD 2006). Commercial management was limited before the forest management plan. Forest stands may lack sufficient regeneration due in part to the cattle grazing, fire suppression, and lack of forest management in place before the forest management plan was developed. Management goals are to provide a source of income from sustained commercial harvest and sale of timber and wood products, to improve habitat for game and nongame wildlife, and to protect and enhance the aesthetic and cultural value of the resource.

Prescribed fire is a primary management tool in upland forest vegetation in the planning area; it is used on approximately 4,500 acres annually to reduce fuel loading and the severity or likelihood of wildland fire (ONENRD 2006).

Tallgrass Prairie

Tallgrass prairies contain primarily grasses, such as little bluestem, big bluestem, Indiangrass (*Sorghastrum nutans*), and switchgrass (*Panicum virgatum*). Other herbaceous plants found in the tallgrass prairie are lead plant (*Amorpha canescens*), Indian plantain (*Arnoglossum plantagineum*), prairie clover (*Dalea purpurea*), heath aster (*Aster ericoides*), pallid coneflower (*Echinacea pallida*), ashy sunflower (*Helianthus mollis*), and Missouri goldenrod (*Solidago missouriensis*).

Tallgrass prairie has declined in acreage due to agricultural conversion throughout the region; however, large expanses of this vegetation type still occur in Osage and adjacent counties (Hoagland 2008; Duck and Fletcher 1943; ONENRD 2006).

The largest protected remnant of tallgrass prairie left on earth is in the planning area (TNC 2015). The 39,650 -acre Tallgrass Prairie Preserve has been managed since 1989 by TNC, which conducts research, prescribed burning, and bison grazing management to maintain and improve ecological diversity. The preserve is a single parcel (with several inholdings), so habitat fragmentation is low.

Prescribed fire is also used to improve rangelands in the planning area; it is used on approximately 39,000 acres annually to reduce woody species encroachment and the likelihood of wildland fire (ONENRD 2006).

Bottomland Forest

Bottomland forest extends from eastern to western Oklahoma, along major rivers, as mapped by Duck and Fletcher (1943). As a result, there is tremendous variation in species composition of bottomland forests. Typical stream growth in central Oklahoma within the tallgrass prairie vegetation type consists of American elm (*Ulmus americana*), chinquapin oak (*Quercus muhlenbergii*), post oak, blackjack oak, hackberry (*Celtis laevigata* and *C. occidentalis*), chittamwood (*Bumelia lanuginosa*), cottonwood (*Populus deltoides*), chickasaw plum (*Prunus angustifolia*), fragrant sumac (*Rhus trilobata*), smooth sumac (*R. glabra*), and roughleaf dogwood (Hoagland 2008; Duck and Fletcher 1943).

Bottomland hardwood forests are also commercially managed pursuant to the Osage Nation Forest Management Plan (ONENRD 2006), as described under Post Oak-Blackjack Forest, above. Forest health can be expected to improve in properly managed stands. Outbreaks of disease and damaging insect populations are monitored in woodlands and forests within the planning area.

Riparian Vegetation

In Oklahoma, forested riparian areas are often referred to as bottomland hardwood forests (OSU 1998), as described above (Hoagland 2008). The Oklahoma landscape, crossed by large rivers, formerly contained millions of acres of riparian land prior to Euro-American settlement (OSU 1998).

Between 1910 and 1980, bottomland hardwood (riparian) forests in the planning area shrank by approximately half, due primarily to agricultural conversion (ONENRD 2006). These areas provide an extensive list of benefits to humans and the natural environment. Riparian areas act as a natural buffer between upland activities and sensitive water resources. They store water, mitigate the effects of flooding, reduce erosion, and provide shelter and forage for wildlife (OSU 1998).

Wetlands

Freshwater wetlands are classified as riverine (rivers, streams, and creeks), lacustrine (lakes and reservoirs), and palustrine (forested, scrub-shrub, and emergent wetlands and ponds [Cowardin et al.

1979]). According to the National Wetland Inventory remote sensing data, approximately 57,600 acres of freshwater wetlands occur in the planning area. See **Table 3-19**, below, for the acreage of each type of freshwater wetland mapped in the planning area. See **Figure 3-11** in **Appendix E** for a map of Osage County wetlands.

Table 3-19
National Wetland Inventory Wetlands

Wetland Type	Acres
Freshwater emergent wetland (palustrine)	3,400
Freshwater forested/shrub wetland (palustrine)	12,300
Freshwater pond (palustrine)	5,700
Lake (lacustrine)	16,400
Riverine	19,800
Total	**57,600**

Source: NWI GIS 2017

Riverine

The riverine system includes nontidal freshwater wetland and deep-water habitats contained within a channel (Cowardin et al. 1979). Wetlands that are in a channel but are dominated by trees, shrubs, or persistent emergent vegetation are described in the palustrine system, below. Riverine wetlands are closely associated with major rivers and larger streams in the planning area, including the Arkansas and Caney Rivers and the Salt and Hominy Creeks (NWI GIS 2017).

Lacustrine

The lacustrine system includes wetlands and deep-water habitats situated in a topographic depression or a dammed river channel. Lacustrine systems lack trees, shrubs, and persistent emergent vegetation and generally have a total surface area of at least 20 acres (Cowardin et al. 1979). Lacustrine wetlands in the planning area are Keystone and Kaw Lakes and Hulah and Skiatook Reservoirs (NWI GIS 2017). Several other smaller reservoirs falling under the lacustrine system are also in the planning area.

Palustrine

The palustrine system includes all nontidal freshwater wetlands dominated by trees, shrubs, persistent emergent vegetation, and emergent mosses or lichens. It also includes wetlands lacking such vegetation but having a total surface area of less than 20 acres. The palustrine system was developed to group the vegetated wetlands traditionally called by such names as marsh, swamp, bog, fen, and prairie. It also includes the small, shallow, permanent, or intermittent waterbodies often called ponds. Palustrine wetlands may be situated shoreward of lakes, river channels, or estuaries; on river floodplains; in isolated catchments; or on slopes. They may also occur as islands in lakes or rivers (Cowardin et al. 1979).

Palustrine wetlands in the planning area are freshwater forested or shrub wetlands, which are associated with larger river and stream systems, including the Arkansas River. Freshwater emergent wetlands are also associated with these river and stream systems, as well as along margins of lacustrine wetlands, like reservoirs and lakes. Hundreds of small freshwater ponds included in the palustrine system are scattered across the planning area. These small ponds are often used for agriculture and livestock grazing. Many of these ponds have freshwater emergent wetlands along portions of their margins (NWI GIS 2017).

Wetlands in the planning area are generally under the jurisdiction of the US Army Corps of Engineers regulatory division. It is responsible for protecting aquatic resources, including wetlands, while allowing reasonable development through informed permit decisions. A comprehensive planning area-wide delineation of wetlands following US Army Corps of Engineers guidelines (Environmental Laboratory 1987) has not been conducted in the planning area.

Noxious Weeds and Nonnative, Invasive Plants

Noxious weeds and nonnative, invasive plants have the potential to impact the ecological integrity of a region. Several species of noxious weeds and nonnative, invasive species occur within the state of Oklahoma and the planning area.

Noxious Weeds

The Oklahoma state noxious weed list includes 3 weeds: musk thistle (*Carduus nutans*), Canada thistle (*Cirsium arvense*), and Scotch thistle (*Onopordum acanthium*) (NRCS 2012a). These 3 thistles grow mostly unimpeded throughout Oklahoma due to a lack of natural disease and insects to control their growth (OSU 2012). Musk thistle was first documented in Payne County, Oklahoma, in 1944, southwest of, but relatively near, the planning area (OSU 2012). Musk thistle has now been documented in almost every county in the state, including Osage County, and was declared a noxious weed in Oklahoma in 1994. Integrated control using herbicides and musk thistle weevils (*Rhinocyllus conicus*) can provide satisfactory control (OSU 2012).

While some Canada thistle plants were collected in the Oklahoma panhandle counties over 50 years ago, no infestations are currently known to exist within the state (OSU 2012). Despite this lack of infestation, the species remains on the Oklahoma state noxious weed list due to the high potential for invasion and rapid spread.

Scotch thistle invaded Oklahoma from the west and is known to exist in several, primarily western, Oklahoma counties. The occurrence nearest to the planning area was reported in 2001 in Garfield County (OSU 2012), west of the planning area. Scotch thistle is difficult to control with herbicides, and no biological control options are currently available.

Nonnative, Invasive Plants

The Oklahoma Invasive Plant Council (OkIPC) maintains a list of problem and watch list species that pose a potential threat of invasion in the state (OkIPC 2014), based on a 2009 invasive plant audit for Oklahoma conducted by TNC (Pruett 2009). OkIPC lists 32 problem species and 21 watch list species in the state (**Table 3-20**). These nonnative invasive species are in addition to the 3 state-listed noxious weeds described above (NRCS 2012a).

OkIPC (2014) indicated that the following nonnative, invasive species listed in **Table 3-20** occur in the planning area: Japanese brome (*Bromus arvensis*), cheatgrass (*Bromus tectorum*), sericea lespedeza (*Lespedeza cuneata*), Johnsongrass (*Sorghum halepense*), beefsteak plant (*Perilla frutescens*), poison hemlock (*Conium maculatum*), field bindweed (*Convolvulus arvensis*), Mexican fireweed (*Bassia scoparia*), sulphur cinquefoil (*Potentilla recta*), and common mullein (*Verbascum thapsus*).

In addition, the 1979 EA for oil and gas leasing in the planning area (BIA 1979) found that Japanese brome and other annual weedy grass species (referred to as chess and threeawn [*Aristida* spp.] in the EA) can become common or dominant in tallgrass prairie habitat in response to persistent severe overgrazing. Threeawn is not listed by OkIPC as a problem or watch list species.

Many of the species on the OkIPC list of problem and watch list species were formerly recommended forage species in the region that are now recognized as invasive (OkIPC 2014); as such, they are now widespread through the planning area, state, and region due to ranching and grazing. Though not included on the OkIPC list, Bermudagrass (*Cynodon dactylon*) is a nonnative, invasive perennial grass in the planning area that was widely planted in the 1940s to control old-field erosion (ONENRD 2006) and provide forage for livestock.

Table 3-20
OkIPC Problem and Watch List Species

Scientific Name	Common Names
Problem Species	
Albizia julibrissin	Mimosa, silk tree
Alternanthera philoxeroides[1]	Alligator weed
Bothriochloa bladhii	Caucasian bluestem
B. ishaemum	Yellow bluestem, King Ranch bluestem
Bromus japonicus	Japanese brome
B. racemosus	Meadow brome
B. tectorum	Cheatgrass
Carduus nutans[2]	Musk thistle, nodding plumeless thistle
Cirsium arvense[2]	Canada thistle
C. vulgare	Bull thistle
Conium maculatum	Poison hemlock
Convolvulus arvense	Field bindweed
Hydrilla verticillata[2]	Hydrilla
Kochia scoparia	Mexican fireweed
Lespedeza cuneata	Sericea lespedeza
Ligustrum sinense	Chinese privet
Lonicera japonica	Japanese honeysuckle
Lythrum salicaria[2]	Purple loosestrife
Microstegium vimineum	Nepalese browntop
Myriophyllum aquaticum[2]	Parrot's feather
M. spicatum[1]	Eurasian watermilfoil
Perilla frutescens	Beefsteak plant
Potentilla recta	Sulphur cinquefoil
Pueraria montana	Kudzu
Rosa multiflora	Multiflora rose
Saccharum ravennae	Revennagrass
Salsola tragus	Russian thistle, tumbleweed
Sorghum halepense	Johnsongrass
Tamarix chinensis	Chinese salt cedar
T. parviflora	Small-flowered tamarisk
T. ramosissima	Salt cedar, tamarisk
Verbascum thapsus	Common mullein
Oklahoma Watch List	
Ailanthus altissima	Tree of heaven
Arundo donax	Giant reed
Broussonetia papyrifera	Paper mulberry
Cyperus rotundus	Nut grass
Eichhornia crassipes[1]	Water hyacinth
Elaeagnus angustifolia	Russian olive
E. pungens	Thorny olive
E. umbellate	Autumn olive
Egeria densa[1]	Brazilian water weed
Erodium cicutarium	Red stem stork's bill
Ligustrum japonicum	Japanese privet

Table 3-20
OkIPC Problem and Watch List Species (cont.)

Scientific Name	Common Names
Lolium arundinaceum	Tall fescue
L. pretense	Meadow ryegrass
L. temulentum	Darnel ryegrass
Lonicera mackii	Bush honeysuckle
Lygodium japonicum	Japanese climbing fern
Melia azedarach	Chinaberry tree
Mililotus officinalis	Yellow sweet clover
Paulownia tomentosa	Princess tree
Pyrus calleryana	Callery pear
Ulmus pumila	Siberian elm

Source: OkIPC 2014
[1] On watch list by law in Oklahoma
[2] Currently banned by law in Oklahoma

Culturally Important Plants

Many native plants in the planning area are culturally important to the Osage. Tribal members use traditional and sacred plants for ceremonies and on a daily basis. Woody plants are used for firewood, poles and fire ash sticks, and handles for tools. They also provide leaves for smoking and medicinal teas (ONENRD 2006). Culturally important plants are native to the planning area and evolved under historical fire regimes; thus, prescribed fire is used to mimic historical fire regimes and to reduce the risk of wildland fire for the benefit of culturally important plants (ONENRD 2006).

3.8 Agriculture

Agriculture in Osage County consists primarily of the production of cattle, corn, wheat, soybeans, sorghum, and other grains, oilseeds, and dry beans and peas. There are 1,325 farms and ranches in Osage County covering 1,216,673 acres (USDA 2012a).

3.8.1 Regulatory Framework

Farmland Protection Policy Act

The Farmland Protection Policy Act (7 USC 4201 et seq.) states that federal agencies must "minimize the extent to which federal programs contribute to the unnecessary conversion of farmland to nonagricultural uses…"

The US Department of Agriculture's NRCS has national leadership for administering the Farmland Protection Policy Act. It is responsible for protecting significant agricultural lands from irreversible conversions that result in the loss of an essential food or environmental resources. Prime farmland has the best physical and chemical characteristics to produce food, feed, forage, fiber, and oilseed crops. Prime farmland is used for food or fiber crops or is available for those crops and is not urban, built-up land, or a water area. The soil qualities, growing season, and moisture supply are those needed to economically produce a sustained, high yield of crops (NRCS 2012b).

American Indian Agricultural Resource Management Act

The American Indian Agricultural Resource Management Act (25 USC 3701 et seq.) was promulgated in recognition of the fact that "Indian agricultural lands are renewable and manageable resources which are vital to the economic, social, and cultural welfare of many Indian Tribes and their members." The act provides that the United States has a responsibility to promote self-determination with respect to the management of such resources. It also calls for measures to protect, conserve, develop, and manage Indian agricultural lands in a manner consistent with identified Tribal goals and priorities for conservation, multiple use, and sustained yield.

2030 Osage County Comprehensive Plan

The 2030 Osage County Comprehensive Plan (Osage County 2011) was adopted in June 2011. The Osage County Board of Commissioners and the Osage County Industrial Authority jointly initiated the preparation of the comprehensive land use plan for the County with the assistance of the Indian Nations Council of Governments, a regional planning association of local and Tribal governments in northeast Oklahoma. The plan was prepared with the help of over 40 federal, state, local, and Tribal agencies, other nongovernmental entities, and the public. The land use plan is the basic tool for future physical and economic development for Osage County and includes ranching and agriculture goals and policies to protect and preserve agricultural lands in the county. These are as follows:

Ranching and agriculture area goals

- Preserve and protect land used for agriculture and ranching and control growth in a manner that supports these elements of the County, as set out in the 2030 Plan
- Protect agricultural and ranching areas from premature or unplanned development until a full range of public facilities, services, and utilities is available, and discourage wasteful scattering of non-agricultural development in prime agricultural areas
- Concentrate the development of medium and high intensity land uses in or close to cities and towns and in the south and southeast areas of the county
- Maintain and preserve prime agricultural land for its highest and best use as agriculture and ranching
- Emphasize matters of compatibility of agriculture and ranching with oil and gas production
- Achieve an orderly transition between agriculture and ranching uses with urban development and, in particular, industrial development; concentrate such industrial development in or next to cities and towns and in the south and southeast areas of the county
- Support and plan for ranching and agriculture uses to continue to be basic economic activities of the county
- Encourage and support the Tourism Committee in the development of “agri-tainment” and “agri-tourism” as future basic elements of the economic growth and development of the county

Ranching and agricultural area policies

- Implement and develop, as needed, those planning and land use policies and regulations that support, protect, and encourage agriculture and ranching as a basic economic industry
- Seek financial and technical assistance in developing the necessary agricultural and rural infrastructure from various federal and state agencies to support the agricultural economy and preserve agricultural lands
- Consider the impact on and preservation of agriculture and ranching before extending urban services into agriculture areas
- Protect soil and water quality in ranching and agriculture areas from erosion, uncontrolled runoff, pollution, and other problems sometimes associated with the initial stages of the development process or poor agricultural cultivation practices (Osage County 2011)

3.8.2 Current Conditions

Ranching is the main agricultural enterprise in Osage County. According to the 2012 agricultural census, livestock sales accounted for approximately $114 million, or 94 percent of the total agricultural market. Osage County ranks 17 out of the 77 counties in Oklahoma in total value of agricultural products sold

(USDA 2012a). The average farm size is 918 acres, and the median size is 160 acres. Total cropland is 131,371 acres and total harvested cropland is 68,529 acres. Total irrigated farmland is just 1,338 acres. Irrigated farmland totals only 1,338 acres (USDA 2012b). About 78.8 percent of the land on farms or ranches is pastureland, 10.8 percent is cropland, 7.6 percent is woodland, and 1.8 percent is other uses (USDA 2012a).

The BIA currently administers 24 active agricultural leases and 309 grazing leases covering 71,632 acres. Small grains, mainly wheat, alfalfa, grain sorghums, and soybeans, are the principal crops in the planning area (BIA 2014). Corn and sorghums, cut for silage and used by local dairies, and orchard crops are grown on a minor acreage. A large acreage of native grasses and tame pastures is cut for hay, which is mostly used by local farmers and ranchers. The other crops are shipped to local and distant markets. Approximately 75 percent of the annual production on rangeland grows in April, May, and June, coinciding with spring rains and moderate temperatures. A secondary growth period generally occurs in September and October, coinciding with fall rains and cooling temperatures (NRCS 2012b).

The farmland classification of soils divided Osage County into prime and not prime farmland as set forth in **Table 3-21**. **Figure 3-12** in **Appendix E** demonstrates that prime farmland is found along the rivers and major creek systems in areas that correspond to a great extent with the 100-year floodplain.

Table 3-21
Farmlands

Classification	Acres
Prime farmland	382,400
Not prime farmland	1,092,000

Source: NRCS GIS 2015

Additionally, the potential in the planning area for non-irrigated crop production soil capability is shown on **Table 3-22** and **Figure 3-13** in **Appendix E**. Land capability classification is a system of grouping soils based primarily on their capability to produce common cultivated crops and pasture plants, without deteriorating over a long period. These are classified as follows:

- Class I soils have slight limitations that restrict their use.
- Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.
- Class III soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.
- Class IV soils have very severe limitations that reduce the choice of plants or that require careful management, or both.
- Class V soils are subject to little or no erosion but have other limitations, impractical to remove, that restrict their use mainly to pasture, rangeland, forestland, or wildlife habitat.
- Class VI soils have severe limitations that make them generally unsuitable for cultivation and that restrict their use mainly to pasture, rangeland, forestland, or wildlife habitat.
- Class VII soils have very severe limitations that make them unsuitable for cultivation and that restrict their use mainly to grazing, forestland, or wildlife habitat.
- Class VIII soils and miscellaneous areas have limitations that preclude commercial plant production and that restrict their use to recreation, wildlife habitat, watershed, or for aesthetic purposes (NRCS 2012b).

Table 3-22
Nonirrigated Crop Capability

Category	Acres
Class I	14,500
Class II	154,100
Class III	390,500
Class IV	327,800
Class V	89,300
Class VI	342,400
Class VII	111,300
Class VIII	44,600

Source: NRCS GIS 2015

3.9 CULTURAL RESOURCES

Cultural resources are locations of human activity, occupation, or use identifiable through field inventory, historical documentation, or oral evidence. Cultural resources include archaeological, historical, or architectural sites and structures, as well as natural features, plants, animals, and locations that have been identified as traditionally important or sacred to a culture, subculture, or community. The significance of these resources is derived from the role they play in a community's cultural identity, as defined by its beliefs, practices, history, and social institutions.

3.9.1 Regulatory Framework

National Environmental Policy Act

NEPA establishes a federal policy of preserving historic, cultural, and natural aspects of our national heritage. The CEQ regulations implementing NEPA require federal agencies to analyze the impacts of a proposed action on historic and cultural resources (40 CFR 1502.16[g]).

National Historic Preservation Act of 1966, as Amended

The principal federal law addressing cultural resources is Section 106 of the NHPA, as amended (54 USC 300101 et seq.) and its implementing regulations, Protection of Historic Properties (36 CFR 800).

Under the NHPA, the compliance procedure for cultural resources, known as the Section 106 process, outlines the steps for identifying and evaluating historic properties, assessing the impacts of federal actions on historic properties, and conducting consultation to avoid, reduce, or minimize adverse impacts.

Historic properties are cultural resources that meet specific eligibility criteria (36 CFR 60.4) for listing on the National Register of Historic Places. After a cultural resource has been determined eligible for listing, it is afforded procedural protections through the Section 106 process, whether or not it is formally nominated or listed. The Section 106 process does not require historic properties to be preserved but does ensure that the decisions of federal agencies concerning the treatment of these resources result from meaningful consideration of cultural and historic values and the options available to protect them.

The NHPA requires federal agencies to consult with Tribes that attach religious and cultural significance to historic properties that may be affected by undertakings, as defined in the Section 106 process. The NHPA also directs the Secretary of the Interior to establish a National Tribal Preservation Program. Administered by the National Park Service, the program is dedicated to working with Tribes, Alaska Natives, Native Hawaiians, and national organizations to preserve and protect resources and traditions that are of importance to Native Americans by strengthening their capabilities for operating sustainable preservation programs.

A 1992 amendment to the NHPA allows Tribes to assume some or all of the duties of the SHPO under Section 101(d)(2). The Osage Nation requested and received certification and a grant from the National Park Service to appoint a THPO, who has assumed most of the SHPO's duties on Tribal lands.

The Section 106 process is triggered when historic properties may be affected by a federally funded, licensed, or permitted action or by actions on federal land. The identification and evaluation of cultural resources for eligibility for listing on the National Register of Historic Places and the resolution of adverse impacts on historic properties is the responsibility of the lead federal agency, in consultation with the SHPO, THPO, interested Tribes, and other interested parties.

American Indian Religious Freedom Act of 1978, as amended

The American Indian Religious Freedom Act (Public Law 95-431; 92 Stat. 469; 42 USC 1996) says that the policy of the US is to protect and preserve the inherent right of freedom of American Indians to believe, express, and exercise their traditional religions. This includes their access to religious sites, use and possession of sacred objects, and freedom to worship through ceremonial and traditional rites. The act is a specific expression of First Amendment guarantees of religious freedom and has no implementing regulations.

Archaeological Resources Protection Act of 1979

The Archaeological Resources Protection Act of 1979 (ARPA; 16 USC 470aa-11) establishes requirements to protect archaeological resources and sites on public and Indian lands and to foster increased cooperation and exchange of information between governmental authorities, the professional archaeological community, and private individuals. ARPA established civil and criminal penalties for the destruction or alteration of cultural resources.

The DOI issued regulations under the ARPA (43 CFR 7), establishing definitions, standards, and procedures to be followed by all federal land managers in protecting archaeological resources on public lands and Indian lands of the US. Permits to excavate or remove human remains and cultural items protected by ARPA require consultation with the Tribe owning or having jurisdiction over the land. Specific regulations at 25 CFR 262, provide guidance to BIA officials on implementing ARPA as it pertains to this agency.

Native American Graves Protection and Repatriation Act of 1990, as amended

The Native American Graves Protection and Repatriation Act (Public Law 101-601; 104 Stat. 3048; 25 USC 3001 et seq.) confirms the rights of Tribes and Native Hawaiian organizations to claim ownership or take custody of human remains and of certain cultural items; examples are funerary and sacred objects and objects of cultural patrimony in the possession or control of federal agencies or museums. The act also determines the disposition of human remains and other cultural items found on federal or Tribal land since 1990. The Secretary of the Interior's implementing regulations are at 43 CFR 10.

Oklahoma State Burial Laws Title 21-1167, 21-1168.1–7 and Title 8-187.

The Oklahoma State Legislature passed a variety of measures protecting cemeteries and access to cemeteries and the display, discovery, use, and disposal of human remains. These measures also require certain institutions and museums to consult Tribal leaders and state entities on the disposition of human remains.

Executive Order 13007

Signed in 1996, EO 13007, directs federal land managing agencies to accommodate access to, and ceremonial use of, Indian sacred sites by Indian religious practitioners and to avoid adversely affecting the physical integrity of such sacred site

3.9.2 Current Conditions

Cultural Overview

This overview is drawn primarily from Jon D. May (2009), "Osage County," in the *Encyclopedia of Oklahoma History and Culture*.

The cultural resources of Osage County reflect a long history of use and occupation dating back possibly 8,000 years or more and continuing to the present day. Archaeologists have identified sites in the county that are roughly classified to the following periods: Paleo-Indian (before 6000 before Christ [BC]), Archaic (6000 BC to anno Domini [AD] 1), Woodland (AD 1 to 1000), and Plains Village (AD 1000 to 1500). According to Osage oral tradition and research, the ancestors of the Osage migrated from what is now the Ohio River Valley, beginning in AD 400.

From AD 500 to 1300, the ancestral Osage lived in what is now Illinois, Missouri, and Arkansas, with the culmination of settlements in the St. Louis area and at Cahokia during the Late Woodland, Emergent Mississippian, and Mississippian Periods. The Osage left Cahokia approximately AD 1300 and began their westward movement to the central and southwestern portions of Missouri. In 1673, this is where the French record the first historical notation of the Osage (Hunter et al. 2013; Tucker 1942).

The first recorded Euro-American exploration of the region was conducted by Lt. James B. Wilkinson in 1806. He was followed by Capt. John R. Bell of the Maj. Stephen H. Long Expedition in 1820, the Glenn-Fowler Expedition in 1821, and Capt. Nathan Boone in 1843. A branch of the Shawnee Trail, a north/south cattle and emigrant route to Texas, crossed southern and western Osage County during the mid-1800s.

As early as mid-AD 1300, the Osage built villages and had camps throughout southwestern Missouri and began traveling out to the plains for their annual hunts. Osage hunting trails were established that were also used for Osage war parties, mourning parties, and trading expeditions (Spaulding 1968; La Flesche 1930, 1939; McDermott 1940). Some of the mid-continent Osage trails spanned portions of Oklahoma and Kansas.

The Osage ceded their claim to the region in 1825 and were removed to a Kansas reservation in 1839. In 1835 the area was included in treaty land guaranteed to the Cherokee Nation. In 1870, under the Cherokee Reconstruction Treaty of 1866, the Osage began purchasing approximately 1,570,059 acres from the Cherokee Nation. Osage Agent Isaac T. Gibson established the Osage Agency at Deep Ford (present Pawhuska) on Bird Creek in 1872. The historic Osage reservation boundary was finalized in 1875 when the Kaw, or Kansa, acquired approximately 100,000 acres in the reservation's northwest corner. The Kaw lands were included in Kay County at statehood.

The historic Osage reservation was part of the Oklahoma Territory under the Organic Act of 1890 and was made a semiautonomous district by the Enabling Act of 1906. At statehood in 1907, the Osage lands were established as Osage County.

The Osage Allotment Act was approved in June 1906. Between 1906 and 1909 each enrolled member of the Osage Tribe received an average allotment of 659.51 acres; 5 town sites were withheld from allotment. Each Osage allottee received the surface rights to their allotments and could rent or, if deemed "competent," sell their lands. In some cases, this led to the formation of large ranches, as the surface land was generally considered not suitable for farming.

Pursuant to the 1906 act, the United States holds the Osage Mineral Estate, consisting of the entire subsurface mineral estate in Osage County, in trust for the benefit of the Osage Nation. The 1906 act requires that royalty income derived from the Osage Mineral Estate be distributed to Osage headright holders on a quarterly, pro rata basis. There are 2,229 headrights, 1 for each individual on the 1906 Osage Tribal membership roll; however, because headrights are subject to succession by inheritance or devise, a headright holder may own 1 of more full headrights or a fractional share of a headright. Today, headrights are owned by members of the Osage Nation, non-Osage Indians, and non-Indians (May 2009).

Cultural Resources

Prehistoric and historic archaeological sites make up most of the recorded cultural resources in the planning area. These sites are typically discovered by surveys that are conducted during the BIA's review of mineral permit applications. Approval of a permit application is a federal undertaking under the NHPA. Compliance with the NHPA in the approval of oil and gas development in Osage County has generally been done through implementing the Section 106 process at a site-specific (quarter section) level; however, there have been surveys conducted at a greater scale (covering multiple sections), providing lessees with information needed for future development planning.

Archaeological site types encountered in the planning area are prehistoric camps and villages, prehistoric lithic or stone tool scatters, prehistoric rock art and rock shelters, prehistoric and historic graves and cemeteries, abandoned farmsteads, structural remains of the earlier periods of oil and gas development, and refuse deposits. Old trail routes, roads, and waterways are frequently associated with archaeological sites.

According to data gathered from the Oklahoma SHPO, as of 2016 there were 838 prehistoric and historic archaeological sites recorded in Osage County. Of these, 495 are prehistoric, 273 are historic, and 69 are both prehistoric and historic. The most common prehistoric site type classification is open habitation without mounds (435 sites), followed by rock shelters (30 sites) and prehistoric quarries/workshops (10 sites). The most common historic site type includes structural remains of historic farmsteads, homesteads, and cabins (146 sites), followed by trash dumps (38 sites) and the location of mills or other commercial or industrial activities (32 sites; SRI 2016). However, much of the county has not been surveyed, and it is likely that additional archeological sites exist.

Almost all of the multicomponent sites are prehistoric open habitation sites associated with farmsteads, homesteads, and cabins or trash dumps (SRI 2016). Most of these have not been evaluated for National Register of Historic Places eligibility. In practice, archaeological sites can almost always be avoided, and further fieldwork to formally evaluate them for National Register of Historic Places eligibility is not conducted. Thus, the potential for adverse effects on historic properties is reduced.

Cultural resources in the county also include historic districts, buildings, bridges, farmsteads, monuments, other standing structures, and groups of buildings. As of April 2017, there were 23 cultural resources formally listed on the National Register of Historic Places; all represent the historic-era built environment. Each of these listed historic-era resources are also included among 31 properties that are designated as Oklahoma State Landmarks.

The Osage Nation THPO, Oklahoma SHPO, and Oklahoma Archeological Survey are notified of each project or permit application where there may be ground-disturbing activities, such as for a road or drilling permit. These agencies carry out programs established under the NHPA to consider the impacts of undertakings on properties listed on, or eligible for listing on, the National Register of Historic Places. They also can assist in determining the potential presence of areas or locations important to contemporary Tribal communities that may be disturbed by permitted activities. These can include ancestral archaeological sites, sacred sites, sensitive sites, or traditional plant gathering or other locations that are included in the category of Traditional Cultural Properties under the NHPA.

The Osage Nation Traditional Cultural Advisors Committee serves as the advisory review board for the Osage Nation Historic Preservation Office. The committee is composed of Osage community members respected for their knowledge, understanding, and appreciation of Osage culture and heritage.

3.10 Socioeconomics and Environmental Justice

The geographic area of analysis for the purpose of evaluating the potential socioeconomic impacts of oil and gas development is Osage County, Oklahoma. This section characterizes the socioeconomic conditions of the population, economy, housing resources, and community services. Socioeconomic conditions of the Osage Nation are described in **Section 3.18**, Trust Assets and Osage Nation Interests.

3.10.1 Regulatory Framework

The EO 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, directs each federal agency to "make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations," which includes Tribal populations.

The presidential memorandum accompanying EO 12898 emphasizes the importance of using the NEPA review processes to promote environmental justice. It directs federal agencies to analyze the environmental effects, including human health, economic, and social effects, of their proposed actions on minority and low-income communities when required by NEPA.

3.10.2 Current Conditions

Population

The population change in Osage County increased from 2000 to 2015, but at a slower rate than that of the state of Oklahoma or the United States as a whole (see **Table 3-23**). Osage County is forecast to have a population increase slightly above that of the state average until 2075 (see **Table 3-24**).

Table 3-23
Population

Population	Osage County	Oklahoma	United States
Population 2015	47,054	3,849,733	316,515,021
Population 2000	44,437	3,450,654	281,421,906
Population change 2000–2015	3,617	399,079	35,093,115
Percent population change 2000–2015	8.1	11.6	12.5

Source: US Census Bureau American Community Survey (ACS) 2015 and 2000 decennial census, as reported in Headwaters Economics 2017
Note: 2015 ACS data in this table are calculated by using annual surveys conducted from 2011–2015 and are representative of average characteristics during this period.

Table 3-24
Population Projections

Population	Osage County	Oklahoma
Population 2020	51,745	4,024,202
Population 2030	55,413	4,302,501
Percent change 2020–2030	7.1	6.9
Population 2040	59,080	4,581,319
Population 2050	62,747	4,860,554
Percent change 2040–2050	6.2	6.1

Source: OK Department of Commerce 2012

Housing

The availability of housing is 1 indicator of the ability of a community to handle changes in population associated with development. In the planning area, the occupancy rate (85.7 percent) was slightly below the state average (86.1 percent) and the national average (87.7 percent). The type of vacant housing by category was also similar to that for the state (**Table 3-25**).

Table 3-25
Housing Occupancy, 2015

	Osage County	Oklahoma	United States
Total housing units	21,381	1,689,427	133,351,840
Occupied	18,271	1,455,321	116,926,305
	85.7%	86.1%	87.7%
Vacant	3,110	234,106	16,425,535
	14.5%	14.5%	12.3%
For rent	265	44,105	2,949,366
	1.2%	2.6%	2.2%
Rented, not occupied	36	8,893	616,375
	0.2%	0.5%	0.5%
For sale only	259	21,837	1,492,691
	1.2%	1.3%	1.1%
Sold, not occupied	38	9,463	628,160
	0.2%	0.6%	0.5%
For seasonal, recreational, occasional use	553	38,538	5,329,103
	2.6%	2.3%	4.0%
For migrant workers	6	709	35,502
	0.0%	0.0%	0.0%
Other vacant	1,953	101,561	5,374,338
	9.1%	6.5%	4.0%

Source: US Census Bureau ACS 2015 data, as reported in Headwaters Economics 2017
Note: The data in this table are calculated by ACS, using annual surveys conducted from 2011 and 2015, and represent average characteristics during this period.

The cost of housing can reflect 1 component of affordability in a community. In Osage County, the cost of housing is below that of the state and national average, with a median monthly mortgage of $1,100 and a median gross rent of $628 (**Table 3-26**). The Osage Nation Housing Department can assist the Osage with down payment assistance, homeownership assistance, senior housing, home rehabilitation, and housing assistance (Osage Nation 2017b).

The Osage Nation Constitution Article XIV reserves Grayhorse Indian Village, Pawhuska Indian Village, and Hominy Indian Village exclusively for the use of Tribal members.

Jobs and Employment

Unemployment in Osage County generally followed national trends, peaking in 2010. The Osage Nation has created a program to provide career development and vocational training to the Osage (Osage Nation 2017c). Unemployment levels have remained below the national average, although they have been consistently higher than the state average. Unemployment between 2008 and 2018 is shown in **Table 3-27**, below.

Table 3-26
Housing Costs as a Percentage of Household Income, 2015

	Osage County	Oklahoma	United States
Owner-occupied housing units with a mortgage	7,180	550,249	48,414,291
Monthly cost less than 15% of household income	2,074	149,648	10,168,990
	28.9%	27.2%	21.0%
Monthly cost more than 30% of household income	1,985	139,993	15,648,374
	27.6%	25.4%	32.3%
Specified renter-occupied units	4,068	493,937	42,214,214
Gross rent less than 15% of household income	587	70,326	4,667,482
	14.4%	14.2%	11.1%
Gross rent more than 30% of household income	1,336	202,825	20,210,842
	32.8%	41.1%	47.9%
Median monthly mortgage cost	$1,100	$1,147	$1,492
Median gross rent	$628	$727	$928

Source: US Census Bureau ACS 2015 data, as reported in Headwaters Economics 2017
Note: The data in this table are calculated by ACS, using annual surveys conducted from 2011 to 2015, and represent average characteristics during this period.

Table 3-27
Average Annual Unemployment

	Osage County	Oklahoma	United States
2018	4.3%	3.4%	3.9%
2017	5.1%	4.2%	4.4%
2016	5.8%	4.8%	4.9%
2015	5.3%	4.4%	5.3%
2014	5.1%	4.5%	6.2%
2013	5.8%	5.3%	7.4%
2012	5.8%	5.2%	8.1%
2011	6.8%	5.9%	8.9%
2010	7.8%	6.8%	9.6%
2009	7.5%	6.4%	9.3%
2008	4.2%	3.7%	5.8%

Source: Bureau of Labor Statistics 2020
Note: Not seasonally adjusted

When industry employment is examined, key sectors of the economy can be identified (see **Table 3-28**, below). Based on 2018 data, top economic sectors as a percentage of employment were government, mining, agriculture, construction, and retail trade. Between 2001 and 2018, the 4 industry sectors that added the most jobs were mining (including oil and gas; 499 additional jobs), government (4,489 additional jobs), construction (343 additional jobs), and retail trade (323 additional jobs) (BEA 2018, as reported in Headwaters Economics 2020).

Mining (including oil and gas) has represented an important industry in the county since the 1920s. **Figure 3-14** in **Appendix E** shows trends in mining employment over the past 20 years. Mining employment trends have had large variations based on changes in oil and gas market value and changes in drilling technologies. Market volatility with a general increase in employment occurred from 1998 to 2013. A downward trend was generally observed between 2013 and 2016 in Osage County and all geographic areas examined, likely due to market conditions (US Census Bureau, as reported in Headwaters Economics 2020). Other factors, including changes to the USFWS ABB guidance for Osage County, may

Table 3-28
Employment by Industry, 2001–2018

	Osage County 2001	Oklahoma 2001	Osage County 2018	Oklahoma 2018
Total employment (number of jobs)	10,830	2,009,163	14,013	2,330,982
Non-services related	~3,406	455,060	~4,099	496,532
	31.4%	22.6%	29.3%	21.3%
Farm	1,687	101,266	1,255	76,092
	15.6%	5.0%	9.0%	3.3%
Forestry, fishing, and related activities	N/A	7,659	N/A	10,148
	N/A	0.4%	N/A	0.4%
Mining (including fossil fuels)	776	58,320	1,275	126,436
	7.2%	2.9%	9.1%	5.4%
Construction	662	111,725	1,005	133,966
	6.1%	5.6%	7.2%	5.7%
Manufacturing	281	176,090	564	149,890
	2.6%	8.8%	4.0%	6.4%
Services related	~4,817	1,219,339	~6,902	1,465,822
	44.5%	60.7%	49.3%	62.9%
Utilities	20	11,269	20	11,082
	0.2%	0.6%	0.1%	0.5%
Wholesale trade	117	61,063	219	63,152
	1.1%	3.0%	1.6%	2.7%
Retail trade	1,042	222,299	1,365	228,279
	9.6%	11.1%	9.7%	9.8%
Transportation and warehousing	138	61,427	375	81,197
	1.3%	3.1%	2.7%	3.5%
Information	52	40,933	52	25,997
	0.5%	2.0%	0.4%	1.1%
Finance and insurance	281	76,791	535	103,675
	2.6%	3.8%	3.8%	4.4%
Real estate and rental and leasing	182	56,083	451	89,837
	1.7%	2.8%	3.2%	3.9%
Professional and technical services	~219	90,004	488	115,597
	2.0%	4.5%	3.5%	5.0%
Management of companies and enterprises	19	13,255	~59	22,934
	0.2%	0.7%	0.4%	1.0%
Administrative and waste services	312	123,664	~528	138,636
	2.9%	6.2%	3.8%	5.9%
Educational services	128	22,413	83	31,027
	1.2%	1.1%	0.6%	1.3%
Health care and social assistance	709	173,642	767	220,495
	6.5%	8.6%	5.5%	9.5%

Table 3-28
Employment by Industry, 2001–2018 (cont.)

	Osage County 2001	Oklahoma 2001	Osage County 2015	Oklahoma 2015
Arts, entertainment, and recreation	~215	24,466	312	36,144
	2.0%	1.2%	2.2%	1.6%
Accommodation and food services	421	123,294	631	169,253
	3.9%	6.1%	4.5%	7.3%
Other services, except public administration	962	118,736	1,085	128,517
	8.9%	5.9%	7.6%	5.5%
Government	2,455	334,764	2,944	368,628
	22.7%	16.7%	21.0%	15.8%

Source: BEA 2018, as reported in Headwaters Economics 2020
Note: Estimates for non-disclosed data indicated with tildes (~)

also have affected trends locally. Since 2017, stabilization of the market has occurred; however, these data do not reflect the downturn in prices in 2020.

Mining (including oil and gas) has represented an important industry in the county since the 1920s. **Figure 3-14** in **Appendix E** shows trends in mining employment over the past 20 years. Mining employment trends have had large variations based on changes in oil and gas market value and changes in drilling technologies. Market volatility with a general increase in employment occurred from 1998 to 2013. A downward trend was generally observed between 2013 and 2016 in Osage County and all geographic areas examined, likely due to market conditions (US Census Bureau, as reported in Headwaters Economics 2020). Other factors, including changes to the USFWS ABB guidance for Osage County, may also have affected trends locally. Since 2017, stabilization of the market has occurred; however, these data do not reflect the downturn in prices in 2020.

Total personal income by industry provides additional information on key economic sectors. In 2018, the 4 industry sectors with the largest personal income in Osage County were government ($156,356,000), construction ($45,516,000), manufacturing ($36,501,000), and retail trade ($26,365,000). From 2001 to 2018, the 4 industry sectors that added the most new personal income (in real terms) were manufacturing, construction, farming, and government; see **Table 3-29**.

Table 3-29
Personal Income by Industry, 2001–2018 (Thousands of 2018 Dollars)

	Osage County 2001	Oklahoma 2001	Osage County 2018	Oklahoma 2018
Labor earnings	$318,945	$89,190,296	$457,419	$126,529,984
Non-services related	$80,612	$21,037,919	$123,552	$30,897,443
	25.3%	23.6%	27.0%	24.4%
Farm	$605	$1,156,026	$19,316	$672,097
	0.2%	1.3%	4.2%	0.5%
Forestry, fishing, and related activities	N/A	$156,357	N/A	$272,512
	N/A	0.2%	N/A	0.2%
Mining (including fossil fuels)	$43,011	$3,153,887	$21,219	$10,624,746
	13.5%	3.5%	4.6%	8.4%
Construction	$23,936	$5,443,135	$46,516	$7,611,879
	7.5%	6.1%	10.2%	6.0%

Table 3-29
Personal Income by Industry, 2001–2018 (Thousands of 2018 Dollars) (cont.)

	Osage County 2001	Oklahoma 2001	Osage County 2018	Oklahoma 2018
Manufacturing	$13,060	$11,128,513	$36,501	$11,716,209
	4.1%	12.5%	8.0%	9.3%
Services related	$125,307	$49,942,606	$179,250	$72,026,322
	39.3%	56.0%	39.2%	56.9%
Utilities	$1,343	$1,277,618	$1,218	$1,501,628
	0.4%	1.4%	0.3%	1.2%
Wholesale trade	$6,781	$4,090,472	$11,319	$4,670,685
	2.1%	4.6%	2.5%	3.7%
Retail trade	$21,090	$6,701,988	$26,365	$7,106,783
	6.6%	7.5%	5.8%	5.6%
Transportation and warehousing	$5,432	$3,816,631	$19,236	$12,333,121
	1.7%	4.3%	4.2%	9.7%
Information	$3,132	$2,452,537	$1,282	$2,068,913
	1.0%	2.7%	0.3%	1.6%
Finance and insurance	$12,139	$3,799,395	$13,985	$5,101,662
	3.8%	4.3%	3.1%	4.0%
Real estate and rental and leasing	$2,567	$1,511,177	$7,111	$1,897,842
	0.8%	1.7%	1.6%	1.5%
Professional and technical services	$5,095	$4,822,146	$14,988	$7,043,999
	1.6%	5.4%	3.3%	5.6%
Management of companies and enterprises	$20	$1,300,791	$1,256	$1,980,734
	0.0%	1.5%	0.3%	1.6%
Administrative and waste services	$6,849	$3,687,234	$12,812	$5,167,274
	2.1%	4.1%	2.8%	4.1%
Educational services	$3,799	$667,348	$690	$977,479
	1.2%	0.7%	0.2%	0.8%
Health care and social assistance	$18,494	$8,413,492	$21,321	$12,954,033
	5.8%	9.4%	4.7%	10.2%
Arts, entertainment, and recreation	$5,744	$424,942	$5,880	$793,076
	1.8%	0.5%	1.3%	0.6%
Accommodation and food services	$4,776	$3,210,326	$9,825	$3,995,681
	1.5%	3.6%	2.1%	3.2%
Other services, except public administration	$28,047	$3,766,510	$31,962	$4,433,412
	8.8%	4.2%	7.0%	3.5%
Government	$108,473	$18,209,771	$156,356	$23,606,219
	34.0%	20.4%	34.2%	18.7%

Source: BEA Table CA05N, as reported in Headwaters Economics 2020
*All employment data are reported by place of work.

When average annual wages are examined, total average wages for all sectors for Osage County are lower than those of Oklahoma and the US (**Table 3-30**). Average annual wages for mining and mining support activities are higher than the average wages for all sectors for all geographic areas examined. Jobs are typically reported by location of employment. When employees commute into or out of a county for employment, they may spend their earnings in other locations. In Osage County, a significant portion of the workforce travels outside the county for work (66.6 percent, as opposed to the 25.6 percent state average in 2018). As a result, employment statistics for Osage County may not accurately reflect the employment of residents in the county (Headwaters Economics 2020).

Table 3-30
Average Annual Wages, 2018 (2018 Dollars)

Sector	Osage County	Oklahoma	United States
All sectors	$37,531	$46,727	$57,226
Private	$35,652	$46,774	$57,198
All Mining	$49,628	$101,805	$104,257
Oil and gas extraction	N/A	$147,777	$170,109
Mining (except oil and gas)	N/A	$59,348	$78,919
Support activities for mining	$42,645	$79,500	$90,905
Non-mining	$33,968	$44,407	$56,942
Government	$40,158	$46,539	$57,658

Source: Bureau of Labor Statistics 2018 data, as reported in Headwaters Economics 2020

Income

A summary of income statistics in the planning area is provided in **Table 3-31**. In the planning area, average earnings per job, income per capita, and median household income were lower than the state and national averages.

Income is composed of 2 major sources: income from employment compensation and income from dividends, interest, and rent (DIR) and transfer payments. DIR includes personal dividend and interest income, rental income of persons with capital consumption adjustment, and income related to the rental of real property and royalties from natural resource leases. These income sources are sometimes referred to as investment income or property income. In the planning area, non-labor income overall represents a slightly larger share of total income, as compared to Oklahoma and US averages (see **Table 3-32**).

Table 3-31
Income and Employment (2018 Dollars)

	Osage County	Oklahoma	United States
Average earnings per job, 2018[1]	$32,642	$54,282	$62,321
Per capita income, 2018[1]	$33,971	$46,233	$54,446
Median Household income 2018[2]	$51,424	$47,789	$60,293

Sources: [1] BEA Tables CA05N and CA30, as reported in Headwaters Economics 2020; [2] US Census Bureau as reported in Headwaters Economics 2020

Table 3-32
Non-Labor Share of Total Personal Income, 2018 (in Thousands of 2018 Dollars)

	Osage County	Oklahoma	United States
Total personal income (in thousands)	1,644,140	182,301,870	17,813,035,000
Non-labor income	665,920	68,906,973	6,653,585,000
	40.5%	37.8%	37.4%
Dividends, Interest, and Rent	265,290	34,443,278	3,682,134,000
	16.1%	18.9%	20.7%
Transfer payments	400,630	34,463,695	2,971,451,000
	24.4%	18.9%	16.7%
Labor earnings	978,220	113,394,897	11,159,450,000
	59.5%	62.2%	62.6%

Source: BEA Table CA05N, as reported in Headwaters Economics 2020
Note: Non-labor income and labor earnings may not add to total personal income. This is because of adjustments made by the Bureau of Economic Analysis to account for contributions for Social Security, cross-county commuting, and other factors.

Local Finance

General Budget

Osage County revenue and expenses are displayed in **Table 3-33**. Revenue in the county is primarily from ad valorem taxes (including property taxes) and various fees. Total valuation of property for 2015/2016 was $345,274,661, including $229,816,229 in real property (*i.e.*, land and buildings) and $46,874,605 in personal property. The county tax rate is set at 14.70 mills (or .0147 percent of assessed value) (Osage County 2015). Additional taxes are imposed at the city and school district level, so exact tax rates vary by municipality. County expenditures were chiefly in the areas of roads and bridges, public safety, and administration.

Osage Nation finances and revenues collected from mineral and energy development are discussed in **Section 3.18**, Trust Assets and Osage Nation Interests.

The production of other natural resources in the planning area is also a source of revenue. Coal bed methane, limestone, sand and gravel, and clay and shale are commonly extracted in Osage County. According to the Oklahoma Department of Mines (ODM) annual report for 2015, Osage County produced 47,420,355 tons of limestone (ODM 2015).

Table 3-33
Osage County Finances—General Budget

	2015/2016
Liabilities, reserves, and cash fund balance	$4,233,018
Total revenue	$8,042,030
Cash balance	$3,501,446
Prior year's cash balance	$136,337
Current ad valorem tax	$3,072,969
Miscellaneous revenue	$1,331,278
Requirements	$4,009,384
Additions	$4,032,666
Deductions	-$20
Expenditures (2014/2015)	$7,621,774

Source: Osage County 2015

Community Services

Less than 10 percent of Osage County contains urban development, and there is limited infrastructure development. Communities are served by multiple municipal services: police, fire, water, power, and other utilities.

Utilities

Utilities are provided by wastewater collection and treatment facilities in Pawhuska and the portion of Tulsa that is in Osage County. Municipal water services are provided in the incorporated areas of Avant, Shidler, McCord, Fairfax, Wynona, and Barnsdall. In most rural areas, residents receive services from various water districts.

Education

Osage County contains 25 schools for pre-kindergarten through 12th grade education, within 11 school districts and with a total enrollment of 3,845 in 2014 (**Table 3-34**). The student-to-teacher ratio can be 1 indication of the ability of a school to accommodate additional students, as may be required if the population grows. Total student-to-teacher ratios vary throughout the county, with most lower than the state and US average of 16.12 and 16.01 (State of Oklahoma 2015).

Table 3-34
Osage County Public Education

District	Enrollment	Student-to-Teacher Ratio (2012/2013)	Total Spending per Student (2010/2011)
Osage Hills	182	16.73	$7,878
Bowring	75	11.13	$13,677
Avant	80	14.00	$10,000
Anderson	271	14.54	$7,024
McCord	263	14.78	$6,359
Pawhuska	831	14.09	$8,815
Shidler	236	13.54	$9,945
Barnsdall	435	16.63	$8,215
Wynona	124	10.19	$6,450
Hominy	582	14.27	$10,272
Prue	328	13.90	$8,110
Woodland	438	14.73	$11,385

Source: State of Oklahoma 2015

Overall, the US spent an average of $11,665 per student. There is some indication that increased spending per student may correlate with education ranking (Annie E. Casey Foundation 2014). In Osage County, spending varies, with most districts below the US average.

Health Services

The availability of health services, particularly emergency services, can be an indicator of the ability of a community to accommodate change in population and can influence worker safety during development. Major medical facilities in the planning area are Fairfax Community Hospital and Pawhuska Hospital. Fairfax Community Hospital provides emergency, laboratory, and inpatient care and has 15 beds (Fairfax Community Hospital 2017). Pawhuska Hospital is a general hospital and has 27 beds and a total of 4,659 patient visits to the emergency room based on 2014 surveys (US News and World Report 2014). Additional services in the region are available in Cleveland, Sand Springs, Ponca City, Bartlesville, Owasso, and Tulsa.

Public Safety

The Osage County Sheriff's Office consists of 34 sworn and 27 civilian law enforcement professionals (Osage Sheriff 2015). Additional law enforcement officers are found in cities in the county. See **Section 3.11**, Public Health and Safety, for information on fire safety operations.

Community Values and Social Setting

The project area is generally rural, with small farming communities and rural residences scattered throughout. The borders of Osage County are contiguous with the former Osage Indian Reservation.

Environmental Justice

Environmental justice refers to the fair treatment and meaningful involvement of all people, regardless of race, color, national origin, or income, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Fair treatment means that no group of people, including racial, ethnic, or socioeconomic groups, should bear a disproportionate share of the negative environmental consequences of industrial, municipal, and commercial operations or the execution of federal, state, local, and Tribal programs and policies.

The CEQ 1997 guidance states that "In order to determine whether a proposed action is likely to have disproportionately high and adverse human health or environmental effects on low-income populations, minority populations, or Indian Tribes, agencies should identify a geographic scale, obtain demographic information on the potential impact area, and determine if there is a disproportionately high and adverse effect on these populations. Agencies may use demographic data available from the US Census Bureau to identify the composition of the potentially affected population. Geographic distribution by race, ethnicity, and income, as well as a delineation of Tribal lands and resources, should be examined" (CEQ 1997).

Specific guidance on environmental justice terminology is as follows:

- Low-income population—This is determined based on annual statistical poverty thresholds developed by the US Census Bureau. In 2015, the poverty level was based on total income of $12,082 for an individual and $24,036 for a family of 4 (US Census Bureau 2015). A low-income community may include either a group of individuals living in geographic proximity to one another or dispersed individuals, such as migrant workers or Tribal populations.
- Minority—A member of the following population groups: American Indian, Alaska Native, Asian, Pacific Islander, Black, or Hispanic.
- Minority population area—An area is so defined if either the aggregate population of all minority groups combined exceeds 50 percent of the total population, or if the percentage of the population in the area comprising all minority groups is meaningfully greater than the minority population percentage in the broader region. As with a low-income population, a minority population may include either individuals living in geographic proximity to one another or those who are dispersed.
- Comparison population—For the purpose of identifying a minority population or a low-income population concentration, state populations are compared to the US population; for counties, populations are compared to the respective state population average.

Approximately 35.7 percent of the population in Osage County identified themselves as minority, belonging to 1 or more racial or ethnic minority group (*i.e.*, a group other than white of non-Hispanic origin). American Indians represent the largest minority group in the planning area; those identifying as American Indian alone represented 15.1 percent of the population, as compared to 7 percent in Oklahoma and less than 1 percent for the US population as a whole (US Census Bureau ACS 2011–2015 data, as reported in Headwaters Economics 2017). Note that this figure does not include those who are American Indian and some other race who listed themselves as being of 2 or more races; therefore, the actual percentage of American Indians may be higher.

The largest Tribal groups by population in the planning area were Cherokee (2,362) and Osage (1,960; US Census Bureau ACS 2011–2015, data as reported in Headwaters Economics 2017). See **Table 3-35** for a detailed breakdown of racial and ethnic minorities in the planning area. Note that those identifying as Hispanic/Latino origin may also identify as 1 or more racial minority.

Based on the county-level data for the American Indian population, the planning area is likely to contain minority populations at a "meaningfully greater" level than the comparison population per CEQ guidelines (CEQ 1997). (This would require analysis for environmental justice impacts for site-specific planning actions.)

Based on US Census Bureau 2015 poverty data, the number of individuals and families below the poverty line in Osage County is less than the state average and does not represent a population for further consideration for environmental justice analysis per CEQ standards (see **Table 3-36**). When broken out by ethnic and racial group, people of white and non-Hispanic origin had substantially lower rates of poverty than people of racial and ethnic minorities (see **Table 3-37**).

Table 3-35
Population by Race and Ethnicity, 2015

	Osage County	Oklahoma	United States
Total population	48,054	3,849,733	316,515,021
Hispanic/Latino origin (of any race)	1,534	371,459	54,232,205
	3.2%	9.6%	17.1%
Non-Hispanic/Latino (of any race)	46,520	3,478,274	262,282,816
	96.8 %	90.4%	82.9%
White alone	31,631	2,813,794	232,943,055
	65.8%	73.1%	73.6%
Black or African American alone	5,476	278,571	39,908,095
	11.4%	7.2%	12.6%
American Indian alone	7,263	279,276	2,569,170
	15.1%	7.3%	0.8%
Asian alone	119	74,570	16,235,305
	0.2%	1.9%	5.1%
Native Hawaiian and Other Pacific Islanders alone	51	4,701	546,255
	0.1%	0.1%	0.2%
Some other race alone	347	98,885	14,865,258
	0.7%	2.6%	4.7%
Two or more races	3,4167	299,936	9,447,883
	6.6%	7.8%	3.08%
Aggregate minority population	17,158	1,258,444	119,256,743
	35.7%	32.7%	37.7%

Source: US Census Bureau ACS 2011–2015 data, as reported in Headwaters Economics 2017
Notes: The data in this table are calculated by ACS using annual surveys conducted from 2009 to 2015 and are representative of average characteristics during this period.
Aggregate minority population includes any individuals who identified themselves as belonging to 1 or more ethnic or racial minority. This population is calculated by total population, minus those of white, non-Hispanic origin.

Table 3-36
Poverty, 2015

	Osage County	Oklahoma	United States
People	46,507	3,734,458	308,619,550
Families	12,576	966,009	77,260,546
People below poverty	7,365	624,043	47,749,043
	15.8%	16.7%	15.5%
Families below poverty	1,395	121,122	8,761,164
	11.1%	12.4%	11.3%

Source: US Census Bureau ACS 2011–2015 data, as reported in Headwaters Economics 2017
Note: The data in this table are calculated by ACS using annual surveys conducted from 2011 to 2015 and are representative of average characteristics during this period.

Table 3-37
Poverty by Race and Ethnicity, 2015

	Osage County	Oklahoma	United States
Hispanic or Latino (of any race)	26.8%	26.9%	24.3%
Not Hispanic or Latino (of any race)	13.3%	12.9%	10.8%
White alone	13.7%	14.0%	12.7%
Black or African American alone	22.2%	30.1%	27.0%
American Indian alone	19.6%	22.8%	28.3%
Asian alone	0.0%	15.3%	12.6%
Native Hawaiian and Pacific Islander alone	0.0%	23.3%	21.0%
Some other race alone	23.0%	25.5%	26.5%
Two or more races	18.8%	22.6%	19.9%

Source: US Census Bureau 2015 ACS data, as reported in Headwaters Economics 2017
Note: The data in this table are calculated by ACS using annual surveys conducted from 2011 to 2015 and are representative of average characteristics during this period. Poverty prevalence is calculated by dividing the number of people by race/ethnicity in poverty by the total population of that race/ethnicity.

Minority status and income level were also examined by census tracts. Based on CEQ criteria, 2 census tracts qualified as minority populations (see **Table 3-38**). Census tract 9400.02, which includes Pawhuska and Pawhuska Indian Village, has a large Native American population, while tract 9400.06, in the extreme southeastern portion of the county near Tulsa, is predominantly African American. No census tracts were identified with low-income populations, based on CEQ guidelines.

The EPA's environmental justice guidance (EPA 2015e) recommends additional measures for consideration beyond CEQ guidance.

Table 3-38
Census Tract Minority Status and Poverty Summary

Census Tract	Aggregate Minority Population (%)	Individuals in Poverty (%)
9400.01	38.5	18.5
9400.02	**45.0**	18.1
9400.03	24.8	19.6
9400.04	32.8	8.0
9400.05	26.1	12.9
9400.06	**86.1**	21.9
9400.07	23.6	11.9
9400.08	26.0	18.2
9400.09	24.4	9.6
9400.10	20.9	15.4
9400.11	23.6	13
Osage County	35.7	15.8
Oklahoma	32.7	15.8

Source: US Census Bureau 2015
Notes: The data in this table are calculated by ACS using annual surveys conducted from 2011 to 2015 and are representative of average characteristics during this period.
Aggregate minority population includes any individuals who identified themselves as belonging to 1 or more ethnic or racial minority. This population is calculated by total population minus those of white, non-Hispanic origin. Bold text indicates census tracts qualifying as minority populations.

Education level may be important for identifying, characterizing, and developing strategies for engaging populations. Education level in Osage County was compared to the state level. The percentage of those with a high school degree in Osage County is higher than that of the state level (87.6 percent versus 86.4 percent). In contrast, the percentage of Osage County residents with a bachelor's degree was lower than the state average (16.1 percent versus 23.5 percent). While still within 10 percentage points of the state average, this differential may affect the jobs available to Osage County residents and the level at which job creation presents opportunities (Headwaters Economics 2017).

Population age was also examined, as some impacts may affect those over 65 or under 5 differently. Osage County contained a slightly higher level of those over 65 than the state average (18.5 percent versus 14.5 percent) and a lower level of those under 5 (5.2 percent versus 6.8 percent).

Additional measures may also provide more information on the poverty status of area populations, including median household income and the percentage of individuals below twice the poverty level. Median household income in 2015 was also similar for Osage County ($45,443) and Oklahoma ($46,879). The percentage of those approximately twice the poverty level was also the same for both Osage County and Oklahoma, at 21 percent of families below $50,000 (Headwaters Economics 2017). This data further supports the conclusion that Osage County does not represent a low-income population.

As noted in CEQ guidance, some population groups may have differential patterns of consumption of natural resources, which relates to subsistence and differential patterns of subsistence. This refers to differences in rates or patterns of fish, water, vegetation, and wildlife consumption among minority populations, low-income populations, or Tribes, as compared with the general population. Where such differential patterns exist, there may be different degrees of impacts. For example, the collection of native plants for Tribal practices may represent a differential pattern of consumption of natural resources that may be affected by proposed activities. See **Section 3.18**, Trust Assets and Osage Nation Interests, for a detailed discussion of Indian trust assets.

3.11 Public Health and Safety

This section is an overview of the laws, regulations, and policies that influence the management of public safety, hazards, and potentially hazardous conditions in the planning area.

3.11.1 Regulatory Framework

25 CFR 226

The regulations governing leasing of the Osage Mineral Estate for oil and gas exploration and development are set forth in 25 CFR 226. These regulations include provisions that impose measures designed to limit risks to public health and safety during the conduct of operations. For example, the regulations prohibit lessees from committing waste or avoidable nuisance, and they require the implementation of pollution prevention measures to avoid the migration of deleterious substances into freshwater-bearing formations and the use of control devices to prevent blowouts.

Occupational Safety and Health Act

The Occupational Health and Safety Act of 1970 established the Occupational Health and Safety Administration to ensure the health and safety of workers by setting and enforcing standards; providing training, outreach, and education; establishing partnerships; and encouraging continual improvement in workplace safety and health (29 CFR 1910).

Comprehensive Environmental Response, Compensation, and Liability Act

The Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) created a tax on the chemical and petroleum industries and provided broad federal authority to respond directly to releases or threatened releases of hazardous substances that may endanger public health or the environment. CERCLA established prohibitions and requirements concerning closed and abandoned hazardous waste sites, provided for liability of persons responsible for releasing hazardous waste at these sites, and established a trust fund to provide for cleanup when no responsible party can be identified (EPA 2015f). Under CERCLA, petroleum and crude oil are not considered hazardous substances.

Resource Conservation and Recovery Act

The Resource Conservation and Recovery Act of 1976 (RCRA) charges the EPA with controlling the generation, transportation, treatment, storage, and disposal of hazardous waste (42 USC 6901 et seq.). The RCRA also promulgated a framework for managing nonhazardous solid wastes. The 1986 amendments to the RCRA enabled the EPA to address environmental problems that could result from underground tanks storing petroleum and other hazardous substances.

Toxic Substances Control Act

The Toxic Substances Control Act of 1976 and RCRA established a program administered by the EPA for regulating the generation, transportation, treatment, storage, and disposal of hazardous waste.

Clean Water Act

The CWA (33 USC 1251 et seq.) was enacted to restore and maintain the chemical, physical, and biological integrity of the Waters of the US. Oil pollution prevention regulations describe the requirements for facilities to prepare, amend, and implement SPCC plans. A facility is subject to SPCC regulations if the total aboveground oil storage capacity exceeds 1,320 gallons or the underground oil storage capacity exceeds 42,000 gallons, and if, due to its location, the facility could reasonably be expected to discharge oil into or on the Navigable Waters of the US.

BIA Regional 10-Year Fire Management Plan for the Eastern Oklahoma Regional Office

The 10-Year Fire Management Plan (FMP) defines the Eastern Oklahoma Regional Office's program for managing wildland and prescribed fire within its service area, based on approved land management goals and objectives. The FMP identifies the planned activities in the region during the relevant period, management practices for initial and extended attack, and prescribed fire and fuels management. The FMP provides for firefighter and public safety and includes fire management strategies, tactics, and alternatives (BIA 2009).

Pipeline and Hazardous Materials Safety Administration

The Pipeline and Hazardous Materials Safety Administration, a federal agency within the US Department of Transportation, is the primary federal regulatory agency responsible for ensuring the safety of America's energy pipelines, including crude oil pipeline systems. As a part of the responsibility, the Pipeline and Hazardous Materials Safety Administration established regulatory requirements for the construction, operation, maintenance, monitoring, inspection, and repair of hazardous liquid pipeline systems (PHMSA 2017).

3.11.2 Current Conditions

Osage County is dominated by farmland and grazed pastures, with residents living in rural or unincorporated communities. The Osage County Sheriff's Office and several local agencies provide law enforcement. In addition, the Osage Nation Police Department is charged with enforcing Tribal, state, and federal laws in Osage County. The chief of police is responsible for the day-to-day operations of the police department (Osage Nation 2012). Rural and municipal fire departments provide fire and emergency response.

The Occupational Safety and Health Administration defines hazardous substances under 29 CFR 1910.120(a)(3). Hazardous substances are primarily generated by industry, hospitals, research facilities, and the government. Improper management and disposal of hazardous substances can lead to pollution of groundwater or other drinking water supplies and the contamination of surface water and soil. The primary federal regulations for managing and disposing of hazardous substances are CERCLA and RCRA.

Public health concerns associated with oil and gas development in Osage County include air quality and exposure to potentially hazardous materials. With respect to air quality, the release of H_2S and emissions and dust from heavy truck traffic are of particular concern. H_2S is a gas commonly found during the drilling and production of crude oil and natural gas. Low-level concentrations of H_2S may produce an odor like that of rotten eggs. High-level concentrations of H_2S—those exceeding 500 ppm—are toxic (OSHA 2017). H_2S is known to occur in Osage County, and oil and gas lessees have encountered it at varying concentrations (Osage Nation 2017a).

Heavy truck traffic in the planning area increases vehicle emissions and has the potential to generate wind-borne dust due to travel on gravel and unpaved roads. At present, the EPA designates Osage County as an "attainment area," meaning the air quality meets or exceeds the NAAQS. The BIA refers all individual air quality complaints relating to oil and gas development to the EPA for investigation.

The primary concern regarding exposure to potentially hazardous materials is the risk of accidental spills, or improper disposal, of deleterious substances used or produced during oil and gas development operations in locations near public water supplies and domestic water wells. Accidental spills and releases of oil, brine, and chemicals associated with oil and gas development have occurred within Osage County (see **Section 3.3**, Water Resources, for more detailed information). In some cases, the EPA has initiated enforcement actions against individual oil and gas lessees for violations of the Safe Drinking Water Act of 1974. To date, however, the EPA has not found any spills or unauthorized releases associated with oil and gas development activities in the planning area to have caused contaminant concentrations in sources of drinking water that exceed Safe Drinking Water Act of 1974 standards.

3.12 Visual Resources

Visual resources refer to the features on a landscape, such as land, water, vegetation, animals, and structures. These features contribute to the scenic or visual quality and appeal of the landscape (BLM 1984).

3.12.1 Regulatory Framework

There are no federal or Tribal laws or programs regarding visual resources in the planning area. At the local level, the 2030 Osage County Comprehensive Plan (Osage County 2011) was developed to guide development in the county by establishing public land use goals and policies, including policies intended to preserve visual resources. This plan is a collaboration of the Osage County Board of Commissioners, the Osage County Industrial Authority, and the Pawhuska-Osage County Planning Commission.

Among the goals and policies that have been adopted for residential land use and recreation, trails, and open space areas, protecting scenic vistas is a stated policy and enhancing visual character is a stated goal. Preservation of public and private open spaces, low impact development, and green building techniques are methods called out for accomplishing this (Osage County 2011).

3.12.2 Current Conditions

The BIA does not have a visual resources management system, nor does it maintain a visual resources inventory; however, in 2016, as part of the OKT Joint EIS/BLM RMP/BIA Integrated RMP, the BLM Oklahoma Field Office, BIA Southern Plains and Eastern Oklahoma Regions completed a visual resource inventory (VRI) which included Osage County (DOI 2016).

The inventory used the process and guidelines established by BLM Manual Handbook H-8410-1 (BLM 1986). Based on the 3 inventory components, described below, lands in the planning area were placed into 1 of 4 VRI classes:

- A **scenic quality** evaluation rates the visual appeal of the inventory area, based on vegetation, landform, water, color, adjacent scenery, scarcity, and cultural modifications. Scenic quality is rated as A, B, or C.
- A **sensitivity level** analysis assesses public concern of the inventory area's scenic quality and the public's sensitivity to potential changes in the visual setting. The evaluation is based on types of users, level of use, public interest (local, regional, national, and international), adjacent land uses, and the presence of special areas. Sensitivity level is rated as high, moderate, or low.
- A delineation of **distance zones** indicates the relative visibility of the inventory area's landscape from primary travel routes or observation points in the foreground-middle ground zone (less than 3 to 5 miles away), background zone (to a distance of 15 miles away), and seldom seen zone (more than 15 miles away or hidden from view in any zone).

Table 3-39 describes the VRI component distribution of Osage County, according to the April 2016 inventory.

Table 3-39
Visual Resource Inventory Component Distribution

Visual Resource Inventory Component	Total Acreage in Decision Area	Total Percent of Decision Area
Scenic Quality		
A	1,474,500	100
B	0	0
C	0	0
Sensitivity		
High	658,500	44.7
Moderate	816,100	55.3
Low	0	0
Distance Zones		
Foreground/middle ground	17,400	1.2
Background	23,700	1.6
Seldom seen	1,433,400	97.2
VRI Class		
Class I	0	0
Class II	1,474,500	100
Class III	0	0
Class IV	0	0

Source: BLM GIS 2016

VRI Classes I and II are the most valued, Class III represents a moderate value, and Class IV represents the least value. VRI class does not establish management direction; instead, it is considered the baseline data for existing conditions. All lands in Osage County were found to be VRI Class II.

The visual conditions of the planning area can also be generally described by its physiographic province. This is a subdivision of physiographic regions that divide the continent based on similar landforms and landscapes. Osage County is in the Central Lowland Province, within the Osage Plains physiographic section (Oklahoma Atlas Institute 2015; Oklahoma Historical Society 2009). The average relief is between 300 and 500 feet elevation (Oklahoma Historical Society 2009) and typically does not change more than

300 feet across the county. Topography is generally flat, with some rolling hills, becoming more varied in the eastern portion of the county where there are more lakes and rivers.

Tallgrasses were the area's predominant vegetation until the late nineteenth century when Euro-American settlers began clearing land for crops and wood (Oklahoma Historical Society 2009). Today, these grasses can be observed in the Tallgrass Prairie Preserve in north-central Osage County. The grassy plains give most of the landscape a tan and light green appearance. Vegetation is darker green around lakes and rivers; more of this dark green vegetation is found in the eastern portion of the county, where there are more of these features.

Another significant visual resource in the planning area is the Osage Nation Heritage Trail Byway. This 70-mile-long byway bisects the entire county and provides unique views and vistas not found along other local roadways, such as historic landmarks and the Osage Hills, which are characterized by rolling hills and rolling tallgrass prairie (America's Scenic Byways 2015; Osage County 2011; Travel OK 2015). Lakes, rivers, and state parks are other visual resources in the planning area, offering scenic and recreational value. The most prominent human-made modifications to the visual landscape are the roads. Several major roadways bisect the county. Cities and towns in the county are characteristic of rural areas. Pump jacks and tank batteries are also frequently visible throughout the landscape.

Night skies are affected by unnatural light sources in the area, including glows from cities and towns. The most populated cities in the county produce the most light pollution: Tulsa, Bartlesville, and Sand Springs, all of which are partially in Osage County. Lighting from oil and gas-related construction also reduces nighttime darkness. Night skies would be most preserved in undeveloped areas, such as the Tallgrass Prairie Preserve and state parks. Viewers of the visual landscape are the residents, tourists, and through-travelers. The population of Osage County in 2015 was 47,054 (US Census Bureau 2015, as cited in Headwaters Economics 2017). More details on county demographics can be found in **Section 3.10**, Socioeconomics and Environmental Justice.

3.13 Noise

Noise is defined as unwanted sound and can be intermittent or continuous, steady or impulsive. Human response to noise is diverse and varies according to the type of noise source, the sensitivity and expectations of the receptor, the time of day, and the distance between the noise source and the receptor.

The decibel (dB) is the accepted unit of measurement for noise. Human hearing is not equally sensitive to all sound frequencies. Because of this, depending on the amplitude of the sound, various frequency weighting schemes have been developed to approximate the way people hear sound. The A-weighted decibel scale (dBA) is normally used to approximate human hearing response to sound. Examples of sound noise levels are shown in **Table 3-40**.

In general, sound waves travel away from the noise source as an expanding spherical surface. The energy contained in a sound wave is spread over an increasing area as it travels away from the source. It decreases in loudness at greater distances from the noise source. A doubling of distance results in an approximately 6-dB reduction in sound pressure level for single point sources of noise; doubling the distance results in a 3-dB reduction for multiple point sources moving in a straight line, such as a highway (Hedge 2011). Loudness—the subjective perception of sound by humans—is generally considered to double for approximately every 6- to 10-dB increase in sound level.

Table 3-40
Example Noise Levels

Characterization	Decibel (dBA)	Example Noise Condition or Event
Painful	140	Jet engine
	130	Jackhammer
	120	Jet plane takeoff, siren
Extremely Loud	110	Maximum output of some MP3 players, model airplane, chain saw
	106	Gas lawn mower, snow blower
	100	Hand drill, pneumatic drill
	90	Subway, passing motorcycle
Very Loud	80-90	Blow-dryer, kitchen blender, food processor
Loud	70	Busy traffic, vacuum cleaner, alarm clock
Moderate	60	Typical conversation, dishwasher, clothes dryer
	50	Moderate rainfall
	40	Quiet room
Faint	30	Whisper, quiet library

Source: American Speech-Language-Hearing Association 2018

3.13.1 Regulatory Framework

Originally, the EPA had the authority to control noise levels to protect human health and welfare, in accordance with the Noise Control Act of 1972 (42 USC 4901 et seq.). Subsequently, the Quiet Communities Act of 1978 (Public Law 95-609) amended the Noise Control Act and encouraged state and local governments to establish noise control programs. In 1981, the federal government transferred substantial authority to regulate noise from the EPA to state and local governments.

There are no Tribal laws regulating noise in Osage County. At the local level, a comprehensive land use plan has been developed to adopt public land use goals and policies to guide development in the county.

The 2030 Osage County Comprehensive Plan is a local document meant to guide future physical and economic development (Osage County 2011). This plan is a collaboration of the Osage County Board of Commissioners, the Osage County Industrial Authority, and the Pawhuska-Osage County Planning Commission. Exterior noise reduction measures are included in the plan to mitigate any negative impacts on adjacent areas, such as sensitive receptors (Osage County 2011). Screening, buffering, setbacks, and landscaping are methods called out for reducing noise (Osage County 2011).

3.13.2 Current Conditions

Existing Noise Sources

Noise levels in the project area are representative of a rural environment. Noise sources in rural areas include vehicles on area roadways, agricultural equipment, and natural sounds, such as wind, weather, and wildlife. Ambient sound levels typical of rural areas range between 30 and 40 dBA (EPA 1978).

The oil and gas industry is also a contributor of noise in the planning area, as it is one of the most important economic industries in the county. Sources of noise from oil and gas development are truck traffic, drilling and completion activities, well pumps, and compressors (Earthworks 2015). **Section 4.13**, Noise (Environmental Consequences), provides typical noise levels for different oil- and gas-associated activities.

Existing Sensitive Receptors

Sensitive receptors in the county include residents of the cities, towns, and communities and users of recreation sites in the county. The population of Osage County in 2015 was 47,054 (US Census Bureau

2015, as cited in Headwaters Economics 2017). Sensitive receptors in the county also include wildlife and livestock; refer to **Section 3.5**, Fish, Wildlife, and Migratory Birds and **Section 3.8**, Agriculture, for information about these sensitive receptors.

Cities in Osage County are the following (US Census Bureau 2010):

- Barnsdall (population 1,243)
- Bartlesville (partially in Osage County; total population 35,750)
- Hominy (population 3,565)
- Pawhuska (population 3,584)
- Sand Springs (partially in Osage county; total population 18,906)
- Shidler (population 441)
- Tulsa (partially in Osage County; total population 603,403)

Towns in Osage County are as follows (US Census Bureau 2010):

- Avant (population 320)
- Burbank (population 141)
- Fairfax (population 1,380)
- Foraker (population 19)
- Grainola (population 31)
- Osage (population 156)
- Prue (population 465)
- Skiatook (partially in the county; total population 7,397)
- Sperry (population 1,206)
- Webb City (population 62)
- Wynona (population 437)

Surface owners next to oil and gas developments may be particularly sensitive to noises from this industry (Hays et al. 2017). Recreationists would be those visiting the Tallgrass Prairie Preserve, lakes, rivers, and state parks.

3.14 Land Use Plans, Utilities, and Timber Harvesting

3.14.1 Regulatory Framework

This section discusses the regulatory framework guiding land use, utilities, and timber harvesting in the planning area.

Trust and Restricted Lands

Surface lands that the United States holds in trust or restricted status for federally recognized Tribes or individual Indian landowners are not typically subject to state and local land use regulations; the lands are managed by the federal government in consultation with the Tribes and individual Indian landowners. The BIA cooperates with state and local authorities to address issues relating to land use as necessary or appropriate. As of the writing of this EIS, the BIA administers approximately 142,769 acres of trust and restricted lands within the planning area (BIA Osage Agency 2020). **Table 1-1** in **Chapter 1** provides surface ownership data for Osage County.

The predominant classification of land use by the County Assessor in the planning area is rural agriculture, which covers approximately 95 percent of the land area. Rural residential and rural commercial comprise approximately 2.6 percent and 2 percent of land use (Osage County 2011).

Osage County Land Use Plan

The Osage County Comprehensive Plan is meant to guide future physical and economic development (Osage County 2011). This plan is a collaboration of the Osage County Board of Commissioners, the Osage County Industrial Authority, and the Pawhuska-Osage County Planning Commission.

The Industrial Authority understands the importance of properly managing growth and development in Osage County and has begun to prepare an industrial land use plan with the INCOG. This is a voluntary association of local and Tribal governments in the Tulsa metropolitan area that provides planning and coordination services in such areas as land use, transportation, and community and economic development.

The planning period and stages of implementation of the goals, policies, and objectives of the comprehensive plan has been divided into the following periods:

- Short term—Adoption of the comprehensive plan and 5 years beyond, 2011 to 2016
- Mid-term—From 6 to 10 years after adoption of the comprehensive plan, 2017 to 2022
- Long term—From 11 years after adoption of the comprehensive plan to the end of the planning period and 2030; the long term also includes those objectives that will take place throughout the planning period, as described at the end of this chapter, 2011 to 2030

Objectives identified in the comprehensive plan address the following:

- Land use planning and intensity
- Public and quasi-public areas and facilities
- Public utilities
- Transportation
- Housing
- Economic development
- Image and appearance
- Quality of life

In general, the objectives for land use planning in Osage County support the preservation and protection of land used for agriculture and ranching (Osage County 2011).

BIA

CFR Regulations

The BIA manages trust and restricted lands in Osage County pursuant to the regulations set forth in 25 CFR 150–152, 158, 162, 163, 166, 169, and 170, described below:

- Part 150 governs the recording, custody, maintenance, use, and certification of title documents and the issuance of title status reports for Indian land.
- Part 151 governs the acquisition of land by the US in trust status for individual Indians and Tribes. Acquisition in fee simple status is not covered by these regulations, even though such land may be held in restricted status following acquisition. Acquisition of land in trust status by inheritance or escheat (reversion of lands) is not covered by these regulations.
- Part 152 governs issuing patents in fee, certificates of competency, removal of restrictions, and sale of certain Indian lands.
- Part 158 governs the application and order for change in designating homesteads, exchanging restrictive lands, instituting partition proceedings and partition records, approving deeds, and distributing proceeds of partition sales.

- Part 162 governs leasing on Indian land for housing, economic development, and other purposes, including agricultural, residential, business, and wind and solar leases.
- Part 163 governs Indian forest land management, including forest management planning and sustained yield management, permitting, contracting, the sale of forest products, forest development, and support of Tribal forestry programs.
- Part 166 governs grazing on Indian land, including permitting, land and operations management, rental rates and payments, trespass, and the enforcement of Tribal laws.
- Part 169 governs granting ROWs over and across Indian land and government land.
- Part 170 governs the Tribal Transportation Program, including the program policy and eligibility requirements, program funding, transportation planning and design, construction of Tribal facilities, contracting, program oversight, and road maintenance.

BIA Eastern Oklahoma Region Record of Decision and Approved Integrated Resource Management Plan

The BIA Approved Integrated RMP includes management direction for allotted and Tribal mineral interests and for lands administered by the BIA Eastern Oklahoma Regional Office in the Oklahoma and Kansas area of jurisdictional authority. In Osage County, for mineral management, only non-fluid minerals are included in the area of jurisdictional authority for the Approved Integrated RMP.

3.14.2 Current Conditions

Regional Setting

With a total land area of 1,474,500 acres, Osage County has the largest land area of any county in Oklahoma. It is in the northeastern portion of the state and is bounded by Kansas to the north, Kay, Noble, and Pawnee Counties to the west, the Arkansas River to the southwest, and Washington and Tulsa Counties to the east. Although most of the planning area is sparsely populated, a part of metropolitan Tulsa extends into the far southeastern corner. Except for large floodplains along the Arkansas River and several other major streams, gently rolling hills generally characterize the county's topography (BIA 2014).

The population of Osage County in 2015 was 47,054, and the population change between 2000 and 2015 was 8.1 percent (US Census Bureau 2015, as cited in Headwaters Economics 2017). Lands in the planning area are generally rural, with small farming communities and residences scattered throughout.

TNC purchased the Tallgrass Prairie Preserve in the northern portion of Osage County in 1989. There have been additional land purchases and leases since then, and TNC now manages approximately 39,650 acres of preserved area (OK GAP GIS 2008). The preserve has free-ranging bison herds, scenic turnouts, hiking trails, and picnic tables (TNC 2015). TNC has worked with numerous energy companies on its preserves; its approach has been to use collaborative conservation within the context of local economies. As of 2013, the Tallgrass Prairie Preserve contained 220 operating oil and gas wells (TNC [Robert G. Hamilton] 2013), with associated roads, power lines, and pipelines.

Utilities

The primary utility infrastructure in the planning area consists of underground pipelines used to transport oil, gas, formation water, and secondary recovery chemicals to refineries outside the planning area. In addition, the Osage Agency estimates that there are several hundred miles of pipelines presently in use in the county; these are used for brine disposal or injection (BIA 2014). The BIA has no regulatory authority over interstate pipeline operations, including spill prevention and cleanup, unless those pipelines are on trust or restricted Indian lands in Osage County. In such instances, the BIA Osage Agency Superintendent must approve the routing of the pipeline.

There are approximately 1,000 miles of pipelines identified by the National Pipeline Mapping System (NPMS) in the planning area, most of which are used for crude oil and natural gas transportation (NPMS GIS 2015).

Due to the rural nature of the planning area, electrical transmission and distribution infrastructure is primarily for interstate transmission lines, rural developments, wind and hydroelectric power generation, and oil and gas development activity. There are approximately 300 miles of transmission lines in Osage County (BIA GIS 2017). Electric power distributers in Osage County are the Public Service Company of Oklahoma and the Indian Electric Cooperative.

At present, wind energy development in Osage County includes 1 wind farm, Osage Wind. Osage Wind, which began operating in 2015, is located approximately 15 miles west of Pawhuska, Oklahoma, and is owned by Enel Green Power North America, Inc. The project is a 150-megawatt wind development using 84 turbines, and it encompasses 8,400 acres (Tradewind Energy 2016).

Figure 3-15 in **Appendix E** displays the location of transmission lines, pipelines, and wind projects in the planning area.

Timber Harvesting

Osage County is in the Cross Timbers ecological region (EPA 2012). Forest management is coordinated with natural, cultural, and other resource programs the Osage Nation operates in the planning area. Timber harvesting and sale are conducted in cooperation with the BIA Osage Agency Superintendent and the Eastern Oklahoma Regional Forester.

Timber management in the planning area is limited to forest lands having the potential to produce accessible commercial timber. These lands are restricted to bottomlands and mixed hardwood stands on drainage terraces in the southern part of the planning area. Commercial lessees cut native timbers as a cash crop, mostly oak, ash, hackberry, cottonwood, sycamore, cherry, and elm, with specialty cash crops of walnut and pecan (ONENRD 2006).

The hardwood community consists primarily of short oak trees that are not prime timber for harvest; however, forested areas have been cleared to create open sections for rangeland, pastures, and farmland. At the time of writing this EIS, Osage County has not had any timber sales since 2004.

3.15 Traffic and Transportation

3.15.1 Regulatory Framework

Osage Nation Long-Range Transportation Plan 2017–2036

The Osage Nation published a long-range transportation plan in 2017; it is the primary planning document for the Osage Nation Roads Department. The plan prioritizes identifying and inventorying roads eligible for the Tribal Transportation Program so that funding can be sought for road improvements (Osage Nation 2017d). The Osage Nation Roads Department is responsible for communicating with federal, state, county, and local officials to ensure that the different entities are collaborating, that efforts are being maximized, and that the safety and well-being of travelers within those boundaries are being addressed (Osage Nation 2018).

BIA Regulations for the Tribal Transportation Program (25 CFR 170)

The regulations in 25 CFR 170 govern the Tribal Transportation Program, including the program policy and eligibility requirements, program funding, transportation planning and design, construction of Tribal facilities, road maintenance, contracting, and program oversight.

Oklahoma Department of Transportation

ODOT's long-range transportation plan focuses on highways and bridges, public transportation, freight movement, passenger rail, bicycle and pedestrian networks, and access to air and water ports (ODOT 2015). There are 8 field divisions across the state, each responsible for road repairs, maintenance, and cleaning within their boundaries; Osage County is in Field Division 8.

3.15.2 Current Conditions

Primary Roads

The primary roadway network consists of several federal and state highways maintained by ODOT. The density of primary roads is higher in the more populated southern portion of the county, with fewer highways in the less populated northern portion of the county.

US Highway 60 crosses Osage County from Bartlesville, west to the county line just south of Ponca City in Kay and Osage Counties. Annual average daily traffic (AADT) on this road ranges between 1,900 and 6,700 vehicles, depending on the location (ODOT 2013). US Highway 60 is a 2-lane paved road with center striping and paved shoulders. In March 2008, the ODOT Scenic Byways Program approved the Osage Nation's request to designate US Highway 60 as the Osage Nation Heritage Trail Scenic Byway.

State Highway 11 enters the southeast corner of Osage County near Skiatook and travels northwest to Pawhuska. It shares its route with US Highway 60 for approximately 20 miles west of Pawhuska to the intersection with State Highway 18. State Highways 11 and 18 then travel north to Shidler, where State Highway 11 continues west across Kaw Lake to the county border. AADT on this road ranges between 450 and 5,300 vehicles, depending on the location (ODOT 2013). State Highway 11 is a 2-lane paved road with center striping and paved shoulders.

State Highway 18 traverses western Osage County in a north-south direction, passing through Shidler and Fairfax. AADT varies between 290 and 1,600 vehicles, depending on the location (ODOT 2013). State Highway 18 is a 2-lane, paved road with center striping and paved shoulders.

Other primary roads in Osage County are State Highways 10, 20, 99, and 123. These are all 2-lane paved roads with center striping and paved shoulders. AADT is under 4,000 vehicles in most areas, except in the vicinity of Tulsa, where AADT for each roadway on State Highway 20 is 16,300 vehicles (ODOT 2013).

Other Roads

There are other paved and unpaved roads in populated areas that support public passenger travel. Most of these roads are maintained by the Osage County Commissioners and the Osage Nation Roads Department. They are categorized by the amount of vehicle traffic they receive. Unpaved roads in rural areas are largely used to access oil and gas wells and are typically owned and maintained by the lessee.

The Osage Nation maintains its own inventory of transportation facilities in the county that are eligible for Tribal Transportation Program (TTP) funding. A TTP route is a public road that is in, or provides access to, an Indian reservation, Indian trust land, or restricted Indian land. These roads, trails, and other facilities provide safe and adequate transportation and public access to, in, and through Indian reservations and native communities for Native Americans, visitors, recreationists, resource users, and others, while contributing to the health and safety and economic development of Native American communities.

The Osage Nation's TTP inventory predominantly uses the county, township, and state roads in its jurisdictional boundaries, which serve all people in Osage County (see **Table 3-41**). The Osage Nation Long-Range Transportation Plan's primary focus is on Tribal economic development, cultural sites, Tribal residences, and headquarters (Osage Nation 2017d).

Table 3-41
Osage Transportation Facility Inventory

Class	Description	Miles
Class 1	Major arterial roads serving traffic between 2 large population centers and carrying an average traffic volume of 10,000 vehicles or more per day	65.2
Class 2	Rural minor arterial roads serving traffic between large population centers and smaller towns and communities; generally designed for relatively high overall speeds, with minimum interference to through-traffic, and carrying fewer than 10,000 vehicles per day	223.9
Class 3	Streets and roads serving residential and urban areas	401.8
Class 4	Rural major collectors of traffic from local rural roads	430.7
Class 5	Local rural roads serve areas around villages or provide access to farming areas, schools, tourist attractions, and various small enterprises; also includes roads and vehicular trails for such activities as administering forests, grazing areas, mining and oil operations, and recreation	963.1
Class 6	Minor arterial streets in the communities that provide access to major arterial roads	0
Class 7	City collector streets in communities that provide access to city streets	2.0
Class 8	Paths, trails, walkways, and other routes for public traffic, bicycles, trail bikes, snowmobiles, all-terrain vehicles, and non-vehicular traffic	0.7
Class 9	Parking facilities next to TTP routes and scenic byways, such as rest areas, scenic pullouts, ferry boat terminals, and transit terminals	8.6
Class 10	Public airstrips within the boundaries of the TTP system for inventory and maintenance only	0
Class 11	Overlapping routes; requires no funding because it is already in the inventory under another route number but is in the system to be complete an example of a Class 11 route is Highway 11 overlapping Highway 60; these are 2 different routes that, at some point, overlap	0
Total		**2,096**

Source: Osage Nation 2017d

Other Transportation

Cimarron Public Transit System (CPTS) provides regional demand response transit service for Barnsdall, Pawhuska, and Skiatook in northeastern Oklahoma, including Osage County (ODOT 2017). In 2015, individuals in the CPTS service area made 126,000 trips on CPTS transit vehicles (United Community Action Program, Inc. 2015). CPTS also has contract services in various parts of Osage County, mostly with health-related agencies, to provide demand response and paratransit services. The City of Hominy Senior Citizens Center also offers demand response transit service in the community (United Community Action Program, Inc. 2015).

3.16 Mineral Extraction

3.16.1 Regulatory Framework

Osage Allotment Act of 1906

This act authorizes the Osage Nation to lease the Osage Mineral Estate for oil and gas exploration and development "with the approval of the Secretary of the Interior, and under such rules and regulations as he may prescribe." The Secretary delegated the authority to approve leases to the BIA Osage Agency Superintendent. Leases of the Osage Mineral Estate may be obtained through public lease sales or negotiation with the Osage Minerals Council.

BIA Regulations on Leasing of Osage Reservation Lands for Oil and Gas Mining (25 CFR 226)

The regulations in 25 CFR 226 govern leasing of the Osage Mineral Estate for oil and gas exploration and development.

3.16.2 Current Conditions

The EPA classifies the oil and gas extraction industry into 4 major processes:

- Exploration
- Well development
- Production
- Site abandonment

Exploration involves the search for rock formations associated with oil or natural gas deposits and geophysical prospecting or exploratory drilling. Wells are developed after an economically recoverable field has been found. Development involves the drilling of 1 or more wells. To begin drilling a well is called spudding. If no hydrocarbons are found, the well is abandoned; if hydrocarbons are found in sufficient qualities, the well is completed (EPA 2000).

Most wells in the planning area are drilled vertically to a hydrocarbon reservoir; however, horizontal and directional drilling are also used to extract resources in the planning area. These drilling methods allow wells to be drilled diagonally or horizontally to extract resources from multiple points in a reservoir or to reach a reservoir that is not directly below the well pad. These drilling techniques can also allow multiple wells to be drilled in different directions from a single well pad on the surface.

The third major oil and gas extraction process, production, extracts hydrocarbons through the well and then separates the oil and gas from by-products before sale. By-products are often separated at a refinery or natural gas processing plant.

Hydraulic fracturing is a technique that produces fractures in a rock formation to increase hydrocarbon production from a well. Fractures are created by pumping large quantities of fluids at high pressure down a wellbore and into the target rock formation. Hydraulic fracturing fluid commonly consists of water, proppant, and chemical additives that open and enlarge fractures in the rock formation, sometimes extending several hundred feet from the wellbore. The proppants hold open the newly created fractures. Sand, ceramic pellets, or other small incompressible particles may be used as proppants (EPA 2015a).

Once the injection process is completed, the internal pressure of the rock formation causes fluid hydrocarbons to return to the surface through the wellbore. This fluid, known as flowback or wastewater, may contain the injected chemicals plus naturally occurring materials, such as brines, metals, radionuclides, and hydrocarbons. Produced water and flowback are typically stored on-site in tanks before disposal or reuse. Produced water in Osage County is disposed of through Class II disposal wells regulated by the EPA or reused in waterflood for enhanced oil recovery (EPA 2015a).

The final major oil and gas extraction process, site abandonment, involves plugging the wells and restoring the site when a producing well becomes no longer economically viable, or when a recently drilled well fails to produce economic quantities of oil or gas (EPA 2000).

The planning area, Osage County, falls within 2 large oil and gas plays. The Excello-Mulky play overlaps the eastern portion of the planning area, and the Mississippian play overlaps the western portion. Within those plays there are 277 known oil and gas fields in Osage County. **Table 3-42** lists the number of fields with each type of resource in the planning area.

Table 3-42
Oil and Gas Fields

Resource	Number of Fields	Acres of Fields
Coal bed methane	16	78,900
Gas	22	20,500
Oil	220	669,500
Oil and gas	19	34,600

Source: USGS GIS 2014

There are 12,885 active oil wells, 1,630 active gas wells, 84 active wells producing both oil and gas, and 2,610 other (injection, disposal, and service) active wells in the planning area (BIA Osage Agency 2018). **Table 3-43** shows the number of currently active wells in the county. **Table 3-44**, below, shows the total number of wells, including plugged and abandoned wells, for each resource broken down by horizontal, directional, and vertical wellbore. Approximately 99 percent of the active wells in the planning area are vertical. **Figure 3-16** in **Appendix E** shows wells and oil and gas fields in the planning area. In addition to production wells, the planning area contains 4,909 injection, disposal, or service wells (including plugged and abandoned wells). Three of these wells are horizontal, 2 are directional, and the rest are vertical (Information Handling Services 2017; BIA Osage Agency 2017).

Table 3-45 shows the number of vertical, horizontal, and directional wells completed in 2013 through 2017. In addition to the oil and gas wells shown, 38 injection wells were completed in 2013, another 11 were completed in 2014, 5 were completed in 2016, and 16 were completed in 2017 (BIA Osage Agency 2018).

As shown in **Table 3-44** and **Table 3-45**, oil extraction is much more prevalent in the planning area than gas extraction. Most wells are vertically drilled, with directional drilling as the second most common method. From 2000 to 2017, horizontal wells made up just 5 percent of new well completions. The RFD for Osage County suggests that geologic conditions and the high costs of horizontal drilling mean that most new wells will continue to be vertical (**Appendix A**, Reasonably Foreseeable Development Scenario). While the planning area has been substantially developed, historical development is heavily concentrated in certain parts of the county.

Table 3-43
Active Oil and Gas Wells

Resource		Number of Wells
Oil		12,885
	Vertical	12,856
	Directional	9
	Horizontal	20
Gas		1,630
	Vertical	1,614
	Directional	5
	Horizontal	11
Oil and gas		84
	Vertical	84
	Directional	0
	Horizontal	0
Other (injection/disposal/service)		2,610

Source: Information Handling Services 2017 and BIA Osage Agency 2018

Table 3-44
Total Oil and Gas Wells (Including Plugged and Abandoned)

Resource		Number of Wells
Oil		25,133
	Vertical	25,003
	Directional	11
	Horizontal	119
Gas		3,113
	Vertical	3,025
	Directional	23
	Horizontal	65
Oil and gas		98
	Vertical	88
	Directional	6
	Horizontal	4
Other (injection/disposal/service)		4,909

Sources: Information Handling Services 2017; BIA Osage Agency 2018

Table 3-45
Annual Oil and Gas Well Completions

Resource		Number of Wells
	2014	
Oil		88
	Vertical	81
	Directional	4
	Horizontal	2
Gas		4
	Vertical	4
	Directional	0
	Horizontal	0
Oil and Gas		7
	2015	
Oil		47
	Vertical	44
	Directional	0
	Horizontal	2
Gas		4
	Vertical	4
	Directional	0
	Horizontal	0
Oil and Gas		1

Table 3-45
Annual Oil and Gas Well Completions (cont.)

Resource		Number of Wells
2016		
Oil		57
	Vertical	55
	Directional	0
	Horizontal	0
Gas		4
	Vertical	4
	Directional	0
	Horizontal	0
Oil and Gas		0
2017		
Oil		49
	Vertical	45
	Directional	0
	Horizontal	0
Gas		7
	Vertical	7
	Directional	0
	Horizontal	0
Oil and Gas		0
2018		
	Oil	37
	Vertical	36
	Directional	0
	Horizontal	1
	Gas	7
	Vertical	7
	Directional	0
	Horizontal	0
	Oil and Gas	

Source: BIA Osage Agency 2018

Table 3-46, below, shows annual oil and gas production in Osage County and statewide in Oklahoma between 2014 and 2018. Globally, oil and natural gas prices dropped significantly between 2014 and 2016 and then rose through late 2018 until dropping steeply in the fall of 2018 (Energy Information Administration 2020a; 2020b).

Table 3-46
Oil and Gas Production in Osage County and Statewide

Year	Oil Production (1,000 barrels)	Statewide Oil Production (1,000 barrels)	Gas Production (thousand cubic feet [MCF])	Statewide Gas Production (MCF)
2018	3,575	200,685	4,533,995	2,946,117,000
2017	4,214	163,907	5,202,696	2,513,897,000
2016	4,279	154,077	6,148,775	2,468,312,000
2015	4,676	165,909	8,615,966	2,499,599,000
2014	4,837	149,693	8,823,988	2,331,086,000

Sources: BIA Osage Agency 2020; Energy Information Administration 2020c, 2020d

The BIA has classified oil and gas development potential throughout Oklahoma, including the planning area, ranging from no potential to high potential (**Appendix A**). 84 percent of the planning area has high or moderate-to-high oil and gas potential.

3.17 Recreation and Special Use Areas

3.17.1 Regulatory Framework

BIA Regulations for Land and Water Leases and Permits (25 CFR 162)

The BIA regulations in 25 CFR 162 govern leasing of trust and restricted Indian lands for hunting and fishing purposes.

While the BIA manages no lands in the planning area specifically for recreation, private, state, and local agencies in Osage County provide diverse opportunities for recreation. Some examples are biking, boating, camping, hiking, horseback riding, hunting, fishing, off-highway vehicle riding, swimming, and tennis playing.

Osage County Land Use Plan

The Osage County Comprehensive Plan is a local document meant to guide future physical and economic development (Osage County 2011). The development of the county's economic potential for tourism and recreation for residents and visitors depends on preserving its natural and human-made recreation and open spaces. Some of the County's objectives for parks, recreation, trails, and open space areas are listed below; a complete list of objectives can be found in Chapter 4 of the 2030 Osage County Comprehensive Plan (Osage County 2011):

- Preserve, maintain, and develop recreation and open spaces for the use and enjoyment of residents, visitors, and tourists
- Meet present and future active and passive recreation needs by setting aside lands for parks, recreation, and open space
- Protect natural open space areas identified as development sensitive and conservation areas to preserve the natural vegetation, wildlife, and environment, while reducing potential hazards to humans from improperly building on steep slopes with erodible soils or flooding potential

3.17.2 Current Conditions

Recreation Areas in Osage County

Osage Hills State Park offers 1,100 acres for recreation. It includes picnic tables and shelters, recreational vehicle campsites, cabins, a swimming pool, hiking trails, a ball field, and a tennis court. Fishing for bass, crappie, catfish, and perch is common in Lookout Lake or in Sand Creek at the south end of the park. The park is also used for fall foliage viewing (OHSP 2017). A system of 3 trails is open for hiking and mountain biking. These unpaved trails are centrally located in the park (see **Table 3-47**).

Table 3-47
State Parks in Osage County

Recreation Area	County	Size (Acres)	Activities	Management Agency
Osage Hills State Park	Osage	1,100	Biking, camping, fishing, hiking, swimming, and tennis	Oklahoma Tourism and Recreation Department

Sources: OTRD 2015; OK GAP GIS 2008

Keystone State Park is just outside Osage County adjacent to the southern boundary of the county, on the south side of the Arkansas River. This park provides fishing areas for striper, walleye, bass, and catfish. It also provides other recreation opportunities, such as boating, waterskiing, swimming, camping, picnicking, and hiking (Keystone 2017). Former state parks in Osage County, including Walnut Creek State Park and

Wah-Sha-She State Park, were shut down or taken over by other entities due to state budget cuts (Hylton 2011; Layden 2014).

The US Army Corps of Engineers operates and controls the Hulah Lake Project in northeast Osage County. Facilities and services are available around the project. Hulah Lake provides opportunities for hunting and fishing, camping, picnicking, swimming, boating, and sightseeing. Approximately 8,900 acres of Hulah Lake project lands are licensed to the Oklahoma Department of Wildlife Conservation (ODWC) for wildlife management (USACE 2015).

TNC bought the Tallgrass Prairie Preserve in the northern portion of Osage County in 1989. It has purchased and leased additional land since then and now manages approximately 39,650 acres of preserved area (OK GAP GIS 2008). The preserve is open to the general public, with no admission charge, every day from dawn to dusk. The preserve has free-range bison herds, scenic turnouts, hiking trails, and picnic tables (TNC 2015).

Hunting and Fishing

Oklahoma provides a diverse hunting experience, with over 12 different ecological regions. The ODWC provides habitat conservation and management across the state at designated WMAs. Game species of interest in Osage County are quail, deer, turkey, rabbit, furbearers, dove, waterfowl, squirrel, and various other small game and migratory birds (ODWC 2016b).

Hunting seasons for individual species vary, but hunting generally takes place in the fall and winter. Additionally, the ODWC manages and stocks lakes and ponds throughout the state. Fish species produced and stocked annually are largemouth bass, smallmouth bass hybrid, walleye, brown trout, and rainbow trout. An average of 11 million fish are stocked annually.

The BIA reviews and approves hunting leases on trust and restricted Indian lands in accordance with 25 CFR 162. On April 24, 2017, the Osage Nation adopted the Osage Hunting and Fishing Regulations pursuant to the Osage Nation Wildlife Conservation Act. The act provides for the protection, conservation, and management of wildlife; requires hunters and fishermen to obtain licenses and permits to hunt and fish on Osage lands; establishes wildlife offenses; and provides for the assessment of civil and criminal penalties for violations (Osage Nation Congress 2017).

Wildlife Management Areas

In the planning area, there are 7 designated WMAs that provide opportunities for hunting, fishing, and camping. Some of the WMAs include US Army Corps of Engineers-operated and controlled reservoirs, though the ODWC operates the park or WMA. The US Army Corps of Engineers creates reservoirs for flood control, water supply, irrigation, hydropower, navigation, recreation, and fish and wildlife (see **Table 3-48**).

Table 3-48
Wildlife Management Areas in Osage County

WMA	Area (Acres)	County	Management Agency
Hulah	14,000	Osage	USACE
Osage (Rock Creek Unit and Western Wall Unit)	9,700	Osage	ODWC
John Dahl	500	Osage	ODWC
Candy	3,600	Osage	USACE
Kaw	1,100	Osage	USACE
Keystone	2,900	Creek, Osage, and Pawnee	USACE
Skiatook	4,000	Osage	USACE

Source: OK GAP GIS 2008
Note: USACE is US Army Corps of Engineers

3.18 TRUST ASSETS AND OSAGE NATION INTERESTS

This section addresses Tribal trust assets and social, cultural, and economic interests that are specific to the Osage Nation. The Osage Nation has a unique history among Tribes, which is reflected in its relationships with other governmental entities and its interests and priorities. Tribal uses and interests in the planning area include both the exercise of economic and resource rights and those uses and resources that are tied to traditional cultural practices.

The Osage Nation's interests within the planning area include cultural interests relating to the Tribe's unique traditions and practices. Traditional lifeways may include the use of certain waters, plants, animals, and earth resources. In addition, certain locations, cultural sites, and landscape features may have ceremonial or religious importance. The Osage Nation's cultural interests are discussed in detail in **Section 3.9**, Cultural Resources.

The social and economic data in this section is specific to the Osage Nation. General social and economic data for the planning area is included in **Section 3.10**, Socioeconomics and Environmental Justice.

The trust assets most relevant to this EIS are the rights to the subsurface mineral estate in Osage County, which were reserved by the US for the benefit of the Osage Nation and not transferred with the surface allotments. The Osage Nation retains trust status on approximately 14,357 acres in the county, meaning that the US holds title to the land as well as the mineral rights for the beneficial interest of the Osage Nation.

3.18.1 Regulatory Framework

Osage Allotment Act of 1906

This act authorizes the Osage Nation to lease the Osage Mineral Estate for oil and gas exploration and development "with the approval of the Secretary of the Interior, and under such rules and regulations as he may prescribe." The Secretary delegated the authority to approve leases to the BIA Osage Agency Superintendent. Leases of the Osage Mineral Estate may be obtained through public lease sales or negotiation with the Osage Minerals Council.

Consultation and Coordination with Indian Tribal Governments (2000), Executive Order 13175

This EO directs federal agencies to continue to work with Tribes on a government-to-government basis to address issues concerning Tribal self-government, Tribal trust resources, and Tribal treaty and other rights. Its intent is as follows:

- To establish regular and meaningful consultation and collaboration with Tribal officials in the development of federal policies that have Tribal implications
- To strengthen the US government-to-government relationships with Tribes
- To reduce the imposition of unfunded mandates on Tribes

Department of the Interior Policy on Consultation with Indian Tribes (December 1, 2011)

The Department of the Interior issued the Policy on Consultation with Indian Tribes in compliance with EO 13175 and the directives set forth in the Memorandum from the President on Tribal Consultation (November 5, 2009). The policy defines provisions for enhancing the department's government-to-government consultation processes by, among other things, ensuring that federal actions are achievable, comprehensive, long lasting, and reflective of Tribal input.

3.18.2 Current Conditions

Trust Assets

Indian trust assets are legal interests in lands, natural resources, funds, and other assets held in trust by the US for the benefit of Tribes or individual Indians. Trust assets cannot be sold, leased, or otherwise encumbered without the federal government's approval. The federal government's fiduciary duties for the protection of Tribal trust assets, resources, and rights are prescribed by statute and regulation. The BIA also has a duty to carry out the mandates of federal law with respect to American Indians and Alaska Natives.

As discussed in **Section 3.9**, Cultural Resources, the Osage were displaced from the original territories, which included lands in Missouri, Kansas, and Oklahoma. As part of the Cherokee Reconstruction Treaty of 1866, the Osage purchased Cherokee land in Oklahoma that became the Osage Reservation. Upon enactment of the 1906 Act, the surface lands comprising the Osage Reservation were allotted to individual Tribe members. Today, a small percentage of surface lands within the planning area remain in trust or restricted status, with most lands in the county being held in fee; approximately 20,408 acres are held in trust or restricted status for the Osage Nation, and approximately 122,361 acres are held in restricted status for individual Indian landowners.[4]

In contrast to surface lands, the 1906 Act reserved the subsurface mineral estate underlying the Osage Reservation in trust to the Osage Nation. In addition, the act directed the Secretary of the Interior to manage leasing of the Osage Mineral Estate for the mining of oil, gas, and other mineral resources. The BIA, acting under delegated authority, fulfills the Secretary of the Interior's duties relating to management of the Osage Mineral Estate. In carrying out this trust responsibility, the BIA must act in the best interest of the Osage Nation, balancing resource conservation with protection of the environment as well as the health and safety of the Osage people. With respect to oil and gas resources, the objective of such management is to promote the maximization of production in the long term.

The Osage Nation is authorized to lease the Osage Mineral Estate, subject to the approval of the BIA Osage Agency Superintendent. In 2006, the Osage Nation reorganized its government under a new constitution. Among other things, the Osage Constitution created the Osage Minerals Council, an independent agency of the Osage Nation vested with the authority to execute leases and manage development of the Osage Mineral Estate. The Osage Minerals Council is comprised of 8 members and is elected solely by Osage headright holders. Osage headrights are discussed further in the ***Osage Nation Economic Data*** section.

The Osage Nation signed a cooperative agreement with the Department of the Interior to implement the Land Buy-Back Program for Tribal Nations, facilitating the Tribe's purchase of individual fractionated interests of land and returning them to communal Tribal ownership as trust lands (DOI 2015). The Osage Nation also purchased the 43,000-acre Bluestem Ranch, lands which were part of the former reservation, and initiated the process to have the lands taken into trust. Participation in the Land Buy-Back Program and the purchase of fee lands within the planning area will prevent further sales and fractionation, promote economic development, protect natural resources, and preserve cultural values (Indian Country Today 2016).

Osage Nation Demographics

The planning area, Osage County, is comprised of the former Osage Reservation. Demographic data for Osage County are provided in **Section 3.10**, Socioeconomics and Environmental Justice. The Osage

[4] Trust lands are land the United States holds in trust for the benefit of a Tribe or individual Indian landowner. Restricted lands are lands that a Tribe or individual Indian owns in fee, but that are subject to federal restrictions against encumbrance or alienation.

Nation has approximately 13,307 enrolled members, with approximately 6,747 members living within the state of Oklahoma (Oklahoma Indian Affairs Commission 2011). Members of the Osage Nation also live in other states and countries.

Osage Nation Economic Data

The Osage Nation identified the strengths and weaknesses of the local economy in its 25-Year Vision and Strategic Plan (Osage Nation 2007). The plan identified the following strengths:

- Gaming revenue
- Civic engagement in government
- Entrepreneurial mentors
- Historical revenue base
- Land base
- Natural resources

The following areas were identified for improvement:

- Size and capabilities of workforce
- Lack of information technology infrastructure
- Lack of adequate public infrastructure
- Transportation
- Lack of housing and hotels
- Resistance to change

General Budget

Major revenue sources and expenses for the Osage Nation are displayed in **Table 3-49**. The largest funding source is revenue from casinos. Top expenditures, in addition to general government, are Tribal health and human services and education programs.

Table 3-49
General Fund—Osage Nation 2016

Revenue and Gaming Distributions	**2016 Actual**
Tax revenue	$2,456,000
Indirect cost recoveries	$6,596,000
Investment income	$1,887,000
Other revenue	$4,680,000
Casino distribution	$ 60,582,000
Total	**$ 76,201,000**
Expenditures	
Community services	$ 507,000
Culture and language	$ 2,630,000
Education	$ 9,887,000
Environmental management	$ 426,000
General government	$ 25,029,000
Health and human services	$ 8,759,000
Housing services	$ 244,000
Public safety	$ 1,410,000
Capital outlay	$13,070,000
Debt service	$1,098,000
Total	**$ 63,060,000**

Source: Osage Nation 2016

Oil and Gas Revenue

Total royalties collected from oil and gas production from the Osage Mineral Estate are shown in **Table 3-50**. The Osage Minerals Council retains a portion of revenue for its operating budget.

Table 3-50
Osage Royalties

	2011	2012	2013	2014	2015	2016	2017
Oil royalties collected	$69,624,382	$72,867,727	$79,169,159	$71,233,059	$34,394,421	$26,607,151	$31,775,618
Gas royalties collected	$6,930,679	$3,722,984	$4,167,565	$4,857,455	$2,934,783	$1,575,836	$1,537,723

Source: BIA 2017b, 2018
Note: Data are rounded to the nearest dollar.

Headright Royalties

The 1906 Act established an official Tribal roll for the Osage Nation and allotted each of the 2,229 individual Tribe members listed on the roll 1 equal share in quarterly, pro-rata distributions of the revenues derived from leasing of the Osage Mineral Estate. Such distributions were net of proceeds following statutorily authorized deductions for Tribal operating expenses and gross production taxes. This prospective interest in distributions of revenues from the Osage Mineral Estate is known as a "headright."

Osage headright interests are subject to succession by inheritance or devise; thus, an Osage headright holder may own 1 or more full headrights or a fractional share of a headright. Due to fractionation, today there are over 8,000 Osage headright holders, including Osage Indians, non-Osage Indians, and non-Indians.

The Osage Minerals Council has authority to negotiate the lease bonus amount and may set the royalty rate, subject to compliance with the minimum royalty and annual rental rates set forth in 25 CFR 226. The quarterly headright distribution amounts per headright for 2000–2016 are displayed in **Table 3-51**.

Gross Production Tax

The 1906 Act was amended by the Act of April 25, 1940 (54 Stat. 168) to authorize the payment of a 5 percent gross production tax to the state of Oklahoma. Gross production tax is assessed on oil and gas royalty revenues. Half of the gross production tax revenues from the Osage Mineral Estate are used for the construction and maintenance of Osage County roads and bridges; the other half are used for the maintenance of Osage County schools.

Other Minerals

The production of other natural resources in the planning area is also a source of revenue. Coal bed methane, limestone, sand and gravel, and clay and shale are commonly extracted in Osage County. According to the ODM annual report for 2015, Osage County produced 47,420,355 tons of limestone (ODM 2015). Salable minerals, such as sand and gravel, are also extracted from the planning area. In 2016, a total of 61,702 cubic yards (249,292 tons) of material was extracted, yielding royalties of $346,093.

Gaming Revenue

The Osage Nation Gaming Enterprise Board oversees the Osage Casino, which is a collection of 7 casinos: Hominy, Pawhuska, Sand Springs, Tulsa, Bartlesville, Skiatook, and Ponca City. Under the State-Tribal Compact, Tribes pay monthly exclusivity fees from class III games revenue, based on a sliding scale. For the

Table 3-51
Annual Osage Headright Payment Totals

Year	Actual	Adjusted to 2016 Dollars
2000	$8,480	$11,776
2001	$10,730	$14,660
2002	$7,675	$10,243
2003	$10,450	$13,689
2004	$13,380	$16,975
2005	$19,380	$23,775
2006	$25,390	$30,376
2007	$25,250	$29,024
2008	$40,130	$46,086
2009	$20,945	$23,416
2010	$28,320	$31,195
2011	$37,375	$39,985
2012	$40,780	$42,881
2013	$36,990	$38,320
2014	$37,545	$38,603
2015	$20,155	$20,573
2016	$12,545	$12,545
2017	$14,905	$14,541
2018	$17,320	$16,555
2019	$15,550	$14,636

Source: Osage Nation 2017e, 2020
Note: Dollars were converted to 2016 dollars, using the Bureau of Labor Statistics' Consumer Price Index inflation calculator (Bureau of Labor Statistics 2016)

Note: The totals provided represent the sum of the quarterly payment amounts (per 1 headright share) for the identified year.

first $10 million in revenue, Tribes pay 4 percent to the state; for the next $10 million, they pay 5 percent, and for revenues more than $20 million, they pay 6 percent.

Total distributions supplied to Osage County from gaming operations was $47,332,127 in 2015 (Osage Nation 2015).

The Osage Nation uses revenues from its casinos for the following enterprises:

- Fund Tribal government and programs
- Provide for the general welfare of the Osage
- Promote Tribal economic development
- Support charitable organizations
- Help fund operations of local government agencies of the Osage Nation

Tribal Community Services

The Osage Nation provides public services, social welfare, and community programs for the Osage within the planning area. Community services provided by Osage County are discussed in **Section 3.10.1**, Socioeconomics and Environmental Justice, Current Conditions. The Osage Nation Police Department provides law enforcement services under the jurisdiction of the Osage Nation. The officers' primary duty is to enforce the criminal laws of the Osage Nation and the federal government when major crimes have been committed within state and local jurisdictions. The Osage Nation Police Department also assists the Osage Nation in protecting and enhancing Tribal sovereignty, along with protecting the religious and ceremonial beliefs of the Osage (Osage Nation 2017f).

The Osage Nation provides education to the Osage, including kindergarten through tenth grade outreach programs and education scholarships. The Osage are also eligible to apply for Osage Nation Health, a limited benefit program, and to receive services at any Indian Health Service facility.

Traditional Lifeways and Practices

The Osage Nation is headquartered in Pawhuska. The Wah-Zha-Zhi Cultural Center in Pawhuska was established in 2004 to maintain the ancestral traditions, values, way of life, and unique identity of the Osage. The Cultural Center hosts classes on traditional craft-wear and artwork exhibits and is home to a library (Osage Nation 2012; Shop Oklahoma 2012).

The extent of traditional religious or resource land use is not public knowledge. Locations of resources are generally considered privileged information that is restricted to specific practitioners. Maintaining confidentiality and customs regarding traditional knowledge may take precedence over identifying and evaluating these resources, unless they are in imminent danger of damage or destruction.

Chapter 4. Environmental Consequences

4.1 INTRODUCTION

This chapter describes the anticipated environmental impacts associated with each of the 4 alternatives set forth in **Chapter 2**, Alternatives. This chapter is organized by resource and resource use topics. Within each topic area the alternatives are analyzed based on alternative-specific actions, operations, and COAs. The indicators, methods, and assumptions relevant to this analysis are identified at the beginning of each topic area.

Impacts are defined as modifications to the existing environment brought about by implementing an alternative. The analysis in this chapter is confined to the actions that have the most prominent, immediate, or direct effects. Some of the proposed management actions and potential future development may affect only certain resources and alternatives. If an activity or action is not addressed in in the section discussing a particular resource or resource use, no impacts are expected, or the impact is expected to be negligible. The analysis of each alternative assumes that the COAs listed under that alternative in **Chapter 2** would be applied. As stated in **Section 2.3.1**, Alternatives Considered for Detailed Analysis, Management Common to All Alternatives, the BIA may waive COAs or apply additional COAs based on site-specific determinations.

The baseline used for the impact analysis is the current condition of the resources in the planning area, as described in **Chapter 3**, Affected Environment. The detailed impact analyses set forth in this chapters are based on the interdisciplinary team's knowledge of the planning and its resources, review of pertinent literature, input from subject matter experts at the DOI and other federal agencies, and feedback received in public comments.

A summary comparison table of the impacts of each alternative is provided in **Table 2-4** in **Appendix D**, Table 2-4: Summary Comparison of Environmental Consequences of the Alternatives. The discussion of impacts is based on the best available data. Knowledge of the planning area and professional judgment, based on observation and analysis of conditions and responses in similar areas, were used to infer environmental impacts where data is limited. At times, when quantitative data or projections are not available, impacts are described using ranges of potential impacts or in qualitative terms. Impacts on resources and resource uses are analyzed and discussed in detail, commensurate with resource issues and concerns identified throughout the EIS process.

4.1.1 General Method for Analyzing Impacts

Potential impacts or effects are described in terms of type, context, duration, and intensity, which are generally defined as follows:

- Type of impact—Impacts are defined as modifications to the existing environment that are occasioned by the implementation of a specific alternative. Impacts can be beneficial or adverse, the direct or indirect result of the action, and short term, long term, or cumulative in nature. As previously noted, this chapter does not characterize impacts as beneficial or adverse except where such characterization is required by law, regulation, or policy. This analysis provides a quantitative or qualitative comparison of alternative-specific impacts based on available data and the nature of the impact.
- Context—Context describes the area or location (site-specific, local, planning area-wide, or regional) in which the impact would occur. Site-specific impacts would occur at the location of the action, local impacts would occur within the general vicinity, planning area-wide impacts would

affect a greater portion of the county, and regional impacts would extend beyond the planning area boundaries.

- Duration—Duration describes the length of time an impact will exist. Impacts may be short term or long term. Short-term impacts are those expected to begin and end within the first 5 years after the action is implemented. Long-term impacts are those expected to last in excess of 5 years after the action is implemented up to and potentially beyond the 20-year planning horizon.
- Intensity—Intensity describes the magnitude of the impacts. Quantitative data are used to analyze the intensity of impacts wherever possible. If quantitative analysis is not possible, qualitative analysis is used.
- Direct and indirect impacts—Direct impacts are caused by implementation of an alternative and generally occur at the same time and place. Indirect impacts are reasonably foreseeable, but usually occur later in time or are removed in location.
- Cumulative impacts—Cumulative impacts are the direct and indirect results of a proposed alternative's incremental impacts, when they are added to other past, present, and reasonably foreseeable actions outside the scope of this EIS, regardless of who carries out the action (40 CFR 1508.7). These other actions may occur within, or adjacent to, the planning area. The list of actions used for cumulative impact analysis is provided in **Section 4.1.3**, Past, Present, and Reasonably Foreseeable Future Actions.

As discussed in **Chapter 1**, Introduction and Purpose and Need, this EIS is a programmatic document that is designed to evaluate planning-level decisions relating to oil and gas leasing and development in Osage County. The EIS does not evaluate project-level decisions, such as the future location of well pads, pipelines, access roads, or other surface facilities. These types of decisions, and the impacts associated therewith, will be analyzed in site-specific EAs that tier from the EIS as part of the APD process. The scope of the impacts analysis in this chapter is commensurate with the level of detail of the leasing and development actions presented in **Chapter 2**, the importance of resources and resource uses and potential that they will experience impacts, and the nature, quality, and quantity of data available.

There are many uncertainties associated with the projection of future oil and gas leasing and development. These uncertainties include the amount and location of economically recoverable oil and gas, advancements in extraction technology and processes, and market prices. To address these uncertainties, reasonable assumptions were made to facilitate the BIA's analysis of impacts. The assumptions are based on the history of development within the planning area, the BIA's knowledge of the planning area and current industry practices, and professional judgment. To minimize the chance that such assumptions would result in an understatement of the potential impacts on resources and resource uses, the BIA evaluated the alternatives based on the most optimistic projections of future leasing, development, and production.

The BIA relied on the best available science to inform its consideration of the environmental impacts associated with oil and gas leasing and development within the planning area. It should be noted, however, that the available data vary, depending upon the action being analyzed, geographic location of activities, and resources or resource uses that may be affected. Acreage figures and other numbers that appear in the analyses are estimates or projections used solely for comparative or analytical purposes. Readers should not infer that such figures reflect exact measurements or precise calculations. Acreage calculations are rounded to the nearest 10 acres for figures that are less than 1,000 acres and to the nearest 100 acres for figures that are greater than, or equal to, 1,000 acres.

Analytical Assumptions

The BIA made certain assumptions to facilitate the analysis of projected environmental impacts. These assumptions should not be interpreted as constraining or redefining the management objections and actions proposed for each alternative, as described in **Chapter 2**.

The analytical assumptions listed below apply to all resource categories. Resource-specific assumptions are provided in the methods and assumptions section for each resource.

- Local climate patterns and conditions affecting plant growth will continue, consistent with historical records.
- The BIA will conduct site-specific environmental analyses for individual APDs as necessary to comply with NEPA and other applicable law.
- Lessees will comply with the terms and conditions of the lease and approved APDs, the regulations in 25 CFR 226, orders and NTLs issued by the BIA Osage Agency Superintendent, and other applicable laws (such as the ESA, NHPA, CWA, and Soil and Water Resources Conservation Act), regardless of which alternative is selected in the ROD.
- Lessees will obtain the BIA Osage Agency Superintendent's approval prior to commencing activities or operations that deviate from the approved APD, applicable COAs, and any other site-specific requirements. Requests for such variances will include required documentation and a plan for mitigating anticipated impacts.

4.1.2 Cumulative Impacts

CEQ regulations require analysis of cumulative impacts because environmental conditions are the result of many different factors that act together. The total impact of an individual action cannot be determined by considering the action in isolation. Potential impacts are evaluated by considering the incremental additional direct and indirect impacts from the alternatives, when added to impacts from past, ongoing, and reasonably foreseeable future actions. Assessment data and information could span multiple scales, surface ownerships, and jurisdictions. These assessments involve determinations that often are complex and, to some degree, subjective.

Cumulative Analysis Method

The cumulative impacts discussion for each resource topic considers the alternatives in the context of the broader human environment, specifically, actions that occur outside the scope of this EIS or outside the planning area.

As previously discussed, this EIS is a programmatic document considering planning-level decisions regarding oil and gas leasing and development within the planning area; thus, the cumulative impact analysis will be broader and more general than the analysis conducted for a project-level review. The cumulative impact analysis in this chapter focuses on the effects that may arise from various management scenarios and other reasonably foreseeable activities and projects associated therewith. Quantitative information is used for this analysis when available and appropriate to portray the magnitude of an impact. For most resources, however, the analysis is qualitative, because the details of reasonably foreseeable activities and projects contemplated, including those that would tier to this EIS, are unknown.

The analysis assesses the magnitude of cumulative impacts by comparing the environment in its baseline condition with the expected impacts of the alternatives and other actions in the same geographic area. The magnitude of an impact is determined through a comparison of anticipated conditions against the naturally occurring baseline, as depicted in the affected environment (**Chapter 3**) or the long-term sustainability of a resource or social system.

The following factors were considered in this cumulative impact assessment:

- Tribal, federal, nonfederal, and private actions
- Potential for synergistic impacts or synergistic interaction among or between impacts
- Potential for impacts across political and jurisdictional boundaries
- Comparative scale of cumulative impacts across alternatives
- Other spatial and temporal characteristics of each affected resource

Temporal and spatial boundaries used in the cumulative analysis are developed based on resources of concern and actions that might contribute to an impact. The baseline year for the cumulative impacts analysis is 2017; the scope of this analysis is a 20-year planning horizon.

Spatial boundaries vary and are larger for resources that are mobile or migrate, such as deer populations, compared with stationary resources. Occasionally, spatial boundaries for the cumulative impact analysis encompass a portion of the planning area or a single location within the planning area. Spatial boundaries were developed to facilitate the analysis and are included under the appropriate resource section heading.

4.1.3 Past, Present, and Reasonably Foreseeable Future Actions

The cumulative impact analysis considers the incremental effects the alternatives may have on the environment, when added to other past, present, and reasonably foreseeable future actions within and surrounding the planning area. These actions are considered for the purpose of identifying whether, and to what extent, the environment has been degraded or enhanced, determining whether ongoing actions are causing impacts, and describing the trends associated with actions within, and impacts on, the planning area. The BIA selected actions for inclusion in the cumulative impact analysis based on their proximity to the planning area, connection to the same environmental systems, potential for impacts on resources and resource uses, and the likelihood that an action or project will occur.

The analysis considers past actions that contributed to the current condition of the resources, as described in **Chapter 3**. This includes historical and existing land uses within and surrounding the planning area. The analysis also considers ongoing actions and reasonably foreseeable future actions that may result in incremental impacts or synergistic effects if implemented in combination with the alternatives.

Reasonably foreseeable future actions are those for which there are existing decisions, funding, or formal proposals that are highly probable based on known opportunities or trends, and that would take place within a 20-year planning period. Reasonably foreseeable future actions are projections used to predict future impacts and are professional estimates based on current conditions and trends; they are not planning decisions or resource commitments. Unforeseen changes in factors such as economics, demand, or federal, state, local, and Tribal laws, regulations, and policies could result in outcomes that are different from those projected in this analysis.

Some potential future actions have been considered and eliminated from further analysis. This is because there is only a small likelihood these actions would be pursued and implemented within the 20-year planning period or because so little is known about the potential action that formulating an analysis of impacts would be premature. In addition, potential future actions to protect the environment (such as new threatened or endangered species listings) are not analyzed because such actions have a low likelihood of creating major environmental consequences alone or in combination with this planning process.

Data on the precise locations and overall extent of resources in the planning area vary according to the resource type and geographic location. It should be noted that the interplay among the resources and resource uses in the planning area will evolve over time. As knowledge improves, the BIA would consider management measures (adaptive or otherwise) for reducing potential cumulative impacts, in accordance with applicable laws, regulations, and policies.

Actions identified as having the greatest likelihood to generate potential cumulative impacts when added to the Osage County Oil and Gas EIS alternatives are displayed in **Table 4-1**.

Table 4-1
Past, Present, and Reasonably Foreseeable Projects, Plans, or Actions

Project	Description	Status
EA for the Oil and Gas Leasing Program of the Osage Indian Tribe	This document is a programmatic assessment of the environmental impacts associated with the BIA's administration of the Osage Mineral Estate for oil and gas leasing and development.	Completed in 1979; no longer valid.
Leasing PEA	This document is a programmatic assessment of the environmental impacts associated with leasing the Osage Mineral Estate for oil and gas mining.	Completed in November 2014; the EIS will replace this document.
Workover PEA	This document is a programmatic assessment of the environmental impacts associated with the approval of workover operations on existing wells on the Osage Mineral Estate. It applies solely to workover operations that do not require new ground disturbance.	Completed in April 2015; the EIS will replace this document.
Osage Nation Environmental and Natural Resources Department Integrated RMP	This document is a long-range, strategic plan that integrates the management actions for the Osage Nation's natural resources and other resources of value.	Completed in December 2005.
OKT Joint EIS/BLM RMP/BIA Integrated RMP	This document will result in a BLM RMP and a BIA Integrated RMP. The BLM RMP will guide the management of BLM-administered lands and federal mineral estate in Oklahoma, Kansas, and Texas. The BIA Integrated RMP will include management direction for allotted and Tribal mineral interests (in Osage County, the Integrated RMP will only apply to solid minerals, such as gravel). It also includes restricted Tribal lands and lands administered by the BIA Eastern Oklahoma and Southern Plains Regional Offices in Oklahoma, Kansas, Texas, and Nebraska.	Record of Decision signed on March 11, 2020.
Osage Wind Project	This is a 150-megawatt wind farm, encompassing 8,400 acres in the planning area, located approximately 15 miles west of Pawhuska, Oklahoma. It was developed by Tradewind Energy, Inc.	Began operating in 2015; subject of pending litigation.
Osage County Rural Water District #15 Phase 1A Capital Improvement	Two projects are proposed to improve storage and transmission. A new 300,000-gallon water tower is proposed along Highway 20 west of Skiatook, Oklahoma, to replace 2 standpipes.	Began operating in 2016.
The Osage Nation Long-Range Transportation Plan 2016–2036	The plan outlines the policies, objectives, and projects intended to improve the transportation system for the Osage Nation through 2036. Recommended roadway system improvements include including reconstructing and improving roads, improving drainages, creating new roads, creating additional parking areas and new recreation areas, and constructing bridges. Specifically, the plan proposes 26.9 miles of route and bridge additions and 10.6 miles of new sections to existing routes.	Plan completed in 2015. Projects to be carried out from 2018 to 2037.

Table 4-1
Past, Present, and Reasonably Foreseeable Projects, Plans, or Actions (cont.)

Project	Description	Status
Osage National Heritage Trail Scenic Byway	In 2008, the ODOT designated the 65-mile stretch of Highway 60 across Osage County as a scenic byway for the purpose of promoting tourism and economic development. The byway includes 4 scenic turnouts where tourists can obtain information regarding Osage Nation heritage.	Completed in 2019.
ODOT Construction Work Plan	This document is the ODOT's 8-year work plan (2018–2025) for road and bridge construction throughout Oklahoma. The plan includes a proposal to improve 47.59 miles of roads in Osage County.	Approved in 2018; ongoing.
Residential Land Use Plans	There is a 5-year plan to develop a 50-lot, single-family home subdivision in Pawhuska, Oklahoma, on the remaining 18 acres of a 23-acre parcel owned by the Housing Authority. The plan will add to a 30-unit apartment complex that was built on the site in 2006.	Construction is anticipated within the next 5 years.
Casinos	The Osage Nation owns 7 casinos, 1 each in Bartlesville, Sand Springs, Ponca City, Skiatook, Hominy, Pawhuska, and Tulsa. In 2016, the Osage Nation broke ground on a major expansion of the Osage Casino Tulsa, adding 247,000 square feet of gaming, hotel rooms, a brewery, and restaurant. The Osage Nation applied to have additional lands taken into trust by the Secretary of the Interior for the purpose of expanding other Osage casino properties in the future.	Construction to expand the Osage Casino Tulsa was completed in February 2019. Additional casino construction projects are anticipated.
Osage Prairie Bike Trail Extension	This is a 24-mile project to extend Osage Prairie Trail on the old Midland Valley Railroad ROW to Barnsdall, Oklahoma, and later to Pawhuska, Oklahoma, and the Tallgrass Prairie Preserve. The trail currently begins in north Tulsa, Oklahoma, and ends in Skiatook, Oklahoma.	Application submitted to the ODOT in 2018. Project is in the final approval stages.
Spearhead Pipeline (Enbridge)	This is a 650-mile, 24-inch pipeline between Flanagan, Illinois, and Cushing, Oklahoma, transporting 193,300 barrels per day of crude oil. Approximately 50 miles of the pipeline run through Osage County.	In operation since the 1950s.
Flanagan South Pipeline (Enbridge)	This is a 593-mile, 36-inch-diameter interstate pipeline between Pontiac, Illinois, and Cushing, Oklahoma, transporting 585,000 barrels per day of crude oil. It parallels the Spearhead crude oil ROW. Approximately 50 miles of the pipeline run through Osage County.	Approved in 2014; in operation.
BLM Wild Horse and Burro Long-Term Holding Facility	There are 11 wild horse and burro long-term holding facilities, covering 130,400 acres in Osage County.	In operation.
Agriculture and Livestock Grazing	Ranching is the main enterprise in Osage County. About 95 percent of the county is in agricultural use (Osage County 2011). The BIA administers 24 agricultural leases, and 309 grazing leases covering 71,632 acres.	Ongoing.

Table 4-1
Past, Present, and Reasonably Foreseeable Projects, Plans, or Actions (cont.)

Project	Description	Status
BIA Eastern Oklahoma Region Fire Plan	This is a 10-year, strategic fire management plan for 2010–2020 for the BIA Eastern Oklahoma Regional Office. It defines a program to manage wildland and prescribed fire on BIA-administered surface, based on approved land management goals and objectives.	Completed in May 2009, updated in 2016, valid through 2021.
USFWS ABB Oklahoma Industry Conservation Plan	Short-Term Oil and Gas Industry Conservation Plan was developed by the USFWS to provide a means for participants in the oil and gas industry to promote ABB conservation.	Completed in May 2014, amended in 2016 and 2019.
Other surface leases	The BIA administers 73 active business leases in Osage County, covering approximately 15,221 acres. These leases authorize such uses as hunting, tank battery sites, gas storage locations, smoke shops, casinos, and residences. Another 28 leases covering approximately 5,693 acres are pending.	Ongoing.
Limestone quarries	The BIA administers 4 active limestone or dolomite leases in Osage County: • The Candy Creek Crusher limestone quarry covers approximately 90 acres. • The APAC limestone quarry covers approximately 639 acres. • The Burbank limestone quarry covers approximately 529 acres. • The Sooner Cattle Company limestone quarry covers approximately 40 acres. There is 1 dolomite lease currently pending; the acreage is to be determined.	Ongoing.
Sandstone leases	The BIA administers 1 active sandstone lease in Osage County, covering 160 acres. There are no sandstone leases currently pending.	Ongoing.
Mining lease for the mining of sand	The BIA administers 2 active sand mining leases in Osage County, covering approximately 130 acres.	Ongoing.
Perdure North Burbank CO_2 enhanced oil recovery project.	This CO_2 enhanced oil recovery project involved the installation of a CO_2 gathering facility and 68 miles of 8-inch CO_2 pipeline, as well as the construction of field infrastructure facilities for CO_2 injection (Tuttle 2013).	Completed in 2013; ongoing.

4.1.4 Incomplete or Unavailable Information

The CEQ regulations implementing NEPA require an agency to identify information that may be incomplete or unavailable when evaluating reasonably foreseeable, significant, adverse effects on the human environment in an EIS (40 CFR 1502.22). If the information is essential to a reasoned choice among alternatives, it must be included or addressed in the EIS. Knowledge and information are, and will always be, incomplete, particularly with complex ecosystems considered at various scales. The BIA used the best available information to develop this EIS. In addition, considerable effort was taken to acquire and convert resource data from the BIA, USGS, and outside sources into digital format for use in the EIS.

The BIA has sufficient data and information to support the planning-level decisions in this EIS. It should be noted, however, that certain information was not available for use in developing the EIS because inventories have not been conducted or are incomplete. Specifically, planning area-wide field surveys for cultural and paleontological surveys have not been conducted, production data for individual wells are incomplete, and critical habitat designations for the ABB are not available. The BIA determined that this information is not essential to the evaluation of reasonably foreseeable significant adverse effects because this EIS is programmatic in nature. Subsequent project-level analyses, including NEPA analyses for APDs, will allow the BIA to collect and evaluate the site-specific data and information necessary to determine the appropriate application of this EIS. Such ongoing data collection will provide a greater understanding of the resource trends that were used in developing the alternatives and assessing impacts associated therewith.

The number, type, and significance of resources for which information is incomplete or unavailable were estimated, based on previous surveys, knowledge of the planning area, and professional judgment. Some impacts could not be quantified, given the proposed management actions. Where this occurred, the BIA projected impacts in qualitative terms or, in appropriate instances, described the impacts as unknown.

4.2 Topography, Geology, Paleontology, and Soils

This section discusses impacts that the alternatives described in **Chapter 2** may have on topography, geology, paleontology, and soils. Impacts on these resources were evaluated based on the maximum potential disturbance under each alternative.

4.2.1 Methods and Assumptions

Indicators

Topography and Geology

Topography is expected to remain the same. An increased understanding of geology and geologic hazards within the planning area can be expected as knowledge is gained through oil and gas exploration and development, as well as through geologic mapping. Geologic hazards are natural physical conditions that could damage land or structures and injure humans.

Indicators of topographic or geologic change are not included in this analysis due to the rate and unpredictability of such changes; an example is sedimentation over millions of years or sudden shifts in surface geology as a result of faulting. Instead, indicators were developed based on the potential effects of geologic hazards on management scenarios. As such, the indicators are the following:

- The location of the planning area in relation to geologic hazards, including fault features and areas of induced earthquake activity
- The presence of high concentrations of H_2S in oil and gas reservoirs

Paleontology

Paleontological resources in the planning area are susceptible to impacts from surface-disturbing activities associated with oil and gas exploration and development. Paleontological resources are considered fragile and nonrenewable; thus, direct impacts are considered to be permanent. Paleontological resources on surface and subsurface lands within the BIA's jurisdiction are managed in accordance with 59 Indian Affairs Manual 7, Paleontological Resources.

The indicator of impacts on paleontological resources is damage to paleontological resources due to surface-disturbing activities in rocks or soils bearing paleontological resources.

Soils

Soil resources in the planning area are susceptible to impacts from surface disturbance associated with oil and gas development activities, such as the construction of well pads, pits, roads, utility corridors, and facilities; the installation of pipelines; site-clearing for construction staging; exploratory and drilling operations; and production operations.

Indicators of impacts on soils are the following:

- Acres of the Osage Mineral Estate open to new surface-disturbing activities
- Accelerated soil erosion, loss of soil, or reduced soil productivity
- Additional salt scarring from accidental releases of produced water or saline water

Assumptions

The analysis of potential impacts on topography, geology, paleontology, and soils includes the following assumptions:

- Proposed ground-disturbing activities will be designed to minimize soil loss, compaction, erosion, and reduction in productivity.
- Underground injection wells used for disposal are typically located close to the oil and gas wells they serve but may be located in other areas if the formations used for disposal cannot be accessed from the leased lands.
- Short-term impacts on these resources will typically occur during the construction phase, including any interim reclamation of construction sites or staging areas.
- Permanent impacts can be minimized by proper construction, responsible and workmanlike operation, proper plugging and abandonment, and restoration of the land to its original contour.
- Impacts will be concentrated in areas of moderate to high potential for oil and gas development.
- Adherence to applicable laws, regulations, BMPs, COAs, orders, and notices will mitigate short- and long-term impacts on these resources. For example, cultural resource surveys conducted prior to ground-disturbing activities in accordance with the NHPA may result in the discovery and avoidance of paleontological resources.

4.2.2 Impacts Common to All Alternatives

Under all alternatives, oil and gas leasing and development would continue to occur. Surface-disturbing activities associated with oil and gas production, such as road and well pad construction, can lead to soil compaction, vegetation removal, and accelerated erosion. Oil and gas production creates a risk of produced water and petroleum spills. These spills can damage or kill vegetation and create salt scars, leading to accelerated erosion.

Toxic hydrogen sulfide (H_2S) is considered a geologic hazard that may be released during drilling and completion, as leakage or as incomplete combustion during flaring. Under all alternatives, flaring would continue to be prohibited without permission of the BIA Osage Agency Superintendent. If this requirement would reduce the overall amount of flaring, it could reduce the amount of H_2S leakage during such flaring. Further impacts of H_2S are discussed in **Section 4.11**, Public Health and Safety.

Disposal of produced water in the Arbuckle formation using injection wells has been shown to stimulate earthquakes (*i.e.*, induced seismicity) in Oklahoma. The cause of the induced seismicity is hypothesized to be due to produced water lubricating existing faults (Weingarten et al. 2015; OGS 2015). As discussed in **Section 3.2.2**, Topography, Geology, Paleontology, and Soils, Current Conditions, injection was temporarily stopped or reduced at several wells in Osage County in response to the Pawnee earthquake. Shortly thereafter, the EPA issued a moratorium on the approval of new permits for Arbuckle disposal wells in Osage County. Produced water disposal has since shifted to other formations, such as the Mississippi Formation, and seismicity in the area has decreased. The produced water disposal in the vicinity of known faults could increase the risk of seismicity. A low risk of induced seismicity would remain under all alternatives, so long as underground injection continues within the planning area.

Hydraulic fracturing (commonly referred to as fracking) has not been prevalent within the planning area; accordingly, fracking has not been linked to induced seismicity in Osage County. In cases where fracking is used to stimulate production, there would likely be increased volumes of produced water as well as increased volumes of wastewater injection. Where there is an increase in the volumes of produced water, there is a risk that there could be more spills or that spills could be larger. In addition, increased volumes of wastewater injection could result in higher levels of seismicity. While fracking is uncommon within the planning area, other enhanced oil recovery methods—waterflooding and CO_2 injection—account for a significant portion of production.

Fracking, waterflooding, and CO_2 injection are designed to change reservoir pressure to increase recovery. These changes in pressure have the potential to force oil and contaminated water out of nearby wells that were plugged and abandoned using historical techniques, that were orphaned and improperly abandoned, or that were plugged using modern technology but have since been compromised due to changes in conditions surrounding the well.

Prior to the approval of operations involving enhanced oil recovery methods, data from nearby wells is reviewed to identify and mitigate potential risks. Despite taking such steps, there is always a possibility that historical information may be incomplete or unavailable or that conditions (including subsurface conditions) at a well site may have changed since the applicable reports were filed; thus, there is still a potential risk that enhanced oil recovery methods could cause nearby wells to purge, which may result in soil or groundwater contamination.

Overpressure zones are areas where subsurface pressure is abnormally high and exceeds hydrostatic pressure at a given depth, usually in buried fluid-filled sediments. This could result in the rapid escape of the over-pressurized fluids, leading to a well blowout, which can harm individuals on the drilling rig (Schlumberger 2015).

Lost circulation is the reduced or total absence of returning fluid during drilling, generally classified as seepage (less than 3 cubic meters per hour), partial loss returns (greater than 3 cubic meters per hour), and total loss, where no fluid returns (Schlumberger 2015). The loss of fluid generally translates into financial loss to the drilling company, well damage, and potential risk to the drilling rig and personnel. Overpressure zones and zones of lost circulation are difficult to predict before drilling, but lessees should expect to encounter these conditions occasionally. Locations of these conditions are difficult to predict and the associated risks would not change, regardless of the alternative chosen.

Under all alternatives, the BIA would apply COAs to workover and drilling permits to reduce the impacts from development operations, prevent environmental degradation, and ensure compliance with applicable laws and regulations. COAs may be applied to all permits or on a case-by-case basis, depending on the alternative selected. Application and enforcement of COAs that reduce surface disturbance (COAs 2, 19, 21, and 23) would protect soil resources by reducing compaction or erosion impacts as well as damage to paleontological resources. COA 19, which requires that lessees comply with EPA UIC program requirements, would also help avoid induced seismicity.

4.2.3 Alternative 1 (No Action)

Under Alternative 1 (No Action), the application of COAs and enforcement of regulations would continue to mitigate impacts on topography, geology, paleontological resources, and soils. COAs 4, 12, and 15 would minimize long-term changes to topography by limiting activities on steep slopes and requiring both the interim reclamation of pits and restoration of surface lands to their original contour once a well is no longer producing. While there are no COAs specific to paleontological resources or geologic hazards, COAs aimed at other resources may result in incidental protections. COAs 1, 2, and 23, which require compliance with the NHPA and avoidance of impacts on cultural resources, would result in the incidental avoidance and protection of paleontological resources. COAs 3, 5, and 6 explicitly protect soil resources, requiring that lessees avoid or minimize soil disturbance, implement appropriate erosion control measures, and confine vehicles and equipment to established roads. COAs 9, 11, and 15 would also reduce impacts on soil resources by requiring the removal of old equipment and contaminated soil from well sites, preparation of spill prevention plans, and interim reclamation of pits. COA 18, which requires the implementation of air quality BMPs if operations penetrate formations containing H_2S of 100 ppm or greater, would reduce the risk of potential impacts from releases of, or exposure to, H_2S gas.

4.2.4 Alternative 2

Under Alternative 2, the BIA would issue a list of standard BMPs that apply to all oil and gas development operations within the planning area. In addition, the BIA would minimize the number of COAs applied to permits and would not prescribe specific methods operators must use to comply with the BMPs or other applicable laws and regulations; operators would be given latitude to determine how best to comply. While there are no COAs specific to paleontological resources or geologic hazards, COAs aimed at other resources may result in incidental protections.

As was the case for Alternative 1, COAs 1, 2, and 23, which require compliance with the NHPA and avoidance of impacts on cultural resources, would result in the incidental avoidance and protection of paleontological resources. The addition of COA 27, which prevents the land application of waste and other deleterious substances, would reduce the risk of soil contamination and salt-scarring, as compared with Alternative I. However, waiver of the COAs relating to soil disturbance, erosion control, vehicle traffic, the removal of equipment and contaminated soil, preparation of SPCC plans, interim and final restoration of surface lands, and prior approval for operations not covered by the APD (COAs 3–6, 9, 11–12, 15, and 23) would increase the probability of soil loss, erosion, compaction, and contamination. In addition, the waiver of COA 18, relating to operations in formations that may contain H_2S, would increase the potential for public health hazards due to exposure. Voluntary compliance with BMPs and agreements between lessees and surface owners regarding restoration of surface lands may mitigate some of these impacts.

4.2.5 Alternative 3

Under Alternative 3, the BIA would issue the same standardized list of BMPs and minimal COAs as Alternative 2 in sections with a high density of historical oil and gas development. The BIA would implement the same well spacing requirements and additional protective COAs as Alternative 4 in sections with a low density of historical oil and gas development. In addition, the BIA would not approve new ground-disturbing activities in the sensitive areas described in **Section 2.3.4**, Alternatives Considered for Detailed Analysis, Alternative 3—Hybrid Development. Applying COAs based on the density of well development would result in location-specific impacts on topography, geology, paleontology, and soils.

In high-density sections, the waiver of COAs relating to soil disturbance, erosion control, vehicle traffic, the removal of equipment and contaminated soil, preparation of SPCC plans, interim and final restoration of surface lands, and prior approval for operations not covered by the APD (COAs 3–6, 9, 11–12, 15, and 23) would increase the probability of soil loss, erosion, compaction, and contamination. The waiver of COA 18, which requires the implementation of air quality BMPs if operations penetrate formations that may contain H_2S of 100 ppm or greater, would increase the risk of public health hazards due to exposure. Voluntary compliance with BMPs and agreements between lessees and surface owners regarding restoration of surface lands may mitigate some of these impacts.

In low-density sections and sensitive areas, Alternative 3 would reduce surface disturbance and provide additional protection to topography, paleontological resources, and soils and would reduce geologic hazards, as compared with Alternative I (No Action). In addition to all COAs applicable to these resources and geologic hazards under Alternatives 1 and 2, COAs 26, 28, 30, and 31 also apply in low-density sections. COAs 26 and 28, which require that well sites and pits be located outside of areas prone to frequent flooding and at least 200 feet from streams and waterways, would reduce the potential for soil contamination. COA 30, which requires the burial of pipelines where appropriate, could increase soil disturbance, as compared with Alternative 1 (No Action). It should be noted, however, that because COA 30 applies only where appropriate, the BIA could waive the COA where necessary to avoid impacts on sensitive soils. Finally, COA 31, which requires the collocation of facilities, would reduce soil disturbance.

4.2.6 Alternative 4

Under Alternative 4, the BIA would apply well spacing requirements and additional protective COAs (COAs 26, 28, and 30–31), beyond those applied under Alternative 1 (No Action), to all new development within the planning area. Further, the BIA would not approve new ground-disturbing activities in the sensitive areas identified under Alternative 3 and the additional sensitive areas described in **Section 2.3.5**, Alternatives Considered for Detailed Analysis, Alternative 4—Enhanced Resource Protection. The types of impacts on topography, paleontological resources, geology, and soils under Alternative 4 are described above for Alternative 3, low-density sections. The scope of those impacts, however, would be further reduced under Alternative 4 due to the application of protective COAs planning area wide and restrictions on ground disturbance in a larger number of sensitive areas.

Under Alternative 4, approximately 524,400 acres would be protected from new ground-disturbing oil and gas development activities, reducing potential impacts on topography, geology, paleontology, and soils. The application of well spacing requirements and cultural resource buffers (see **Table 2-2** in **Chapter 2)** countywide under this alternative would provide direct protection for paleontological resources. Such buffers would also provide incidental protections for topography and soils by reducing surface disturbance, particularly near streams, rivers, ponds, reservoirs, lakes, and wetlands. Due to the application of protective COAs, well spacing requirements, and cultural resource buffers throughout the planning area, Alternative 4 would reduce potential impacts on topography, geology, paleontology, and soils compared with Alternative 1 (No Action).

4.2.7 Cumulative Impacts

The cumulative impact analysis area for topography, geology, paleontology, and soils is the planning area. Past, present, and reasonably foreseeable future actions and conditions involving ground disturbance have affected, and would likely continue to affect, topography, geologic hazards, paleontological resources, and soils within the cumulative impact analysis area. Examples of such actions and conditions are set forth in **Table 4-1**. Oil and gas development activities under the alternatives would have impacts like those of past and present development and would contribute to the cumulative effects on topography, geologic hazards, paleontological resources, and soils.

Alteration of the landscape during development and construction activities would result in impacts on topography and soils. Potential impacts on topography resulting from future oil and gas development activities would generally be localized to the well pad, adjacent area, and access roads, which typically require surface disturbance of 2 acres or less. Impacts on topography could include changes in soil composition, drainage patterns, erosion, and scenery. Such impacts could be short or long term, depending on the duration of the action or condition and associated disturbance.

Oil and gas development activities would likely affect topography until the well is abandoned. The requirement that lessees return surface lands to their original contour upon plugging and abandonment would mitigate these affects. Temporary surface disturbance during construction, development, and road maintenance activities would have short-term impacts on soils. In contrast, the removal of vegetation and construction of well pads, foundations for oil and gas or wind energy facilities and roads could have long-term impacts on soil compaction and erosion.

Future drilling and injection operations would increase susceptibility to geologic hazards. Development and construction activities involving surface or subsurface ground disturbance could result in irreversible damage to or destruction of paleontological resources. Conversely, preparation of required surveys, COAs relating to the protection of cultural resources, and mitigation measures could result in the discovery and preservation of important paleontological resources.

4.3 WATER RESOURCES

This section discusses impacts that the alternatives described in **Chapter 2** may have on water resources. Impacts on these resources were evaluated based on the maximum potential disturbance under each alternative.

4.3.1 Methods and Assumptions

Indicators

Indicators of impacts on surface water and groundwater resources are the following:

- Alteration of the physical, chemical, or biological characteristics of streams, springs/seeps/fens, wetlands, riparian areas, and groundwater aquifers to a point that these resources are not properly functioning or sustainable
- Inability to meet federal water quality standards or federally approved state or Tribal water quality standards for surface water and groundwater
- Changes in water quality that affect downstream aquatic or riparian species
- Miles of roads constructed
- Contamination from spills of hazardous or other harmful materials
- Depletion of water supplies or significant reduction in streamflow

Assumptions

- Water quality associated with oil and gas development is determined by the proximity of development and associated roads to drainages and groundwater wells, location in the watershed, time and degree of disturbance, potential to restore surface lands to the original contour, vegetation, precipitation, and mitigating actions applied to the disturbance.
- In general, the shallower the groundwater, the more susceptible the aquifer is to contamination.
- New transportation facilities will be properly designed (minimum standards).
- Unconfined aquifers and groundwater that are less than 100 feet deep are the most vulnerable to leaks and spills of deleterious substances associated with oil and gas development.
- The majority of new oil and gas wells drilled in the planning area between 2018 and 2037 will be vertical (conventional) wells.
- The BIA will continue to require SPCC plans for new drilling activities to minimize potential adverse impacts from accidental spills of deleterious substances.

4.3.2 Impacts Common to All Alternatives

Under all alternatives, oil and gas leasing and development would continue. The primary uses of surface water and groundwater are expected to remain the same—public water supplies, agriculture, and oil and gas development. Oil and gas development require the use of water for well stimulation (including hydraulic fracturing), enhanced oil recovery, water-based drilling muds, and for other minor uses, such as for dust suppression and equipment cleaning.

Both the population and oil and gas development activity in the planning area are expected to increase over the next 20 years (see **Section 4.10**, Socioeconomics and Environmental Justice, and **Section 4.16**, Mineral Extraction). As oil and gas development and populations increase, the demand for water is also likely to increase.

Oil and gas development may affect water resources in the following ways:

- Surface disturbance (*e.g.*, road, power line, pipeline, and well pad construction) can increase runoff or change the physical characteristics of waterbodies.
- Subsurface disturbance can change aquifer properties.
- Leaks and spills can contaminate groundwater and surface water with naturally occurring pollutants or chemicals used for oil and gas drilling and extraction.
- Leaks and spills of brine can inhibit plant growth and affect soil structure, leading to greater erosion of soils to surface water.

Water quality and quantity are susceptible to impacts from surface disturbance, drilling, water use and extraction, and other actions that alter the physical characteristics of surface and groundwater, which are inextricably linked. Every management action that could directly or indirectly alter aquifer properties, water quality or quantity, or the physical features of waterbodies can have accompanying temporary or permanent impacts on water resources.

Oil and gas development utilizes water that may go back into the natural system. Results from a study of 2 historical oil and brine pit sites located near Skiatook Lake indicated that significant amounts of salts from produced water releases and petroleum hydrocarbons remained in the soils and rocks after more than 60 years of natural attenuation (USGS 2003b).

Under all alternatives, lessees would be responsible for complying with the CWA and Safe Drinking Water Act of 1974, as amended. Such compliance ensures that any water quality degradation that could occur would be within federal water quality standards. The application of COAs 1, 2,16, 19, 21, and 23, which reduce surface disturbance, would reduce impacts on water resources by restricting the flow of sediment into waterways. COAs that require setbacks from waterways and development of structural enhancements would also protect water quality.

COA 19, which requires that lessees comply with EPA UIC Program permitting and operational requirements for all injection and disposal wells, would reduce the risk of surface water and groundwater contamination. It would do this by ensuring proper well construction and monitoring. COA 19 would also reduce the risk that induced seismicity could impact water resources by regulating the formations available for injection, as well as injection volume and pressure.

Under all alternatives, the BIA would apply COAs to workover and drilling permits to reduce the impacts from development operations, prevent environmental degradation, and ensure compliance with applicable laws and regulations, such as the CWA and SDWA. COAs may be applied to all permits or on a case-by-case basis, depending on the alternative selected. Application and enforcement of COAs that reduce surface disturbance would reduce impacts on water resources by restricting the flow of sediment into waterways, maintaining drainage, and reducing the risk of leaks or spills of deleterious substances.

Surface Water

Oil and gas exploration, development, and production could have short- and long-term impacts on surface water resources. Surface-disturbing activities, such as road, power line, pipeline, and well pad construction, can remove or disturb essential soil-stabilizing agents, such as vegetation diversity, soil crusts, litter, and woody debris. These soil features function as living mulch by retaining moisture and discouraging annual weed growth (Belnap et al. 2001). Loss of 1 or more of these agents increases potential erosion and sediment or pollutant transport to surface waterbodies, leading to surface water quality degradation.

Under certain circumstances, surface-disturbing activities could lead to soil compaction, which decreases water infiltration rates. Soil compaction also elevates the potential for overland flow, which can increase erosion and sediment or pollutant delivery potential to the surface waterbodies in the area, leading to surface water quality degradation.

Surface-disturbing activities in areas of low reclamation potential, such as sensitive soils (see **Section 3.2**, Topography, Geology, Paleontology, and Soils) and slopes greater than 40 percent result in a greater potential for erosion and sediment delivery to surface waters, thereby degrading water quality.

Surface-disturbing activities in stream channels, floodplains, and riparian habitats are more likely to alter natural morphologic stability and floodplain function. Morphologic destabilization and loss of floodplain function accelerate stream channel and bank erosion, increase sediment supply, dewater near-stream alluvium, cause the loss of riparian and fish habitat, and deteriorate water quality (Rosgen 1996). Altering or removing riparian habitats can reduce the hydraulic roughness of the bank and increase flow velocities near the bank (National Research Council 2002). Increased flow velocities near the bank can accelerate erosion, decreasing water quality.

Surface-disturbing activities, such as the location and construction of well pads, facilities, roads, and culverts, could affect natural drainage patterns. When surface-disturbing impacts are allowed to alter natural drainage patterns, the runoff critical to recharging and sustaining locally important aquifers, springs/seeps/fens, wetlands, and associated riparian habitats is redirected elsewhere. As a result, these sensitive areas can be dewatered, compromising vegetative health and vigor, while degrading the proper function and condition of the watershed.

Altering natural drainage patterns can also cause the water level and volume to increase or decrease, depending on the magnitude of the change and location of the construction or installations. The resulting changes could influence erosion and sedimentation rates. Temporary construction or development activities would likely have short-term impacts on surface water resources. The construction of well pads, facilities, and roads would impact surface water resources for the duration of the project. Post-construction dust and traffic associated with operations could slightly increase turbidity and sedimentation; however, implementation of best management practices would reduce impacts to a minimal effect.

Horizontal and directional drilling would reduce surface disturbance and the potential for adverse impacts on surface water quality. Using such drilling to access mineral resources located in sensitive areas, such as steep slopes, streams, and rivers, would allow for testing and extraction of those resources, while minimizing impacts on the surface.

Future pipeline construction could affect surface water due to withdrawals. Narrow drainages are typically crossed using elevated pipelines or suspension spans. Once installed, aboveground pipelines would have virtually no impact on water flow characteristics but could affect water quality in the event of leaks or spills.

Oil and gas development operations could cause surface water contamination due to spills and accidents at and around well sites, from pipelines and storage facilities, through trucks delivering chemicals or removing wastes, and through the improper disposal of wastes (AWWA 2013). The extent of the impacts from a spill depends on volume, release duration, and water constituent concentrations (i.e., salts, naturally occurring radioactive material, and metals). Permitting, COAs, spill containment systems, and safety-conscious management would mitigate the risks to surface water resources.

Groundwater

Impacts from oil and gas development under all alternatives in the planning area include changes to water availability and quality, increased wastewater disposal, and possible wastewater injection-induced seismicity. Determining the potential impacts on groundwater requires the consideration of all stages of water management during oil and gas development; however, long-term impacts on local groundwater resources have been poorly defined (Alley 2014; NGWA 2016; King 2012).

Most studies of groundwater impacts have been largely based on sampling of domestic wells, which are inadequate for determining contamination migration pathways, attenuation processes, and the overall impacts on freshwater resources (Alley 2014). Lack of adequate scientific information can be a constraint to implementing mitigation (Clement et al. 2014). If groundwater contamination is suspected or identified, the BIA, EPA, USGS, and state agencies will be notified so an investigation can be conducted and mitigation measures can be applied or remedial action can be taken, if necessary.

Oil and gas development could impact groundwater resources due to the withdrawal of freshwater, subsurface disposal of produced water, and contamination from spills. Under all alternatives, the availability of freshwater resources would be reduced. The extent of that reduction would depend upon a variety of factors, including precipitation, the volume of new development, and the drilling techniques utilized. The drilling and completion of conventional oil and gas wells often requires a substantial amount of water; however, air drilling, a technique commonly used to drill vertical wells in the planning area, would reduce the amount of water required.

Hydraulic fracturing (or fracking) is uncommon within the planning area, but if conducted, it would use several million gallons of groundwater per completion. Should the amount of fracking in the planning area increase, it could affect the availability of freshwater resources for other uses, as well as wastewater disposal and treatment requirements.

Extensive water withdrawals can reduce groundwater discharge to connected streams and springs, which, in turn, can damage or eliminate riparian vegetation and aquatic life. In addition, groundwater and surface water connectivity could affect the domestic water supply if oil and gas wells are drilled within the same aquifer or near domestic water wells. Groundwater withdrawals that exceed natural recharge rates also have the potential to mobilize lower-quality water from the land surface or adjacent subsurface formations.

Oil and gas development operations could cause groundwater contamination due to spills and accidents at and around well sites, from pipelines and storage facilities, through trucks delivering chemicals or removing wastes, and through the improper disposal of wastes (AWWA 2013). The extent of the impacts from a spill depends on volume, release duration, and water constituent concentrations (i.e., salts, naturally occurring radioactive material, and metals).

A properly constructed and managed oil or gas well that complies with regulations and standard industry practices is unlikely to directly cause groundwater contamination, though such contamination is possible. Technological, regulatory, and procedural safeguards (i.e., proper casing, cementing, and well construction) are designed to prevent such contamination. For example, federal regulations require that surface casing be installed in the wellbore from the surface to a point below the deepest drinking water aquifer. While the degradation of well casings over time has been linked to groundwater contamination, technological advances to the casing used in modern wells is less likely to degrade. Degradation can also be reduced through appropriate monitoring and testing. Failure to plug a well or the improper plugging and abandonment of a well could also result in contamination if production zones, drinking aquifers, and the surface are not properly isolated from each other (AWWA 2013). Permitting, COAs, spill containment systems, and safety-conscious management would mitigate these risks.

If aquifers are contaminated, the changes in groundwater quality could affect downstream users who divert groundwater. Changes in groundwater quality could also affect springs, surface waters, and municipal, public, and domestic wells that are hydrologically connected to the affected aquifers. The extent of potential contamination would depend on the point of contamination and volume of contaminants released. The permitting, COAs, and the enforcement of rigorous casing protocols would reduce the risk of contamination.

The storage of produced water in pits prior to disposal could contaminate shallow groundwater if there are surface spills, leaks, or infiltration through soils. The severity of such impacts would depend on pit construction, soil properties, proximity to drinking water resources, and water table depth. The regulations in 25 CFR 226, notices and orders issued by the BIA Osage Agency Superintendent, and application of COAs relating to pit location, construction, maintenance, and closure minimize the risk that produced water could impact drinking water.

The disposal of produced water through subsurface injection could impact groundwater quality if it migrates to the surface or into freshwater aquifers. In the planning area, the EPA permits and regulates all Class II disposal wells, pursuant to the Underground Injection Control (UIC) Program, established to protect underground sources of drinking water from contamination. **Table 4-2** describes potential impacts on drinking water. The UIC Program works with injection well operators throughout the life of the well to ensure proper well construction; prevention of leaks; proper monitoring, recordkeeping, and reporting; compliance with any required operating conditions; and proper well abandonment once

Table 4-2
5 Common Stages of Water Management During Oil and Gas Development

Stage	Description	Activity	Potential Impact on Drinking Water Resources
1	Water acquisition	Water is withdrawn from groundwater or surface water resources to be used during drilling and hydraulic fracturing.	Changes in the quantity and quality of water available for drinking
2	Chemical additive mixing	Once delivered to the well site, the acquired water is combined with chemical additives and proppant to make drilling or hydraulic fracturing fluids, or both.	Releases to surface water and groundwater through on-site spills or leaks
3*	Hydraulic fracturing process	Pressurized fluid is injected into the well, creating cracks in the geological formation that allow oil or gas to escape through the well to be collected at the surface.	Release of hydraulic fracturing fluids to groundwater due to inadequate well construction or operation
4	Flowback and produced water**	Following enhanced recovery by water flood or hydraulic fracturing operations, when pressure in the well is released, fluids, formation water, or natural gas begin to flow back up the well. This combination of fluids containing drilling and hydraulic fracturing additives or naturally occurring substances must be stored on-site—typically in tanks or pits—before treatment, recycling, or disposal.	Release to surface or groundwater through spills or leakage from on-site storage
5	Wastewater treatment and waste disposal	Wastewater is dealt with in 1 of several ways, including disposal by underground injection, treatment followed by disposal to surface waterbodies, or recycling (with or without treatment) for use in future oil and gas operations.	Contaminants reaching drinking water due to surface water discharge, or contamination of groundwater due to inadequate well design and construction at the disposal well site

Source: Modified from EPA 2015h
*Stage 3 applies only to wells developed through the hydraulic fracturing process.
**Flowback consists primarily of fluids used during the hydraulic fracturing process that are usually flushed out during the first couple weeks of production (this may contain some produced water). Produced water consists primarily of naturally occurring water produced along with oil or gas, or both (this may contain some flowback).

operations end. The EPA's regulation of disposal wells under the UIC Program significantly reduces the risk of impacts on drinking water due to subsurface disposal of produced water.

Significant attention has also been directed toward the possibility of subsurface migration of fracturing fluids or hydrocarbons into freshwater aquifers. Birdsell et al. (2015) concluded that it is less likely that hydraulic fracturing fluids would reach an overlying drinking water resource if (1) the vertical separation distance between the targeted rock formation and the drinking water resource is large and (2) there are no open pathways (e.g., natural faults or fractures or leaky wells). As the vertical separation distance between the targeted rock formation and the underground drinking water resource decreases, the likelihood of upward migration of hydraulic fracturing fluids to the drinking water resource increases.

The interaction between hydraulically generated fractures and existing wells does not necessarily imply that leakage to an overlying aquifer will occur, but the potential exists. The horizontal proximity of hydraulic fracturing to domestic groundwater wells requires consideration too (Jasechko and Perrone 2017; Brown, Lowe et.al, 2016; EPA 2016e; Birdsell et al. 2015).

Table 4-2, above, describes potential indirect impacts on drinking water from oil and gas development.

Impacts on Water Resources Due to Hydraulic Fracturing

Wastewater from hydraulic fracturing is disposed of in the following ways: disposal by underground injection, treatment followed by disposal to surface waterbodies, or recycling (with or without treatment) for use in future hydraulic fracturing operations.

Potential impacts on water resources from wastewater disposal from fluid-mineral development in the planning area include contaminants reaching drinking water due to surface water discharge, or inadequate treatment of wastewater and byproducts formed at drinking water treatment facilities by reaction of hydraulic fracturing contaminants with disinfectants. Impacts from underground wastewater injection include groundwater contamination from inadequate well construction, movement of fracturing fluids from the target formation to drinking water aquifers through human-made or natural features, or movement into drinking water aquifers of wastewater fluid that may contain natural substances found underground, such as metals or radioactive materials, that were mobilized during hydraulic fracturing activities (EPA 2016e).

The disposal of wastewater from hydraulic fracturing using injection wells could result in induced seismicity. Such seismicity has the potential to cause aquifer disturbances; shifting saturated zones, particularly near fault lines; well damage; and the release of oil and gas into aquifers.

Subsurface disturbances, such as induced seismicity, can also alter natural aquifer properties; for example, they can enhance conductivity of existing fractures; breach confining units; and change hydraulic pressure gradients. Further, altering natural aquifer properties can dewater locally important freshwater sources, such as groundwater, springs, seeps, fens, and streams. At the leasing stage, it is unknown whether hydraulic fracturing could be conducted as part of subsequent operations. Accordingly, the potential impacts that hydraulic fracturing would have on water resources would be addressed during the NEPA review process for APDs.

Subsurface disturbances can alter natural aquifer properties; for example, they can enhance hydraulic conductivity of existing fractures, breach confining units, and change hydraulic pressure gradients. This can increase the potential for contaminating surface water and groundwater. Furthermore, altering natural aquifer properties can dewater locally important freshwater sources, such as groundwater, springs, seeps, fens, and streams.

There is a risk that hydraulic fracturing fluids, saline produced water, and condensate could be spilled during use, storage, or transportation. The migration of such fluids to surface water or groundwater could affect water quality.

Hydraulic fracturing occurs in gas-producing formations at depth. Water, sand, and chemical additives are pumped into the formation at an extremely high pressure to create fractures that allow gas to flow into the well. Theoretically, improperly completed wells or perforations into zones of geological weakness—faults or fractures—could create conduits that allow fracturing fluids, produced water, and methane to migrate to groundwater. If groundwater is contaminated, there are few cost-effective ways to reclaim it; thus, the long-term impacts of groundwater contamination would be considerable.

Compliance with federal laws, such as the CWA and SDWA, applicable regulations, and COAs would reduce the potential impacts hydraulic fracturing could have on water resources by helping ensure water quality standards are met.

4.3.3 Alternative 1 (No Action)

Under Alternative 1 (No Action), the application of COAs and enforcement of regulations would continue to mitigate impacts on water resources by reducing the risk of surface water or groundwater contamination. The regulations in 25 CFR 226 prohibit drilling within 200 feet of an established watering place, which would protect certain water sources from the impacts of surface disturbance described in **Section 4.3.2**, Impacts Common to All Alternatives. The regulations also prescribe standards for the construction and maintenance of pits, which protect water resources from contamination due to leaks and infiltration.

COA 14 directly protects water resources by prohibiting oil and gas development activities in stream channels or wetlands without authorization and requiring lessees to avoid the discharge of soil and contaminants or removals of water, which could result in violations of federally approved water quality standards. COAs 8 and 11, which require proper storage of chemicals and preparation of SPCC plans for tank batteries, reduce the risk of surface water and shallow groundwater contamination due to spills.

COAs 3, 4, and 5, developed to protect other types of resources, would also provide incidental protection for water resources. These COAs, which require avoidance of soil and vegetation disturbance, minimization of alterations of topography, and erosion control, would reduce runoff that could impact surface water quality. COA 13, which requires lessees to minimize dust, could help protect surface water quality by reducing sedimentation. The withdrawal of surface water for the purpose of dust abatement, however, could impact water levels if withdrawal rates exceed recharge rates.

4.3.4 Alternative 2

Under Alternative 2, the BIA would issue a list of standard BMPs that apply to all oil and gas development operations within the planning area. In addition, the BIA would minimize the number of COAs applied to permits and would not prescribe the specific methods operators must use to comply with the BMPs or other applicable laws and regulations; operators would be generally be given latitude to determine how best to comply. As this alternative imposes the least number of COAs, it would generally provide less protection for water resources than Alternative 1 (No Action).

Waiver of the COAs relating to the avoidance of activities in stream channels or wetlands, prohibition on discharging soil or contaminants, removal of water for operations, proper storage of chemicals, preparation of SPCC plans, soil and vegetation disturbance, erosion control, and dust abatement (COAs 3–5, 8, 11, and 13–14) would increase potential impacts on water quality and quantity. Like Alternative 1 (No Action), however, the enforcement of regulations in 25 CFR 226 relating to line drilling and the construction and maintenance of pits would mitigate impacts on water resources. This would come about by reducing the risk of surface or groundwater contamination. Alternative 2 also applies a COA that may provide additional protection to water resources, as compared with Alternative 1 (No Action). COA 27, which prohibits the land application of waste, wastewater, contaminated soil, or other deleterious substances, would protect water sources from contamination due to seepage and infiltration.

Applying fewer COAs to oil and gas development could affect hydrology, increase sedimentation and turbidity, alter natural drainage, deplete water sources, or result in contamination and degradation of water quality. The waiver of COAs, however, does not impact lessees' obligation to comply with applicable law. Lessees would still need to conduct operations in a manner consistent with 25 CFR 226, the CWA, the SDWA, and the EPA UIC Program. The requirement to conduct operations in accordance with federal law, voluntary compliance with BMPs, and agreements between lessees and surface owners regarding restoration of surface lands could mitigate some of these impacts.

4.3.5 Alternative 3

Under Alternative 3, the BIA would issue the same standardized list of BMPs and minimal COAs as Alternative 2 in sections with a high density of historical oil and gas development. The BIA would implement the same well spacing requirements and additional protective COAs as Alternative 4 in sections with a low density of historical oil and gas development. In addition, the BIA would not approve new ground-disturbing activities in the sensitive areas described in **Section 2.3.4**, Alternatives Considered for Detailed Analysis, Alternative 3—Hybrid Development. Accordingly, Alternative 3 high-density sections would provide less protection for water resources than Alternative 1 (No Action); Alternative 3 low-density sections would provide more protection for water resources than Alternative 1 (No Action).

The application of COAs based on well density, implementation of well spacing, and reduction in ground disturbance would result in location-specific impacts on water resources. In high-density sections, the waiver of COAs relating to the avoidance of operations in aquatic environments, proper storage of chemicals and waste, construction and closure of pits, soil and vegetation disturbance, and erosion control would increase the probability of short-term and long-term impacts on surface water and groundwater quality and quantity, as described in **Section 4.3.2**, Impacts Common to All Alternatives. Compliance with federal laws and regulations, application of a COA preventing land application of waste, voluntary compliance with BMPs, and agreements between lessees and surface owners would mitigate these risks.

In low-density sections and sensitive areas, this alternative would reduce surface disturbance and provide additional protection to water resources. In addition to all COAs applicable to water resources under Alternatives 1 and 2, COAs 26, 28, 29, and 30 also apply in low-density sections. COAs 26 and 28, which require that well sites and pits be located outside of areas prone to flooding and at least 200 feet from streams and waterways, would reduce the potential for contamination due to spills. COAs 29 and 30, which require lessees to avoid road and pipeline crossings of aquatic environments and bury pipelines would reduce potential impacts from sedimentation, water quality impairment, and changes to hydrology. It should be noted, however, that because COA 30 applies only where appropriate, the BIA could waive the COA when necessary to avoid impacts on water resources.

Under Alternative 3, the application of well spacing requirements and cultural buffers in both high- and low-density sections would further mitigate impacts on water resources (see **Table 2-2** in **Chapter 2**). Well spacing requirements would reduce the amount of surface disturbance in the planning area. Cultural buffers require setbacks from certain types of cultural resources. As many cultural resources are located near sources of surface water, the application of buffers would incidentally protect water resources by reducing the risk of contamination due to spills.

The limitation on development in sensitive areas would reduce or, in some cases, eliminate the risk of impacts on water resources. This is because sensitive areas would include approximately 80,800 acres of floodplains, 151.2 miles of CWA Section 303(d) streams, and portions of major drinking water aquifers, as shown below in **Table 4-3**.

Table 4-3
No New Ground Disturbance Aquifer Acreage—Alternative 3

Aquifer*	Acres	Percent of Total Aquifer Acreage in Planning Area
Alluvium	51,400	36%
Terrace	30,800	72%
Vamoosa-Ada	89,600	13%

Source: BIA GIS 2017
*Aquifers overlap, so the total of acres is not equal to the total spatial acreage.

4.3.6 Alternative 4

Under Alternative 4, the BIA would apply well spacing requirements and additional protective COAs, beyond those applied under Alternative 1 (No Action), to all new development within the planning area. Further, the BIA would not approve new ground-disturbing activities in the sensitive areas identified under Alternative 3 and the additional sensitive areas described in **Section 2.3.5**, Alternatives Considered for Detailed Analysis, Alternative 4—Enhanced Resource Protection. Accordingly, Alternative 4 is the most protective of water resources.

The types of impacts on water resources under Alternative 4 are the same as those described above for Alternative 3, low-density sections. The scope of those impacts, however, would be further reduced due to the application of protective COAs, implementation of cultural resource buffers (see **Table 2-2** in **Chapter 2**) countywide, and restrictions on ground disturbance in a larger number of sensitive areas. The BIA could also apply additional COAs, where appropriate. Such COAs could include compliance with established infrastructure setbacks at US Army Corps of Engineers lakes, observance of reasonable setbacks requested by municipalities, a prohibition on the construction of pits and disposal of waste near public water supply wells, or a requirement that lessees prepare emergency plans to supply drinking water in the event that a sensitive public water supply is contaminated by activities on the lease.

The limitation on development in sensitive areas would reduce or, in some cases, eliminate the risk of impacts on water resources. This is because sensitive areas would include approximately 96,300 acres of floodplains, 167.7 miles of CWA Section 303(d) streams, and portions of major drinking water aquifers, as shown below in **Table 4-4**.

Table 4-4
No New Ground Disturbance Aquifer Acreage—Alternative 4

Aquifer*	Acres	Percent of Total Aquifer Acreage in Planning Area
Alluvium	62,400	43%
Terrace	32,500	76%
Vamoosa-Ada	210,900	32%

Source: BIA GIS 2017
*Aquifers overlap, so the total of acres is not equal to the total spatial acreage.

4.3.7 Cumulative Impacts

The cumulative impact analysis area for water resources is the planning area. Past, present, and reasonably foreseeable future actions and conditions involving ground disturbance have affected, and would likely continue to affect, water resources within the cumulative impact analysis area. Examples of such actions and conditions are set forth in **Table 4-1**. Oil and gas development activities under the alternatives would have impacts like those of past and present development and would contribute to the cumulative effects on water resources.

Cumulative impacts on water resources would be the same as the direct and indirect impacts described in **Section 4.3.2**, Impacts Common to All Alternatives. The application of BMPs, COAs, buffers, and mitigation measures would not prevent all impacts on water resources, but it would reduce irreversible impacts on water quality and quantity. Oil and gas development would likely affect, or have the potential to affect, water resources until the well is plugged and abandoned. Depending on the life of a project, there could be long-term reductions in available surface water and groundwater. This would be due to withdrawals for drilling, completion, and production operations. It also would be due to the increased sedimentation and turbidity due to erosion and runoff from well pads, roads, and facilities. Consumption of water resources for oil and gas development would be in combination with agricultural and industrial use within the planning area (Scanlon et al. 2014a, 2014b; Nicot et al. 2012; Murray 2013).

4.4 Air Quality and Climate

This section discusses the potential impacts that the alternatives described in **Chapter 2** may have on air quality and climate.

4.4.1 Methods and Assumptions

The BLM and BIA obtained inventories for oil, gas, and coal mining emissions in Oklahoma, Kansas, and Texas as part of the planning process for the OKT Joint EIS/BLM RMP/BIA Integrated RMP (Grant et al. 2016a, 2016b). The BIA utilized relevant data and information from those inventories to analyze impacts on air quality and climate in this EIS. Emissions were estimated for 5 criteria pollutants, VOCs, hazardous air pollutants (HAPs), and GHGs. The inventories reported emissions by state and by mineral estate designation type (federal, Indian, and private/state). Emissions inventories were developed for a base year of 2011 to estimate existing emissions and forecast to future years 2015, 2020, 2025, and 2030 to evaluate potential increases or decreases in emissions over time. The emissions inventory report (Grant et al. 2016a, 2016b) is included as **Appendix K**, Emissions Inventory.

Indicators

Air Quality

Indicators of impacts on air quality are as follows:

- Changes in oil and gas emissions resulting from BIA-permitted activities
- Changes in visibility and other air quality related values (AQRVs)

Climate

Indicators of impacts on climate are as follows:

- Changes in GHGs resulting from BIA-permitted activities

Assumptions

Air Quality

- Alternatives that apply more COAs would have fewer air quality impacts.
- Air pollutant emissions presented in this analysis are useful for estimating the scale of future potential emissions but may not represent actual future emissions.
- Based on current rates of surface disturbance per well, as presented in the Osage RFD (**Appendix A**, Reasonably Foreseeable Development Scenario), the county can expect a maximum gross disturbance of up to 9,522 acres between 2018 and 2037. Taking into account

potential interim reclamation, the net surface disturbance is estimated to be approximately 3,571 acres (**Appendix A**).

Climate

- There is a correlation between global concentrations of GHGs and climate change; however, it is not currently possible to link projected GHG emissions associated with any particular activity to specific environmental impacts at a specific site or location. While there are difficulties in attributing specific climate change impacts on any given project or activity and quantifying those impacts, projected GHG emissions can serve as a proxy for a proposed action's climate change impacts.

4.4.2 Impacts Common to All Alternatives

Under all alternatives, oil and gas leasing and development would continue. Oil and gas leasing would have no direct impact on air quality but would have indirect impacts from subsequent oil and gas development, described below.

Sources of Air Emissions

Air pollutant emissions would occur as part of field construction and well production activities. Sources of emissions during construction include vehicle traffic, well pad and road construction, pit construction, pipeline construction, and well drilling and completion. The primary pollutants emitted during construction are criteria air pollutants (carbon monoxide, nitrogen oxide, sulfur dioxide, PM_{10}, and $PM_{2.5}$), VOCs, and HAPs (benzene, toluene, ethyl benzene, xylene, n-hexane, and formaldehyde). H_2S is present in some oil and gas production zones and can be released during well development. These activities would temporarily elevate pollutant levels, but impacts would be localized and occur only for the short-term duration of the activities. Fugitive dust emissions (PM_{10} and $PM_{2.5}$) would result from work crews commuting to and from the work site and from the transportation and operation of equipment during construction. Wind-blown fugitive dust emissions would also occur from open and disturbed land during construction. Emissions from well development using hydraulic fracturing methods would be higher than well development using conventional methods (BLM 2016a).

During field production, air pollutant emissions would occur from compressor station operation, well site pumping unit engines, water transfer pump engines, well site heaters, valve/flanges (fugitive releases of pollutants), and vehicle traffic on roads during field operations and maintenance. The primary pollutants emitted would be carbon monoxide, nitrogen oxide, sulfur dioxide, PM_{10}, $PM_{2.5}$, VOCs, and HAPs. These emissions would affect air quality for the duration of production.

Compliance with federal laws, such as the CAA and NAAQS, and applicable regulations and COAs would reduce the potential impacts that oil and gas development could have on air quality and climate. COA 2 requires that all surface disturbance be confined to the approved well pads and access roads unless the proposed expansion undergoes further review. It would minimize areas of surface disturbance and associated fugitive dust emissions under all alternatives. COA 7, which prohibits venting and flaring without prior approval from the BIA Osage Agency Superintendent, applies under all alternatives and would reduce air pollutant emissions and GHGs. Venting and flaring emit carbon dioxide and methane (a GHG precursor to ozone), as well as VOCs, HAPs, and other criteria pollutants.

Emissions Inventory

Table 4-5, shows estimated emissions from oil and gas development in Osage County and compares them to statewide emissions for context. As shown in this table, estimated emissions from oil and gas development in Osage County comprise between 0.44 and 3.27 percent of statewide oil and gas emissions, depending on the year and the pollutant.

As shown in **Table 4-5**, continued oil and gas development in the planning area would lead to increases in GHG emissions, which contribute to climate change, and criteria pollutants, VOCs, and HAPs, which could exceed the NAAQS (for criteria pollutants). Continued development could also have impacts on visibility and public health.

Well development and production equipment would be subject to EPA emissions control regulations, and lessees would be required to conform to all applicable local, state, Tribal, and federal air quality laws, regulations, standards, or implementation plans in place at the time of permitting. Current oil and gas emissions control regulations include the following:

- Nonroad diesel engine tier standards (1-4) (40 CFR 89.112, 1039.101, and 1039.102) and fuel sulfur standards (40 CFR 80 I)
- New Source Performance Standards Subpart OOOO for pneumatic devices, gas well completions, crude oil, and condensate tanks (40 CFR 60 OOOO)
- New Source Performance Standards Subpart JJJJ for compressor engines (40 CFR 60 JJJJ)
- New Source Performance Standards Subpart HH for dehydrators (40 CFR 60 HH)

Table 4-5
Osage County Oil and Gas Emissions Estimate

Year	Emissions (tons/year)[1]							GHG (MMt CO_{2e}/yr)
	NOx	VOC	CO	PM_{10}	$PM_{2.5}$	SO_2	HAPs	
Osage County Emissions by Year								
2011 (BY)	2,238	5,859	2,758	52	52	5	164	0.8
2015	2,534	7,955	3,133	66	66	6	204	1.0
2020	2,729	8,510	3,351	73	73	6	235	1.1
2025	2,801	8,438	3,422	75	75	6	248	1.2
2030	2,851	8,232	3,466	76	76	6	258	1.2
Total Statewide Oil and Gas Emissions by Year[2]								
2011 (BY)	127,550	210,798	122,246	3,488	3,483	930	8,107	46
2015	137,203	243,343	132,748	3,818	3,814	1,000	9,158	51.2
2020	155,074	273,007	149,984	4,405	4,402	1,174	11,363	59.7
2025	165,420	286,201	159,671	4,732	4,730	1,279	12,685	64.4
2030	175,084	296,646	168,416	5,045	5,043	1,375	13,891	68.6
Percentage of Osage County Emissions to Statewide Oil and Gas Emissions by Year								
2011 (BY)	1.75	2.78	2.26	1.49	1.49	0.54	2.02	1.74
2015	1.85	3.27	2.36	1.73	1.73	0.60	2.23	1.95
2020	1.76	3.12	2.23	1.66	1.66	0.51	2.07	1.84
2025	1.69	2.95	2.14	1.58	1.59	0.47	1.96	1.86
2030	1.63	2.78	2.06	1.51	1.51	0.44	1.86	1.75

Source: Grant et al. 2016a
BY = Base Year
MMt CO_{2e}/yr = million metric tons of CO_2e per year
[1]Future year emissions (emissions in 2015–2030) were based on production activity forecasts presented in an RFD prepared by the BLM for lands in in Kansas, Oklahoma and Texas (BLM 2016b). In 2017, the Indian Energy Service Center prepared an RFD for Osage County (**Appendix A**). Because the Osage RFD is based on well spud forecasts rather than production forecasts, it is difficult to compare the 2 RFDs; however, the BLM RFD used production forecasts developed prior to the economic downturn in the energy market. Thus, the estimates in the BLM RFD were a conservative estimate of projected oil and gas development, and the emissions in this table are presumed to be a reasonable estimation of likely future emissions from oil and gas development in Osage County.
[2]Statewide emissions include federal, Indian, and private/state sources.

Venting and flaring emit carbon dioxide and methane (a GHG and a precursor to ozone). They also emit VOCs, HAPs, and other criteria pollutants. Globally, venting and flaring are responsible for about 1 percent of total carbon dioxide emissions and 4 percent of the total methane emissions caused by human activity (GAO 2004).

4.4.3 Alternative 1 (No Action)

Under Alternative 1 (No Action), the application of COAs and enforcement of regulations would continue to limit impacts of dust from oil and gas-related development activities on air quality in the planning area. COA 3 requires operators to avoid or minimize soil and vegetation disturbance in specific areas, COA 4 minimizes alteration of the natural topography and limits activities on steep slopes, COA 5 implements erosion control measures, COA 6 confines vehicles and equipment to roads described in the approved APD, and COA 15 requires operators to promptly remediate disturbed areas associated with workovers. All of these measures would minimize the potential for fugitive dust emissions associated with surface disturbance. Emissions from equipment used in drilling, workover, and production operations would occur as described in **Section 4.4.2**, Impacts Common to All Alternatives, above; under Alternative 1 (No Action) up to 4,671 wells would be developed.

COA 18 would also minimize impacts on air quality by reducing the risk of H_2S exposure through the implementation of air quality BMPs from the site-specific EA when concentrations of H_2S greater than 100 ppm are anticipated in the gas stream.

4.4.4 Alternative 2

Under Alternative 2, the BIA would issue a list of standard BMPs that apply to all oil and gas development operations within the planning area. In addition, the BIA would minimize the number of COAs applied to permits and would not prescribe the specific methods operators must use to comply with the BMPs or other applicable laws and regulations; operators would be given latitude to determine how best to comply. The COAs related to limiting surface disturbance described under Alternative 1 (No Action) would not apply under Alternative 2 (COAs 3 through 6 and 15). This may lead to increases in localized fugitive dust emissions, compared with Alternative 1 (No Action). Emissions from equipment used in drilling, workover, and production operations would be as described under Alternative 1 (No Action), with the same number of wells expected to be developed. No COAs relating to H_2S emissions would be applied under this alternative, resulting in increased potential for H_2S exposure, compared with Alternative 1 (No Action).

4.4.5 Alternative 3

Under Alternative 3, the BIA would issue the same standardized list of BMPs and minimal COAs as Alternative 2 in sections with a high density of historical oil and gas development. The BIA would implement the same well spacing requirements and additional protective COAs as Alternative 1 (No Action) in sections with a low density of historical oil and gas development. In addition, the BIA would not approve new ground-disturbing activities in certain sensitive areas (described in **Section 2.3.4**, Alternatives Considered for Detailed Analysis, Alternative 3—Hybrid Development).

In high-density sections, the waiver of COAs relating to surface, soil, and vegetation disturbance; erosion control; and vehicle traffic, and interim restoration of surface lands (COAs 3–6 and 15) may lead to increases in localized fugitive dust in high-density sections, compared with Alternative 1 (No Action). Voluntary compliance with BMPs and agreements between lessees and surface owners regarding restoration of surface lands may mitigate some of these impacts.

In low-density sections and sensitive areas, this alternative would reduce fugitive dust and H_2S impacts, compared with Alternative 1 (No Action). In addition to all COAs applied under Alternatives 1 and 2, COAs 25 and 31 also apply in low-density sections. COA 25 provides additional protection to workers and members of the general public by requiring that lessees conduct an initial test of H_2S in the gas stream for each well and production facility. If such tests indicate that concentrations exceed 100 ppm, lessees would need to determine the 100 ppm and 500 ppm radius of exposure and post appropriate signage warning of the potential for exposure. COA 31, which requires the collocation of new and existing facilities when feasible, minimizes fugitive dust impacts by reducing soil disturbance. Under Alternative 3, emissions from equipment used in drilling, workover, and production operations would be less than under Alternative 1 (No Action), with up to 4,011 new wells potentially drilled (660 fewer wells than could be drilled under Alternative 1 [No Action]).

4.4.6 Alternative 4

Under Alternative 4, the BIA would apply well spacing requirements and additional protective COAs, beyond those applied under Alternative 1 (No Action), to all new development in the planning area. Further, the BIA would not approve new ground-disturbing activities in the sensitive areas described in **Section 2.3.5**, Alternatives Considered for Detailed Analysis, Alternative 4—Enhanced Resource Protection. The types of fugitive dust and H_2S impacts under Alternative 4 are described above for Alternative 3, low-density sections. The scope of those impacts, however, would be further reduced under Alternative 4 due to the application of protective COAs planning area-wide and restrictions on ground disturbance in a larger number of sensitive areas.

Application of COAs 25 and 31 throughout the planning area would reduce potential impacts from fugitive dust and H_2S exposure, as compared with Alternative 1 (No Action). Under Alternative 4, emissions from equipment used in drilling, workover, and production operations would be less than under Alternative 1 (No Action), with up to 3,095 new wells that may be drilled (1,576 fewer wells than Alternative 1 [No Action]).

4.4.7 Cumulative Impacts

Air Quality

The cumulative impact analysis area for air quality encompasses the air basins in and around northeastern Oklahoma. Past, present, and reasonably foreseeable future actions and conditions have affected, and would likely continue to affect, air quality within the cumulative impact analysis area. Examples of such actions and conditions are set forth in **Table 4-1**. Oil and gas development activities under the alternatives would have impacts like those of past and present development and could contribute to cumulative effects on air quality and AQRVs.

Air quality monitoring data trends, which can predict future air quality conditions within the cumulative impact analysis area, are reported regionally by the EPA. Monitoring has shown decreases in criteria pollutant concentrations in the southern region of the United States, which includes Oklahoma, of less than 10 percent to over 80 percent over the last 2 decades, depending on the pollutant; the smallest decrease was for PM_{10} concentrations and the greatest was for sulfur dioxide concentrations (EPA 2020).

The air modeling study for the OKT Joint EIS/BLM RMP/BIA Integrated RMP planning process (Jung et al. 2016) evaluated the cumulative effect of federal and Indian oil and gas development using the 2030 future year emissions scenario. The Indian category included Osage County sources, as well as limited other Indian sources, and, therefore, represents a conservative estimate of the contribution of Osage County oil and gas emissions to the cumulative impacts analysis area.

Osage County oil and gas emissions would have a minor incremental cumulative impact on air quality and AQRVs. As reported in the air modeling study (Jung et al. 2016), Indian oil and gas sources would contribute less than 1 percent of the threshold for the EPA's standards for PSD Increments under the CAA for nitrogen dioxide, sulfur dioxide, PM_{10}, and $PM_{2.5}$ in all Class I and sensitive Class II areas for the 2030 emission scenario. In addition, Indian oil and gas sources would have zero days above the 0.5 deciview (the unit of measurement for haze) visibility threshold at Class I areas and only 2 days above the 0.5 deciview threshold at the Tallgrass Prairie Class II area for the 2030 emission scenario.

The study also modeled NAAQS concentrations for the 2030 future year scenario. In Oklahoma, the model showed potential exceedances of the ozone standard and the annual $PM_{2.5}$ standard in northeastern Oklahoma, and no exceedances of the other NAAQS. Modeled exceedances all occurred in the Tulsa metropolitan area. The contribution of Osage County oil and gas development to these potential exceedances, while small, would still contribute to the cumulative impact.

Climate Change

While climate change is a global phenomenon, the cumulative impact analysis area for climate change in this analysis is the state of Oklahoma. Past and present actions in **Table 4-1** have directly emitted GHGs. Actions that have contributed GHGs to the atmosphere are mineral development, energy production, fossil-fuel burning (primarily transportation-related use), and wildfire. Reasonably foreseeable direct and indirect impacts from oil and gas development include the direct GHG emissions from extraction and the indirect GHG emissions from combustion of the resource.

Potential direct emissions from Osage County oil and gas production are described in **Table 4-5**; these emissions are a very small fraction of total US GHG emissions. US emissions due to petroleum and natural gas use in the energy sector are predicted to increase by 2 percent from 3,410 MMT CO_{2e} in 2011 to 3,465 MMT CO_{2e} in 2020. Total gross US emissions are projected to grow by 2 percent from 6,702 MMT CO_{2e} in 2011 to 6,815 MMT CO_{2e} in 2020. In early 2020 however, the COVID-19 pandemic converged with an international oil price war, resulting in a significant decline in the demand for oil and gas and a historic drop in commodity prices. Due to such market volatility, estimates of future emissions are uncertain.

End-use or "downstream" emissions are generated by a product or service when they are used and disposed of by the consumer. End uses of hydrocarbons extracted from Osage County could include the combustion of transportation fuels, fuel oils for heating and electricity generation, the production of asphalt and road oil, and the manufacturing of chemicals, plastics, and other synthetic materials. While it can be reasonably assumed that the oil and gas produced in Osage County will be combusted for energy consumption and use, the exact locations or types of end uses are not known at this stage. Therefore, the BIA can only provide an estimate of potential GHG emissions using national approximations of where or how the end use may occur.

To estimate the end-use energy consumption emissions, annual oil and gas production values were estimated and then multiplied by appropriate emission factors to calculate CO_2 emissions. These emissions are shown in Table 4-6, below. As shown in Table 4-6, total Osage County end-use emissions represent 1.95 to 3.28 percent of total statewide end-use emissions.

Table 4-6
Downstream/End-Use GHG Emissions from Oil and Gas Production in Osage County and Oklahoma

Year	CO_2 Emissions (million metric tons)		
	Oil Production[1]	Natural Gas Production[1]	Total Production
Osage County Downstream/End-Use Emissions by Year			
2011 (BY)	1.97	0.54	2.52
2015	3.00	0.58	3.58
2020	3.16	0.69	3.85
2025	3.05	0.75	3.80
2030	2.87	0.82	3.68

Table 4-6
Downstream/End-Use GHG Emissions from Oil and Gas Production in Osage County and Oklahoma (cont.)

Year	CO_2 Emissions (million metric tons)		
	Oil Production[1]	Natural Gas Production[1]	Total Production
Total Statewide Downstream/End-Use Oil and Gas Emissions by Year[1]			
2011 (BY)	31.76	97.03	128.79
2015	48.30	103.91	152.20
2020	50.88	122.72	173.60
2025	49.04	134.43	183.47
2030	42.89	69.47	112.36
Percentage of Osage County Downstream/End-Use Emissions to Statewide Oil and Gas Downstream/End-Use Emissions by Year			
2011 (BY)	6.21%	0.56%	1.95%
2015	6.21%	0.56%	2.35%
2020	6.21%	0.56%	2.22%
2025	6.21%	0.56%	2.07%
2030	6.69%	1.17%	3.28%

Source: Adapted from BLM and BIA 2019, Table 5-8
BY = base year
[1]Oil and gas production forecasts based on the RFD prepared by the BLM for lands in Kansas, Oklahoma, and Texas (BLM 2016b). In 2017, the Indian Energy Service Center prepared an RFD for Osage County (**Appendix A**). Because the Osage RFD is based on well spud forecasts rather than production forecasts, it is difficult to compare the 2 RFDs; however, the BLM RFD used production forecasts developed prior to the economic downturn in the energy market. Thus, the estimates in the BLM RFD were a conservative estimate of projected oil and gas development, and the end-use emissions in this table are presumed to be a reasonable estimation of likely future end-use emissions from oil and gas produced in Osage County.
[2]Statewide emissions include federal, Indian, and private/state sources.

4.5 Fish, Wildlife, and Migratory Birds

This section discusses impacts that the alternatives described in **Chapter 2** may have on fish, wildlife, and migratory birds. Impacts on fish, wildlife, and migratory birds were evaluated based on the maximum potential disturbance under each alternative.

4.5.1 Methods and Assumptions

Indicators

Indicators of impacts on fish, wildlife, and migratory birds are as follows:

- Extent and condition of available habitat
- Likelihood of death, injury, or direct disturbance
- Likelihood of habitat disturbance

Fisheries

Indicators of impacts specific to aquatic species and their habitats are the following:

- Sediment and turbidity—Increased sediment loading in waters containing sediment-intolerant fish species, loss of recruitment, stress, nutrient loading, and habitat loss
- Habitat alteration—Changes in habitat that make it nonfunctional for select species or more conducive to competitive species
- Loss or reduction of streamside vegetation and cover—Increased temperatures, stress, reduced productivity, and impacts on food webs

- Water quality alteration—Actions that alter important water quality parameters, such as pH, dissolved oxygen, temperature, hardness, alkalinity and salinity, turbidity, or other chemical, physical or biological characteristics
- Water depletions—Habitat loss, water quality changes, sediment accumulation, habitat complexity loss, and food source reduction
- Potential direct destruction of aquatic wildlife from motorized vehicles

Wildlife and Migratory Birds

Indicators of impacts specific to wildlife and migratory birds are the following:

- Disturbance or loss of plant communities, food supplies, cover, breeding sites, and other habitat components necessary for population maintenance and used by any species to a degree that would lead to substantial population declines
- Disturbance, fragmentation, or loss of seasonally important habitat (*e.g.*, critical for overwintering or successful breeding) to a degree that would lead to substantial population declines
- Interference with a species' movement pattern that decreases its ability to breed or overwinter successfully to a degree that would lead to substantial population declines

Assumptions

This analysis is based on the following assumptions:

- Disturbance of a key or critical component of a species' habitat would be detrimental, with the degree of detriment dependent on the importance of the habitat component to the maintenance of the population.
- Habitat conditions and quality, including soil and water, are linked to the health, vigor, and cover provided by vegetation communities upon which fish and wildlife depend.
- Impacts on terrestrial wildlife from displacement would depend on the location, extent, timing, or intensity of the disruption.
- Avoidance means reduced use and does not imply a complete absence of use by wildlife.
- Impacts on populations that exceed the current carrying capacity that would not reduce those populations below the carrying capacity would not be considered significant.

4.5.2 Impacts Common to All Alternatives

Under all alternatives, oil and gas leasing would continue; such leasing can reasonably be expected to result in oil and gas development. Oil and gas development could affect fish, wildlife, and migratory bird species or habitats through disturbance; direct habitat loss; reduced habitat effectiveness; habitat modification, degradation, and fragmentation; direct mortality; habitat avoidance; and interference with movement patterns. Surface disturbance and vegetation removal may remove or degrade habitat for certain wildlife species, depending on the size and location of the project.

Oil and gas development activities could affect fish due to localized loss of or alteration of aquatic habitats. Short-term water quality changes, such as increased turbidity, due to the construction of well pads, roads, and facilities could both disturb and displace fish. Such construction could also increase sedimentation due to runoff and the potential for contamination. The hazards include potential spills of deleterious substances at or around wells, storage facilities, or pipelines and the mobilization of contaminants into aquatic systems due to erosion. Spills have the potential to injure or kill fish, and the effects can be short or long term, depending on the type, volume, and duration of the spill.

Oil and gas development could affect wildlife species due to disturbance or avoidance of human activity, habitat loss and fragmentation, and mortality or injury. The impacts on wildlife would likely be proportional to surface disturbance, but the intensity of the impacts could vary, based on such factors as species tolerance, habitat quality, seasonal use patterns, and fluctuations in natural processes, such as precipitation. These factors could improve or worsen habitat conditions.

The extent of wildlife displacement would depend on the magnitude, duration, and frequency of the proposed activities, as well as the amount of construction and operational noise levels. Although difficult to predict, displacement could result in local reductions in wildlife populations, particularly if adjacent undisturbed habitats are at carrying capacity. Following construction and drilling operations, some species may acclimate and begin to reoccupy areas previously avoided, if disturbance and ongoing human activity do not exceed tolerance thresholds. Birds and other wildlife species may be affected by oil field waste pits or hydraulic fracturing reserve pits because they are attracted to oil-covered ponds. Potential impacts are the following:

- Entrapment in oil waste or reserve pits and drowning
- Death or illness from ingestion of toxic quantities of oil or hydraulic fracturing fluids
- Cold stress if oil or fracturing fluids were to damage the insulation provided by feathers
- Increased susceptibility to disease and predation (USFWS 2000)

Potential impacts on birds due to oil and gas development would vary, depending on the species and the season in which development occurs. Surface disturbance from oil and gas development activities would likely decrease the amount and quality of suitable nesting and foraging habitat for some species of birds. Such activities could also increase avoidance by species sensitive to lighting, vibration, noise, dust, and human presence. Activities such as the construction of well pads, roads, and facilities, which require a large human presence and high levels of traffic and heavy equipment, could cause disturbance and habitat loss. Oil and gas development activities could also increase the risk of collisions with vehicles, equipment, and fences surrounding ponds, impoundments, and reserve pits.

Under some alternatives, mitigation measures included in other guidance documents would be incorporated as mitigation measures for special status species (see **Section 4.6**, Special Status Species). These measures could reduce disturbance to all wildlife habitats and benefit a variety of species. Specific guidance can be found in the USFWS Oklahoma Ecological Services Field Office Migratory Bird and Eagle Impact Avoidance Measures for Actions Associated with Oil and Gas Projects (USFWS 2014a), which includes recommendations that would reduce, but not eliminate, the risk of bird deaths from development activities.

Under all alternatives, the BIA would apply COAs 1, 2, 7, 16, 19, 21 and 23 to drilling and workover permits. It would do this to reduce the impacts from development operations, prevent environmental degradation, and ensure compliance with applicable laws and regulations, such as the ESA, MBTA, and CWA. COAs may be applied to all permits or on a case-by-case basis, depending on the alternative selected. Application and enforcement of COAs that reduce surface disturbance and resulting habitat degradation or otherwise limit disturbance of wildlife would reduce the potential impacts on fish, wildlife, and migratory birds.

4.5.3 Alternative 1 (No Action)

Under Alternative 1 (No Action), the application of COAs and enforcement of regulations would continue to mitigate impacts on fish, wildlife, and migratory birds. In addition to the COAs applied under all alternatives, several additional COAs will be applied under Alternative 1 (No Action).

COAs 3–6, which require lessees to avoid soil and vegetation disturbance, minimize alteration of the natural topography, implement erosion control measures, confine vehicles and equipment to approved lease roads, and minimize noise and traffic, would help maintain suitable bird nesting and bat roosting habitats and prevent habitat loss. COAs 8 and 9, which require the removal of open containers of chemicals or waste and proper disposal of trash and contaminated soil, would reduce the risk of injury to wildlife and birds as well as the risk of contamination of food and water sources. COA 10, which requires the enclosure of production equipment and facilities, would also reduce the risk of injury or mortality.

COA 13, which requires that lessees minimize the disturbance of wildlife due to noise, traffic, and dust, would reduce potential habitat avoidance. COA 14, which prohibits operations in aquatic environments and the discharge of soil or contaminants, would reduce the risk of habitat destruction and changes in water quality that could impact fish and wildlife. COA 15, which requires restoration of surface lands to the original contour and revegetation with seed or sod, would reduce habitat loss and degradation. COA 22, which requires lessees to screen, net, or cover open-top tanks and pits, would reduce the risk of bird injury or mortality. Even with these COAs, habitat fragmentation, noise disturbance, and injury or mortality of birds and bats may still occur.

4.5.4 Alternative 2

Under Alternative 2, the BIA would issue a list of standard BMPs that apply to all oil and gas development operations within the planning area. In addition, the BIA would minimize the number of COAs applied to permits and would not prescribe the specific methods operators must use to comply with the BMPs or other applicable laws and regulations; operators would be given latitude to determine how best to comply. The waiver of protective COAs (COAs 3–6, 8–10, 13–15, and 22) would result in increased potential for soil, vegetation, noise, and traffic disturbances; erosion; habitat fragmentation, degradation, and loss; changes in water quality; and injury or mortality.

The application of COAs 24 and 27, however, would reduce impacts on fish, wildlife, and migratory birds, compared with Alternative 1 (No Action). Noise-control measures would reduce the potential for habitat avoidance and other behavioral impacts. Prohibiting the land application of waste and contaminated soil would likely keep injurious material out of important fish and wildlife habitat, such as wetlands and riparian zones.

Overall, the impacts of oil and gas development on fish and wildlife under Alternative 2 would increase, compared with Alternative 1 (No Action). Voluntary compliance with BMPs and agreements between lessees and surface owners regarding restoration of surface lands may mitigate some of these impacts.

4.5.5 Alternative 3

Under Alternative 3, the BIA would issue the same standardized list of BMPs and minimal COAs as Alternative 2 in sections with a high density of historical oil and gas development. The BIA would implement the same well spacing requirements and additional protective COAs as Alternative 4 in sections with a low density of historical oil and gas development. In addition, the BIA would not approve new ground-disturbing activities in the sensitive areas described in **Section 2.3.4**, Alternatives Considered for Detailed Analysis, Alternative 3—Hybrid Development. Applying COAs based on the density of well development would result in location-specific fish and wildlife impacts.

In high-density sections, the waiver of COAs relating to soil and vegetation disturbance, erosion control, noise and traffic, prevention of pollution, livestock enclosures, restoration of surface lands, commencement of operations in aquatic environments, and coverings for open-top tanks and pits (COAs 3–6, 9, 10, 13, 15, and 22) would increase the potential impacts on important bird and wildlife habitat as well as the risk of injury or mortality. The waiver of COAs relating to erosion control and operations in aquatic environments (COAs 5 and 14) would also increase the risk that water sources may be contaminated due to sedimentation and runoff. Voluntary compliance with BMPs and agreements between lessees and surface owners regarding restoration of surface lands may mitigate some of these impacts.

In low-density sections and sensitive areas, Alternative 3 would reduce potential impacts on fish, wildlife, and migratory birds compared with Alternative 1 (No Action). In addition to all COAs applied under Alternatives 1 and 2, COAs 28–31 also apply in low-density sections. COA 28, which requires that drilling pits be located at least 200 feet from streams and waterways, would reduce potential impacts on fish and water quality due to turbidity, sedimentation, and spills. COAs 29 and 30, which require lessees to avoid new road and pipeline crossings of aquatic environments and alterations to hydrology, and to bury pipelines, would further reduce habitat modification and avoidance as well as noise and visual disturbances. COA 31, which requires the collocation of new and existing facilities when feasible, would reduce surface disturbance and minimize habitat loss, modification, and degradation. The implementation of cultural resource buffers (see **Table 2-2** in **Chapter 2**) and well spacing requirements in low-density sections would further reduce surface disturbance.

Under Alternative 3, approximately 248,800 acres would be protected from new ground-disturbing oil and gas development activities, reducing potential impacts on fish, wildlife, and migratory birds compared with Alternative 1 (No Action). Overall, compared with Alternative 1 (No Action), Alternative 3 would afford more protections for fish and wildlife, particularly in low-density sections and areas where new ground-disturbing activities would not be approved.

4.5.6 Alternative 4

Under Alternative 4, the BIA would apply well spacing requirements and additional protective COAs (COAs 3–6, 8–15, 17–18, 20, 22, and 24–31), beyond those applied under Alternative 1, to all new development within the planning area. Further, the BIA would not approve new ground-disturbing activities in the sensitive areas identified under Alternative 3 and the additional sensitive areas described in **Section 2.3.5**, Alternatives Considered for Detailed Analysis, Alternative 4—Enhanced Resource Protection. The types of impacts on fish, wildlife, and migratory birds under Alternative 4 are described above for Alternative 3, low-density sections. The scope of those impacts, however, would be further reduced under Alternative 4 due to the application of protective COAs throughout the planning area (COAs 28–31) and restrictions on ground disturbance in a larger number of sensitive areas.

Under Alternative 4, approximately 524,400 acres would be protected from new ground-disturbing oil and gas development activities, reducing potential impacts on fish, wildlife, and migratory birds. The application of cultural resource buffers (see **Table 2-2** in **Chapter 2**) countywide would also provide incidental protections due to the implementation of setbacks from streams, rivers, ponds, reservoirs, lakes, and wetlands. Such buffers further limit new ground disturbance and reduce the risks of habitat loss and degradation, noise and visual disturbances, and contamination due to spills within the buffer zones. Accordingly, Alternative 4 would afford more protections than Alternative 1 (No Action) and likely result in the greatest reduction of impacts on fish, wildlife, and migratory bird species of all the alternatives.

4.5.7 Cumulative Impacts

The cumulative impact analysis area for fish, wildlife, and migratory birds is the planning area. Past, present, and reasonably foreseeable future actions and conditions involving ground disturbance have affected, and would likely continue to affect, fish, wildlife, and migratory birds within the cumulative impact analysis area. Examples of such actions and conditions are set forth in **Table 4-1**. Oil and gas development activities under the alternatives would have impacts like those of past and present development and would contribute to the cumulative effects on fish, wildlife, and migratory birds.

Surface disturbance resulting from oil and gas development activities would continue to disturb and displace fish, wildlife, and birds and alter, reduce, or fragment their habitat. Other activities within the cumulative impact analysis area that may contribute to these impacts are livestock grazing, agriculture, mining (other than oil and gas), infrastructure projects, and population growth. Fish, wildlife species, and birds would be susceptible to cumulative impacts because human encroachment has resulted in, or could result in, habitat loss or fragmentation and displacement in areas that are already at or near relative carrying capacity.

At present, approximately 95 percent of land use in Osage County is for agriculture (Osage County 2011). The combination of oil and gas development and conversion of tallgrass prairie to agricultural lands is expected to continue and will affect birds, mammals, and other species that depend on prairie habitats for nesting, foraging, and cover. Such conversion could result in long-term habitat loss or fragmentation for species dependent on tallgrass prairie habitat. Infrastructure development (e.g., pipelines, transportation projects, and wind farms), which could cross multiple land jurisdictions, would further contribute to habitat fragmentation. In addition, tall infrastructure could increase prairie bird habitat avoidance. In areas where tall infrastructure is highly concentrated or overlaps oil and gas development, there is a risk of increased predation and potential declines in populations for prairie birds. While many fish, wildlife, and bird populations would likely continue to occupy their respective ranges, population numbers could decrease, relative to the amount of cumulative habitat loss and disturbance from incremental development.

As discussed in **Section 4.3**, Water Resources, cumulative impacts on surface water and groundwater sources could affect trends in water quality and quantity. In turn, changes in water quality and quantity could affect fish and other aquatic communities. Surface-disturbing activities that remove or disturb soil-stabilizing agents, such as vegetation, soil crusts, and wood debris, could increase erosion and sediment transport to surface waters. This could degrade habitat for sediment-intolerant fish species.

In addition, continued agricultural use would likely contribute to eutrophic (oxygen depleted) conditions in some streams and lakes by means of nutrient input (e.g., poultry, cattle, and hog waste and fertilizer runoff). Eutrophication during periods of drought or low water levels could create anoxia (low oxygen) conditions, which may decrease habitat suitability for some fish species. Anoxia conditions could destroy other aquatic communities, such as mollusks, which are unable to escape the bottom of aquatic systems where conditions would be most severe (ODWC 2005b).

While surface disturbance corresponds with impacts on fish, wildlife, and migratory birds, quantification of cumulative impacts cannot be accurately determined. This is because they are species specific and depend on a number of factors; examples of such factors are status and condition of the population affected, habitat quality and quantity within the project area, seasonal timing of disturbance, type of surface disturbance, duration of surface disturbance, and physical parameters of the affected and nearby habitats.

It is worth noting that much of the surface disturbance from oil and gas development activities that is projected under the alternatives would occur as an expansion of existing infrastructure into habitats that are already fragmented by oil and gas development and other activities within the planning area.

4.6 SPECIAL STATUS SPECIES

This section discusses impacts that the alternatives described in **Chapter 2** may have on special status species. Impacts on special status species were evaluated based on the maximum potential disturbance under each alternative.

4.6.1 Methods and Assumptions

For purposes of this section, special status species include federally listed, proposed, or candidate species and state threatened or endangered species.

Indicators

Indicators of impacts on special status species are as follows:

- Acres of special status species habitat removed temporarily and long term

- The likelihood that activities would cause or be likely to cause special status species injury; substantial interference with normal breeding, feeding, or sheltering behavior; or nest abandonment
- Injury or mortality of an individual special status plant or population
- Elimination or reduction of, or adverse effects on, a unique or rare natural plant community

Assumptions

This analysis is based on the following assumptions:

- The health of a special status species is directly related to the overall health and abundance of their habitat. Special status plant health is also directly related to an abundance of individual plants and the condition and abundance of their habitat. This analysis assesses whether managing oil and gas development under each alternative could lead to the destruction, degradation, or modification of habitat, as well as impacts that could improve wildlife, plant, and aquatic habitat.
- If the listing status of a species included in the EIS changes, or if new species are listed with habitat in the planning area, consultation with the USFWS regarding appropriate avoidance and mitigation measures for those species will be required.

4.6.2 Impacts Common to All Alternatives

Under all alternatives, oil and gas leasing would continue to occur. Such leasing can reasonably be expected to result in oil and gas development. Oil and gas development could affect special status species or their habitats through disturbance; direct habitat loss; reduced habitat effectiveness; habitat modification, degradation, and fragmentation; direct mortality; habitat avoidance; and interference with movement patterns. These potential disturbances are directly linked to changes in vegetation conditions and water quality and quantity.

Oil and gas development would require the construction of well pads, roads, pipelines, and other facilities. The surface disturbance and removal of vegetation due to construction and subsequent use and operation of such infrastructure could result in habitat loss, degradation, and fragmentation; introduction of noxious weeds, displacement; mortality; and nest abandonment. The season in which activities occur would either moderate or accentuate the effects on special status species.

In general, impacts on special status bird species and their habitats from oil and gas development would be like those discussed in **Section 4.5**, Fish, Wildlife, and Migratory Birds. Such impacts include avoidance of nesting habitat due to lighting, noise, dust, and human presence; increased predation; increased risk of collisions; and injury or mortality due to contact with, or ingestion of, chemicals or deleterious substances stored in pits. Special status bird species may also be impacted by the displacement of native habitat due to invasive plant spread and the impairment of water quality and quantity due to withdrawals and contamination in the event of spills.

Under all alternatives, the BIA would apply COAs 1, 2, 7, 16, 19, 21 and 23 to workover and drilling permits to reduce the impacts from development operations, prevent environmental degradation, and ensure compliance with applicable laws and regulations, such as the ESA (16 USC 1531, et seq.). Section 7 of the ESA requires federal agencies to consult with the USFWS to ensure that federal actions do not jeopardize the continued existence of any listed species or result in adverse effects on designated critical habitat of such species. COAs may be applied to all permits or on a case-by-case basis, depending on the alternative selected. Application and enforcement of COAs that reduce surface disturbance would reduce potential impacts on special status species.

The following sections discuss the potential impacts on certain special status species within the planning area in more detail. There would be no effect on other listed, proposed, or candidate species found in the planning area under any of the alternatives—the northern long-eared bat, red knot, piping plover, interior least tern, or Neosho mucket mussel.

Osage County is on the edge of the range for the northern long-eared bat. As the northern long-eared bat does not roost in grassland areas, it is unlikely to be affected by oil and gas development within the planning area. The regulations in 25 CFR 226 require a 200-foot setback from all established watering places. Oil and gas development activities that occur outside this setback are not anticipated to impact the red knot, piping plover, interior least tern, or Neosho mucket mussel, due to the distance from suitable habitat. Additionally, the aforementioned avian species do not nest, roost, or reproduce in habitat affected by oil and gas development.

American Burying Beetle

Oil and gas development could disturb, or result in take of, ABBs and have adverse effects on ABB habitat. The potential for such impacts depends on the location and nature of development activities as well as the season. Surface disturbance from the construction, operation, and maintenance of well pads, roads, pipelines, and other facilities may impact ABBs or result in take due to vegetation removal, habitat fragmentation, vehicle and heavy equipment use, soil disturbance and movement, and the use of artificial lighting (USFWS 2014a). In general, however, construction-related activities have a higher potential for impacts than post-construction operations and maintenance.

Vegetation removal and maintenance could injure or kill ABBs if they are crushed by equipment or exposed to adverse weather conditions. In addition, vegetation removal on undisturbed soils in areas with suitable ABB habitat could result in the degradation of breeding, foraging, or sheltering habitat and reduce habitat connectivity, which could limit reproductive success. Soil compaction and changes in soil moisture due to vegetation maintenance could degrade habitat, result in temporary habitat loss, increase the potential for incursion by nonnative or invasive species, and reduce the ABBs' ability to bury carrion, which would also impact reproductive success (USFWS 2014a). Additional discussion regarding potential impacts on ABBs is provided in **Appendix B**, Osage County Oil and Gas Biological Assessment.

Although oil and gas development could result in take of ABBs within the planning area, the USFWS found that oil and gas development is not likely to jeopardize the continued existence of the ABB. The application of COAs and appropriate conservation measures will minimize impacts on the species, reduce the level of take, and result in long-term mitigation by preserving ABB habitat.

Sprague's Pipit and Whooping Crane

Tallgrass prairies in northwestern Osage County provide high-value nesting habitat for Sprague's pipit as well as migratory stopover habitat for whopping crane. Tallgrass prairie acreage has substantially declined due to agricultural conversion throughout the region; riparian vegetation is threatened by use as farmland or pastureland as well as urban encroachment. Increased road density within the planning area has led to soil erosion, soil compaction, and visual and noise disturbance in wetlands, including areas potentially used by whooping crane (ODWC 2005a).

Oil and gas development activities such as the construction of well pads, roads, pipelines, and other facilities, could result in habitat fragmentation or degradation. Loss of migratory stopover habitat could also result in flight response and increased energy expenditures for whooping crane. Increased noise and visual disturbances and vehicle traffic near breeding and nesting grounds could disturb reproduction and result in the abandonment of nests and leks, the courtship areas used by whooping cranes (Aldridge and Boyce 2007; Pitman et al. 2005), Increased vehicle and equipment traffic and infrastructure could also increase the risk of collisions. Although the risk of collisions is generally low, the consequences of such collisions are high, as they often result in mortality.

Under all alternatives, compliance with COAs that reduce surface disturbance would reduce the potential impacts on Sprague's pipit and whooping crane. Potential impacts would also be reduced by compliance with conservation measures, the ESA, and MBTA and guidance in the USFWS Migratory Bird and Eagle Impact Avoidance Measures for Actions Associated with Oil and Gas Projects (USFWS 2014b).

Raptors and Birds of Prey, Including Bald Eagle and Golden Eagle

Raptors nest in large trees, cliffs, and ledges near prairie vegetation. Oil and gas development activities could impact raptors and birds of prey due to habitat loss, alteration, or degradation; disturbance and displacement; changes in water quality; and injury and mortality. The construction of well pads, roads, pipelines, and other facilities would change vegetation structure, which could result in habitat loss and soil erosion. If such habitat loss decreases prey abundance, birds could shift their foraging patterns, forcing them to travel farther and expend additional energy. Degradation in water quality due to sedimentation, turbidity, or contamination could lower the availability of aquatic prey. Increased human presence, traffic, and noise and visual disturbances could cause displacement and increase the risk of collisions.

Under all alternatives, compliance with COAs would reduce the potential impacts on raptors and birds of prey because they would reduce surface disturbance. Potential impacts would also be reduced by complying with conservation measures, the ESA, and MBTA and guidance in the USFWS Migratory Bird and Eagle Impact Avoidance Measures for Actions Associated with Oil and Gas Projects (USFWS 2014b). The USFWS impact avoidance measures for eagles require lessees to document eagle use and conduct nest surveys in winter prior to conducting activities that would alter nest site habitat. If an area is determined to be used by eagles, the installation of power lines would be avoided when possible, equipment used to flare gas would be fitted with anti-perching devices, existing poles would be marked, and new poles would be designed in accordance with the Avian Power Line Interaction Committee guidelines to minimize the risk of electrocution.

Rattlesnake Master Borer Moth

The rattlesnake master borer moth depends on the perennial rattlesnake master, a plant native to tallgrass prairie, as its sole source of food (USFWS 2013). Surface disturbance from oil and gas development activities that involves the removal or alteration of vegetation could therefore result in mortality or increased energy expenditures as the moth travels farther in search of food. Vegetation removal may also result in breeding, foraging, or sheltering habitat degradation and reduced habitat connectivity, which may limit reproductive success.

Depending on the season, vegetation removal, soil grading, and off-road use of vehicles and equipment could crush eggs. Such activities could also crush or injure larvae or adults in or on host plants. As artificial light sources may attract the moth, there is an increased risk of injury or death due to collision with equipment and exposure to flares. Artificial light could also increase predation.

4.6.3 Alternative 1 (No Action)

Under Alternative 1 (No Action), the application of COAs and enforcement of regulations would continue to mitigate impacts on special status species. COAs 3–6, which require lessees to avoid soil and vegetation disturbance, minimize alteration of the natural topography, implement erosion control measures, confine vehicles and equipment to approved lease roads, and minimize noise and traffic, would help maintain suitable nesting and roosting habitats and reduce habitat loss, avoidance, and fragmentation. COAs 12 and 15, which require interim and final restoration of surface lands, would reduce the impacts of habitat modification, loss, or fragmentation. COA 13, which requires the lessees to minimize the impacts of noise and traffic on wildlife, would help prevent habitat avoidance and other behavioral disturbances. COAs 17 and 20, which requires compliance with USFWS protocols in areas where the ABB is known or expected to exist and vegetation maintenance where there is suitable ABB habitat, would help prevent habitat loss, modification, or degradation, as well as injury or mortality. COA 22, which requires lessees to screen, net, or cover open-top tanks and pits, would also reduce the risk of bird injury or mortality.

American Burying Beetle

For ABB compliance, the BIA prepared a BA, and the USFWS issued a BO describing the total amount of acreage in the county where incidental take of ABB can occur (see **Appendix B**). Minimization and mitigation measures from the Oil and Gas Industry Conservation Plan Associated with Issuance of ESA Section 10(a)(1)(B) Permits for the ABB in Oklahoma (USFWS 2014a) are proposed in the BA and have been concurred with and accepted in the BO. COAs 17 and 20, which require compliance with USFWS protocols in areas where the ABB is known or expected to exist and the maintenance of vegetation height where there is suitable ABB habitat, would help prevent habitat loss, modification, or degradation, as well as injury or mortality. This would improve the likelihood of survival and reproduction of the species (USFWS 2014a).

Migratory Birds

In addition to the requirement to follow USFWS Impact Avoidance (USFWS 2014b) guidance, described in **Section 4.7.2**, Impacts Common to All Alternatives, COAs would also protect migratory birds. COAs 3–6, which require lessees to avoid soil and vegetation disturbance, minimize alteration of the natural topography, control erosion, confine vehicles and equipment to approved lease roads, and minimize noise and traffic, would help maintain suitable nesting and roosting habitats, prevent habitat avoidance, and reduce habitat loss and fragmentation. COAs 12 and 15, which require interim and final restoration of surface lands, would further reduce habitat modification, loss, or fragmentation.

COA 13, which requires the lessees to minimize the impacts of noise and traffic on wildlife, would reduce the risk of habitat avoidance and other behavioral disturbances, as well as injury or mortality. COA 22, which requires lessees to screen, net, or cover open-top tanks and pits, would reduce the risk of bird injury or mortality. Implementation of these COAs would improve protections for migratory birds, but habitat disturbance remains likely. In the event of habitat loss, modification, or degradation, the whooping crane may face increased energy expenditures from loss of migratory stopover habitat.

Raptors and Birds of Prey, Including Bald Eagle and Golden Eagle

As with migratory birds, the application of COAs 3–6, 12–13, 15, and 22, combined with the requirement to follow USFWS Impact Avoidance (USFWS 2014b) guidance, described in **Section 4.7.2**, Impacts Common to All Alternatives, would reduce potential impacts on raptors and birds of prey.

Rattlesnake Master Borer Moth

No COAs would require identifying or avoiding the rattlesnake master plant before disturbing its habitat under Alternative 1 (No Action); however, COAs 3–6 applied under Alternative 1 (No Action) would minimize surface disturbance and vegetation removal and may consequently lessen impacts on the rattlesnake borer moth by preventing removal of the rattlesnake master plant. The rattlesnake master borer moth would continue to be affected by oil and gas development, as described in **Section 4.6.2**, Impacts Common to All Alternatives.

4.6.4 Alternative 2

Under Alternative 2, the BIA would issue a list of standard BMPs that apply to all oil and gas development operations within the planning area. In addition, the BIA would minimize the number of COAs applied to permits and would not prescribe the specific methods operators must use to comply with the BMPs or other applicable laws and regulations; operators would be given latitude to determine how best to comply.

The application of COAs 24 and 27, however, would reduce impacts on special status species, compared with Alternative 1 (No Action). COA 24, which requires lessees to minimize noise and visual disturbances, would reduce the potential for habitat avoidance, nest abandonment, and other behavioral impacts. COA 27, which prohibits the land application of waste or deleterious substances, would reduce the risk of habitat degradation and injury or mortality due to ingestion of chemicals or other deleterious substances. Voluntary compliance with BMPs and agreements between lessees and surface owners regarding restoration of surface lands may mitigate some of these impacts.

American Burying Beetle

Like Alternative 1 (No Action), under Alternative 2, lessees would be required to protect the federally endangered ABB; however, without key BMPs and COAs, the BIA would likely need to revise the BA and reinitiate formal consultation under ESA Section 7 for ABB compliance. Until the USFWS issues the new BO, lessees would be solely responsible for documenting compliance under ESA Section 10. Because ESA compliance would still be required under this alternative, impacts on the ABB would be the same as those described under Alternative 1 (No Action).

Migratory Birds

Under Alternative 2, potential impacts on migratory birds would increase, compared with Alternative 1 (No Action), due to the waiver of protective COAs (COAs 3–6, 12–13, 15, and 22). The waiver of COAs relating to vegetation, noise, traffic, and visual disturbances at breeding and nesting grounds would disturb reproduction for prairie-nesting birds. The waiver of COAs relating to restoration of surface lands could also increase habitat loss and fragmentation. In the event of loss of migratory bird stopover habitat, whooping cranes could face increased energy expenditures. Waiver of the COA requiring that lessees cover open-top tanks and pits could result in increased injury or mortality. The requirement to comply with USFWS Impact Avoidance (USFWS 2014b) guidance, described in **Section 4.6.2**, Impacts Common to All Alternatives, would mitigate some habitat-degradation impacts and reduce the risk of mortality.

Raptors and Birds of Prey, Including Bald Eagle and Golden Eagle

Under Alternative 2, potential impacts on raptors and birds of prey would increase compared with Alternative 1 (No Action) due to the waiver of protective COAs (COAs 3–6, 12–13, 15, and 22). The potential impacts of such waivers would be the same as those discussed for migratory birds. Similarly, the requirement to comply with USFWS Impact Avoidance (USFWS 2014b) guidance, described in **Section 4.6.2**, Impacts Common to All Alternatives, would mitigate some habitat degradation impacts and reduce the risk of mortality.

Rattlesnake Master Borer Moth

No COAs would require identifying or avoiding the rattlesnake master plant before disturbing its habitat under Alternative 2. The rattlesnake master borer moth would continue to be affected by oil and gas development, as described in **Section 4.6.2**, Impacts Common to All Alternatives.

4.6.5 Alternative 3

Under Alternative 3, the BIA would issue the same standardized list of BMPs and minimal COAs as Alternative 2 in sections with a high density of historical oil and gas development. The BIA would implement the same well spacing requirements and additional protective COAs as Alternative 4 in sections with a low density of historical oil and gas development. In addition, the BIA would not approve new ground-disturbing activities in the sensitive areas described in **Section 2.3.4**, Alternatives Considered for Detailed Analysis, Alternative 3—Hybrid Development. Applying COAs based on well density would result in location-specific impacts on special status species. In high-density sections, the waiver of COAs relating to soil and vegetation disturbance, erosion control, noise and traffic, restoration of surface lands, and coverings for open-top tanks and pits (COAs 3–6, 10, 12, 13, 15, and 22) would increase the potential impacts on special status species. Voluntary compliance with BMPs and agreements between lessees and surface owners regarding restoration of surface lands may mitigate some of these impacts.

In low-density sections and sensitive areas, Alternative 3 would reduce potential impacts on special status species, compared with Alternative 1 (No Action). In addition to all COAs applied under Alternatives 1 and 2, COAs 28–31 also apply in low-density sections. COA 28, which requires that drilling pits be located at least 200 feet from streams and waterways, would reduce potential impacts on fish and water quality due to turbidity, sedimentation, and spills. COAs 29 and 30, which require lessees to avoid new road and pipeline crossings of aquatic environments and to bury pipelines in sensitive areas, would further reduce habitat modification and avoidance, as well as noise and visual disturbances. COA 31, which requires the collocation of new and existing facilities when feasible, would reduce surface disturbance and minimize habitat loss, modification, and degradation. The implementation of cultural resource buffers (see **Table 2-2** in **Chapter 2**) and well spacing requirements in low-density sections would further reduce surface disturbance.

Under Alternative 3, approximately 248,800 acres would be protected from new ground-disturbing oil and gas development activities, reducing potential impacts on special status species. These sensitive areas are important habitats for special status species in the planning area. Accordingly, Alternative 3 would afford more protections for special status species than Alternative 1 (No Action), particularly in low-density sections.

American Burying Beetle

Like Alternative 1 (No Action), under Alternative 3, lessees would be required to follow provisions of Oil and Gas Industry Conservation Plan Associated with Issuance of ESA Section 10(a)(1)(B) Permits for the ABB in Oklahoma (USFWS 2014a) to protect the ABB in low-density sections (COA 17). In addition, in low-density sections under Alternative 3, the BIA would apply a buffer around culturally sensitive areas, such as historic sites, sacred sites, and grave sites (see **Table 2-2** in **Chapter 2**), and require collocation of new facilities with existing facilities when feasible (COA 31). These buffers and requirements would preserve vegetation and habitat for the ABB and other special status species found in these areas by reducing surface disturbance. Under Alternative 3, new oil and gas-related ground-disturbing activities would not be permitted in 209,100 acres of potential ABB range, including 53,600 acres (11 percent) of conservation priority area (BIA GIS 2017).

Migratory Birds

Under Alternative 3, the impacts on migratory birds in high-density sections would be the same as those described under Alternative 2; the impacts in low-density sections would be the same as those described under Alternative 4. In low-density sections, additional protective COAs (COAs 28–31) would reduce impacts on waterways, streams, and wetland habitats, and require covering or netting open-top tanks and pits to reduce bird injury and mortality. Additionally, preventing new ground disturbance in sensitive areas would reduce impacts on migratory birds and migratory bird habitat in those areas.

Raptors and Birds of Prey, Including Bald Eagle and Golden Eagle

Under Alternative 3, the impacts on raptors and birds of prey in high-density sections would be the same as those described under Alternative 2, and the impacts in low-density sections would be the same as those described under Alternative 4. As with migratory birds, in low-density sections, additional protective COAs (COAs 28–31) would reduce impacts on raptors and birds of pretty, compared with Alternative 1 (No Action). Additionally, preventing new oil and gas-related ground disturbance in certain sensitive areas would reduce impacts on raptors, birds of prey, and their habitat in those areas.

Rattlesnake Master Borer Moth

No COAs would require identifying or avoiding the rattlesnake master plant before disturbing its habitat; however, populations present within sensitive areas and low-density sections would be afforded increased protections. This is because new oil and gas-related surface disturbance would be prevented in certain sensitive areas and COAs would be applied in low-density sections that limit surface disturbance and thus incidentally protect habitat (COAs 28–31). This would reduce impacts of oil and gas development on rattlesnake master borer moths, compared with Alternative 1 (No Action).

4.6.6 Alternative 4

Under Alternative 4, the BIA would apply well spacing requirements and additional protective COAs (COAs 3–6, 8–15, 17–18, 20, 22, and 24–31), beyond those applied under Alternative 1 (No Action), to all new development within the planning area. Further, the BIA would not approve new ground-disturbing activities in the sensitive areas identified under Alternative 3 and the additional sensitive areas described in **Section 2.3.5**, Alternatives Considered for Detailed Analysis, Alternative 4—Enhanced Resource Protection. The types of impacts on special status species under Alternative 4 are described above for Alternative 3, low-density sections. The scope of those impacts would be further reduced under Alternative 4 due to the application of protective COAs planning area-wide and restrictions on ground disturbance in a larger number of sensitive areas. Additional COAs may be applied to development on lands enrolled in federal conservation programs, such as the NRCS Wetlands Reserve Program, which would also result in reduced impacts on special status species.

Under Alternative 4, approximately 524,400 acres would be protected from new ground-disturbing oil and gas development activities, reducing the potential impacts on special status species. The cultural resource buffers (see **Table 2-2** in **Chapter 2**) countywide under this alternative would also provide incidental protections due to the implementation of setbacks from streams, rivers, ponds, reservoirs, lakes, and wetlands. Such buffers further limit new ground disturbance and reduce the risks of habitat loss and degradation, noise and visual disturbances, and contamination due to spills within the buffer zones. Thus, Alternative 4 would afford more protections than Alternative 1 (No Action) and would likely result in the greatest reduction of impacts on special status species.

American Burying Beetle

Under Alternative 4, the ABB would be provided a high level of protections in the same way as in low-density sections under Alternative 3. For example, the BIA would apply a buffer around culturally sensitive areas, such as historic sites, sacred sites, and grave sites, and require collocation of new facilities with existing facilities, when feasible (see **Table 2-2** in **Chapter 2**). These buffers and requirements would preserve vegetation and habitat for the ABB and other special status species found in these areas by reducing surface disturbance. As a result, impacts of oil and gas development on the ABB would be reduced, compared with Alternative 1 (No Action). Under Alternative 4, new oil and gas-related ground-disturbing activities would not be permitted in 484,700 acres of potential ABB range, including 141,500 acres (29 percent) of conservation priority area (BIA GIS 2017).

Migratory Birds

Under Alternative 4, the potential impacts on migratory birds would be less than those described under Alternative 1 (No Action). In addition to the requirement to comply with USFWS Impact Avoidance (USFWS 2014b) guidance for migratory birds and eagles, described in **Section 4.6.2**, Impacts Common to All Alternatives, all COAs, well spacing orders, and cultural resource buffers would be applied throughout the planning area. This would minimize the impacts of oil and gas operations on suitable habitat for these species. The application of COAs 24 and 27 would be particularly protective of migratory birds. COA 24, which requires that lessees minimize noise and visual impacts harmful to sensitive environmental receptors, may prevent habitat avoidance or nest abandonment. COA 27, which prohibits the land application of wastewater, waste oil, and contaminated soil, would likely keep injurious material out of important habitat, such as wetlands. Preventing new ground-disturbing activities in certain sensitive areas would further reduce impacts on migratory bird habitat in those areas.

Raptors and Birds of Prey, Including Bald Eagle and Golden Eagle

Under Alternative 4, potential impacts on raptors and birds of prey would be less than those described under Alternative 1 (No Action). As with migratory birds, the combination of USFWS Impact Avoidance guidance (USFWS 2014b), protective COAs (COAs 24 and 27), cultural resource buffers, well spacing requirements, and limitations on activities in sensitive areas would result in the greatest reduction in potential impacts on raptors and birds of prey of all the alternatives.

Rattlesnake Master Borer Moth

No COAs would require identifying or avoiding the rattlesnake master plant before disturbing its habitat; however, populations would be afforded the most indirect protections under Alternative 4. Buffer zones around cultural sites and waterways throughout the planning area would preserve some suitable habitat for this species. Additionally, new oil and gas-related ground disturbance would be prevented in more sensitive areas. This would reduce impacts of oil and gas development on rattlesnake master borer moths, compared with Alternative 1 (No Action).

4.6.7 Cumulative Impacts

The cumulative impact analysis area for special status species is the regional habitat range for each species. Past, present, and reasonably foreseeable future actions and conditions involving ground disturbance have affected, and would likely continue to affect, water resources within the cumulative impact analysis area. Examples of such actions and conditions are set forth in **Table 4-1**. Oil and gas development activities under the alternatives would have impacts like those of past and present development and would contribute to the cumulative effects on special status species.

Surface disturbance resulting from oil and gas development activities would continue to disturb and displace special status species and alter, reduce, or fragment their habitat. Other activities within the cumulative impact analysis area that may contribute to these impacts are livestock grazing, agriculture, mining (other than oil and gas), infrastructure projects (e.g., pipelines, transportation projects, and wind farms), and population growth.

At present, approximately 95 percent of land use in Osage County is for agriculture (Osage County 2011). The combination of oil and gas development and conversion of tallgrass prairie to agricultural lands is expected to continue and will affect special status species that depend on prairie habitats for nesting, foraging, and cover. Such conversion could result in long-term habitat loss or fragmentation for species dependent on tallgrass prairie habitat. Infrastructure development (e.g., pipelines, transportation projects, and wind farms), which could cross multiple land jurisdictions, would further contribute to habitat fragmentation.

The proliferation of oil and gas development projects in areas that are suitable ABB habitat and the ABB's small size could mean that a potentially vast number of individuals could be taken during project construction. Mortality of ABBs is project specific and constitutes a short-term, adverse effect; nevertheless, the cumulative loss of ABBs from multiple development and infrastructure projects over time may eventually reduce the ability of a given population to survive in a fragmented landscape (see **Appendix B**). The same is true of the rattlesnake master borer moth if development and infrastructure projects result in the loss of host plants.

Overall, oil and gas development activities, combined with other projects in the cumulative impacts analysis area, would likely result in adverse impacts on special status species raptors and birds of prey. This would result from the loss of foraging habitat, habitat fragmentation, increased human activity that could disrupt breeding behavior, visual and noise disturbances, and temporary reduction in prey populations. There would also be an increased risk of collisions. All types of habitat loss are long term, though some habitat function would likely be restored as the result of well abandonment operations when production has ceased.

Oil and gas leasing and development, in combination with converting tallgrass prairie habitat to agricultural use, is likely to continue to affect ABB and special status bird species that use prairie habitat for nesting, foraging, and protection from predators. As discussed, the ABB's small size makes them difficult to avoid. The proliferation of oil and gas projects across ABB habitat means an indeterminate but potentially vast number of individuals will be taken during project construction. Although direct mortality of ABBs from individual construction activities is local and constitutes a short-term adverse effect, the cumulative loss of ABBs from multiple development projects in a larger area may eventually reduce the ability of a given population to survive in a fragmented landscape (see **Appendix B**).

Under all alternatives, the rattlesnake master borer moth also would cumulatively lose an indeterminate but potentially large number of individuals from loss of its host plant and sole food source, the rattlesnake master plant. Losses would occur during construction of oil and gas and infrastructure projects across the region.

Infrastructure development (*e.g.*, oil and gas pipelines, roads projects, and wind farms) across public and private lands would all contribute to habitat fragmentation for special status prairie birds. Approximately 95 percent of Osage County is already in agricultural use (Osage County 2011); further conversion of native habitats to agriculture would result in permanent habitat loss and fragmentation for special status birds that nest and forage in tallgrass prairie. In areas where infrastructure is highly concentrated or overlaps with oil and gas development, increased predation may result from the proliferation of tall structures that provide vantage for predators. The concentration of disturbances may result in population declines for special status prairie birds.

4.7 VEGETATION, WETLANDS, AND NOXIOUS WEEDS

This section discusses impacts that the alternatives described in **Chapter 2** may have on vegetation, wetlands, and noxious weeds. Impacts on vegetation, wetlands, and noxious weeds were evaluated based on the maximum potential disturbance under each alternative.

4.7.1 Methods and Assumptions

Riparian and Wetland Vegetation

Indicators of impacts on vegetation, wetlands, and noxious weeds are as follows:

Upland Vegetation

- Acres and condition of upland vegetation communities
- Extent of fragmentation of upland vegetation communities

Wetlands

- Acres and condition of wetlands and riparian communities
- Extent of fragmentation of wetlands and riparian communities

Noxious Weeds

- The potential for noxious weed or invasive species introduction or spread
- The potential for increases or decreases in noxious weed or invasive species populations
- Acres of ground-disturbing activities

Assumptions

- Impact intensity would be influenced by multiple factors, including the size and location of a project (*i.e.*, the amount of new surface disturbance proposed and the proximity to undisturbed upland vegetation, wetlands and riparian areas, or noxious weed infestations).
- A formal delineation of wetlands and waters of the US that may be under the jurisdiction of the US Army Corps of Engineers under Section 404 of the CWA has not been completed. Before the project begins, potential jurisdictional areas would be delineated, and any necessary US Army Corps of Engineers permits required for impacts on jurisdictional areas would be obtained.
- Weeds would continue to be introduced and spread as a result of ongoing water flows, wind, and other natural factors; vehicle traffic; recreational activities; and wildlife movements in the planning area.
- All short- and long-term surface disturbance would result in the disturbance or removal of vegetation.
- Surface disturbance of riparian areas and wetlands is more likely to occur as a result of the construction of linear project features, such as roads, than as a result of the construction of non-linear project features, such as well pads.
- As surface disturbance and traffic increase, also increasing would be the risk of spreading existing invasive plant species and noxious weeds and/or establishing new populations of invasive plant species and noxious weeds not currently present within the planning area.

4.7.2 Impacts Common to All Alternatives

Under all alternatives, oil and gas leasing and development would continue. Surface disturbance and vegetation removal due oil and gas development activities, such as the construction of well pads, roads, pipelines, and other facilities, could affect plant community structure, species composition, diversity, and density. Surface disturbance and increased personnel and vehicle traffic could also increase the potential for trampling of vegetation and the invasion or establishment of noxious weeds and nonnative grasses.

Invasion by noxious weeds and nonnative grasses is problematic because they can successfully outcompete native species for space, water, light, and nutrients. Vegetation could also be affected due to soil erosion and compaction as well as airborne dust. Fugitive dust could cover existing vegetation and inhibit photosynthesis and respiration. Impairment of these functions could affect the vigor, growth rate, and reproductive capacity of individual plants and increase their susceptibility to disease (Lewis 2013). While the potential for vehicle-induced grass or brush fire is low, increased vehicle traffic does increase the risk of accidental grass or brush fire during certain seasons.

Oil and gas development activities could directly affect riparian and wetland vegetation, due to filling, draining, alterations in surface or subsurface hydrology, and changes in water quality or quantity. Wetland vegetation communities are particularly sensitive to impacts from changes in watershed function. Species composition and density in riparian and wetland areas could shift, due to erosion, soil compaction, dust, surface water diversion, changes in drainage and runoff patterns, and the introduction of noxious weeds or nonnative species.

With any oil and gas development, there is also an increased risk of contamination due to accidental spills. Increased sediment loads or contamination could harm riparian and wetland vegetation and impair its ability to function properly, resulting in plant mortality. Typically, accidental spills would result in localized, short-term impacts.

Where interim restoration and revegetation of disturbed areas occurs, impacts would likely be temporary, lasting less than 5 years; however, long-term impacts on vegetation community composition and structure could persist for years following restoration. This would be due to the length of time it can take for certain vegetation community characteristics to return or regenerate. If disturbed areas cannot be restored or revegetated (for example, where a permanent access road or monitoring well was installed), impacts would be permanent.

Under all alternatives, the BIA would apply COAs to drilling and workover permits to reduce the impacts from development operations, prevent environmental degradation, and ensure compliance with applicable laws and regulations, such as the CWA and Federal Noxious Weed Act (COAs 1, 2, 7, 16, 19, 21 and 23). COAs may be applied to all permits or on a case-by-case basis, depending on the alternative selected. Application and enforcement of COAs would reduce impacts on vegetation and wetlands. These COAs reduce surface disturbance and the risk of contamination, minimize the removal of vegetation, prevent the spread of noxious weeds and invasive species, and protect water resources. Regulatory requirements limiting the size of well pads, providing standards for pits construction and maintenance, and requiring dust abatement would further mitigate potential impacts.

It should be noted that, pursuant to the BO for the ABB, the BIA must enforce conservation or mitigation measures to avoid or reduce the impacts of oil and gas development on ABB habitat. Such measures include reducing soil erosion, soil compaction, and the risk of wildfires; restoring ABB habitat; and monitoring vegetation maintenance and noxious weed incursion (see **Appendix B**). These measures would provide incidental protection for vegetation and wetlands by minimizing the impacts thereon. If the ABB is removed from the endangered species list, the BIA Osage Agency Superintendent could require site-specific mitigation measures for vegetation and wetlands, as appropriate.

4.7.3 Alternative 1 (No Action)

Under Alternative 1 (No Action), the application of COAs and enforcement of regulations would continue to mitigate impacts on vegetation, wetlands, and noxious weeds. COAs 3–6 would reduce potential impacts on vegetation density, growth, and reproduction by requiring lessees to avoid soil and vegetation disturbance, minimize alteration of the natural topography, implement erosion control measures, and confine vehicles and equipment to approved lease roads. COAs 3–6 would also reduce potential impacts on wetland species composition and density by preventing alterations in hydrology and drainage and by minimizing erosion and soil compaction. COA 13, which requires lessees to minimize fugitive dust, would reduce potential impacts on vegetation due to dust covering plants and impairing respiration or photosynthesis. COA 13 would also provide protection for wetlands by reducing the risk of changes in water quality due to sedimentation.

COA 14, which prohibits the commencement of operations in aquatic environments without prior authorization, requires lessees to avoid discharging soil or contaminants to water, and prohibits the removal of stream water, would further protect wetlands by reducing the risk of vegetation removal and contamination. COA 15, which prohibits the use of noxious weeds or invasive species in the restoration of surface lands, would limit the potential for the spread of such weeds and species, which could impact vegetation growth and reproduction. COAs 20 and 21, which are directed at protection of the ABB, would incidentally protect vegetation by limiting disturbance and requiring vegetation maintenance, where appropriate.

Culturally important plants (see **Section 3.7**, Vegetation, Wetlands, and Noxious Weeds) would be protected by implementing COAs (COAs 1 and 2) in Alternative 1 (No Action). This would come about because COAs would provide protections for habitats where culturally important plants grow. The COAs under Alternative 1 (No Action) specify review of actions that may affect resources that are traditionally important to the Osage Nation (see **Section 4.18.3**, Trust Assets and Osage Nation, Alternative 1 [No Action]); this review should provide additional protection for culturally important plants.

4.7.4 Alternative 2

Under Alternative 2, the BIA would issue a standard list of BMPs that apply to all oil and gas development operations within the planning area. In addition, the BIA would minimize the number of COAs applied to permitted activities and would not prescribe the specific methods operators must use to comply with the BMPs or other applicable laws or regulations; operators would be given latitude to determine how best to comply. Alternative 2 would generally provide the least amount of protection for wetlands and vegetation and the least prevention of noxious weed spread. The waiver of protective COAs (COAs 3–6, 13–15, and 20–21) would result in increased habitat fragmentation as well as the potential for erosion, sedimentation, and the introduction and spread of noxious weeds. The potential for impacts on culturally important plants would increase under this alternative, as compared with Alternative 1 (No Action), as the lack of protective COAs could result in poor habitat conditions for culturally important plants (ONENRD 2006).

The application of COA 27 would reduce potential impacts on vegetation, wetlands, and noxious weeds, as compared with Alternative 1 (No Action). COA 27, which prohibits land application of waste oil, wastewater, and contaminated soil without the BIA Osage Agency Superintendent's prior approval, would provide incidental protection for vegetation and wetlands by preventing contaminated materials from leaching into soils and water sources and by keeping waste materials out of wetlands and vegetated areas. Voluntary compliance with BMPs and agreements between lessees and surface owners regarding restoration of surface lands may mitigate some of these impacts.

4.7.5 Alternative 3

Under Alternative 3, the BIA would issue the same standardized list of BMPs and minimal COAs as Alternative 2 in sections with a high density of historical oil and gas development. The BIA would implement the same well spacing requirements and additional protective COAs as Alternative 4 in sections with a low density of historical oil and gas development. In addition, the BIA would not approve new ground-disturbing activities in the sensitive areas described in **Section 2.3.4**, Alternatives Considered for Detailed Analysis, Alternative 3—Hybrid Development. The application of COAs based on the well density would result in location-specific impacts on vegetation, wetlands, and noxious weeds.

In high-density sections, the waiver of protective COAs relating to soil and vegetation disturbance, alteration of topography, erosion control, vehicle traffic, operation in aquatic environments, removal of waste and contaminated soil, and restoration of surface lands (COAs 3–6, 13–15, and 20–21) would increase the risk of impacts on vegetation and wetlands due to soil loss, erosion, and compaction; contamination of soils and water sources; and the spread of noxious weeds. Voluntary compliance with BMPs and agreements between lessees and surface owners regarding restoration of surface lands may mitigate some of these impacts.

In low-density sections and sensitive areas, Alternative 3 would reduce potential impacts on special status species, compared with Alternative 1 (No Action). In addition to all COAs applied under Alternatives 1 and 2, COAs 26 and 28–31 also would apply in low-density sections. COA 26, which prohibits the location of wells and pits in areas subject to frequent flooding, would reduce the risk of vegetation and wetland contamination in the event of a flood. COA 28, which requires that drilling pits be located at least 200 feet from streams and waterways, would also reduce the potential for contamination and vegetation removal. COA 30, which requires lessees to avoid new road and pipeline crossings of aquatic environments, would prevent vegetation removal and reduce the risks of erosion, sedimentation, and water diversion. COA 31, which requires the collocation of new and existing facilities when feasible, would reduce surface disturbance, helping maintain the acreage, density, and condition of native vegetation communities and reduce the potential for the introduction and spread of noxious weeds. Culturally important plants would benefit from the increased COAs in low-density sections as described above, as these COAs offer additional protections to native upland, riparian, and wetland vegetation, which provide habitat for culturally important plants. In high-density sections, impacts on culturally important plants would be as described under Alternative 2 because the same COAs would apply.

The implementation of cultural resource buffers (see **Table 2-2** in **Chapter 2**) and well spacing requirements in low-density sections would further reduce surface disturbance and the risks of vegetation removal and fragmentation, as well as invasive species and noxious weed establishment and spread. Under Alternative 3, approximately 248,800 acres would be protected from new ground-disturbing oil and gas development activities, reducing potential impacts on vegetation, wetlands, and noxious weeds, compared with Alternative 1 (No Action).

4.7.6 Alternative 4

Under Alternative 4, the BIA would apply well spacing requirements and additional protective COAs, beyond those applied under Alternative 1 (No Action), to all new development within the planning area. Further, the BIA would not approve new ground-disturbing activities in the sensitive areas described in **Section 2.3.5**. The type of impacts on vegetation, wetlands, and noxious weeds under Alternative 4 are described above for Alternative 3, low-density sections. The scope of those impacts, however, would be further reduced under this alternative due to the application of protective COAs (COAs 26 and 28–31) throughout the planning area and restrictions on ground disturbance in a larger number of sensitive areas. In addition to protecting native upland, riparian, and wetland vegetation, these additional protective COAs would also protect culturally important plants within the planning area.

Under Alternative 4, approximately 524,400 acres of sensitive areas, including sensitive water supply areas, US Army Corps of Engineers lakes, state parks, and others, would be protected from new ground-disturbing oil and gas development activities, reducing potential impacts on vegetation, wetlands, and noxious weeds. The application of cultural resource buffers (see **Table 2-2** in **Chapter 2**) countywide under this alternative would also provide incidental protections due to the implementation of setbacks from streams, rivers, ponds, reservoirs, lakes, and wetlands. Such buffers would further limit new ground disturbance, reduce the potential impacts from vegetation removal, and minimize the risks of wetland contamination and alterations of hydrology. As Alternative 4 has the greatest reduction in surface disturbance and applies protective COAs throughout the planning area, it would have the greatest reduction in potential impacts on vegetation and wetlands and the lowest risk of noxious weed establishment and spread.

4.7.7 Cumulative Impacts

The cumulative impact analysis area for vegetation, wetlands, and noxious weeds is the planning area. Past, present, and reasonably foreseeable future actions and conditions involving ground disturbance have affected, and would likely continue to affect, vegetation, wetlands, and noxious weeds within the cumulative impact analysis area. Examples of such actions and conditions are set forth in **Table 4-1**. Oil and gas development activities under the alternatives would have impacts like those of past and present development and would contribute to the cumulative effects on such resources.

Surface disturbance resulting from oil and gas development activities would continue to affect vegetation and wetlands. This would be due to loss or modification of vegetation communities and structures, changes in species composition, establishment and spread of noxious weeds and nonnative invasive species, soil disturbance, and increased risk of fugitive dust, wildland fire, and contamination due to accidental spills. Other activities within the cumulative impact analysis area that may contribute to these impacts are livestock grazing, agriculture, mining (other than oil and gas), infrastructure projects (e.g., pipelines, transportation projects, and wind farms), and residential development.

Tallgrass prairie has substantially declined in acreage throughout the region, though large expanses of this vegetation type still occur within the planning area (Hoagland 2008). Historical use of tallgrass prairie for pasture (Duck and Fletcher 1943; Sampson and Knopf 1994) led to the conversion of exotic pasture grasses, and this is an ongoing threat to tallgrass prairie within the region (Hoagland 2000). Management of the Tallgrass Prairie Preserve will continue to improve the ecological integrity of native tallgrass prairie in the planning area. The frequency and extent of fire in these vegetation systems has dramatically declined due to fire suppression and the reduction of fuels due to grazing. This can give rise to changes in the plant community, loss of riparian vegetation, and invasion of native or nonnative species, including eastern red cedar.

Projections for the future of riparian vegetation in Oklahoma show continued loss of riparian areas (OSU 1998). Many riparian areas have been cleared for pastureland, row crops, or other agriculture. Urban encroachment, channelization, and other water resource projects also have the potential to impact riparian areas. Development projects, agricultural conversion, and water resource projects would likely continue within the planning area and could affect wetlands under the jurisdiction of the US Army Corps of Engineers; however, US Army Corps of Engineers wetland permits include mitigation requirements, such as restoring, enhancing, creating, and preserving aquatic functions and values, to offset unavoidable impacts (USACE 2017).

Invasive species are spreading or increasing in density in certain parts of the planning area, including oil and gas fields; along roadways, transmission lines, and other ROWs; and at the margins of agricultural operations where ground disturbance is concentrated and increased human activities have increased the number of potential invasive plant introductions (Smith and Knapp 2001). Typically, as ground disturbance increases in areas of weed populations, the likelihood that invasive plants move into disturbed areas increases. Linear development, particularly roads, pipelines, transmission lines, and fences, can facilitate long-distance weed dispersal (Sheley et al. 1996; Forest Service 2012).

If native upland, riparian, and wetland vegetation continues to decline in the planning area, culturally important plants may also be at risk of decline. Noxious weed and invasive plant programs through the MRCS, Oklahoma State University, OkIPC, and Oklahoma Biological Survey will continue increasing awareness of noxious weeds and nonnative invasive plants within the planning area. Recognition of the sources of noxious weeds and invasive species and their economic and ecological impacts, along with early detection and prevention, will help prevent additional infestations within the planning area. The application of appropriate control and management strategies for such species will also prevent further expansion of current infestations.

It is likely that impacts from climate changes will affect vegetation in the cumulative impact analysis area within the 20-year planning horizon. Current climate change models project a range of potential shifts in climate, including increasing temperatures and more intense rainfall. Such shifts are expected despite a decrease in the average amounts of total annual precipitation (Karl et al. 2009). Altered climatic patterns would likely influence species distribution within vegetation communities within the planning area. This would happen particularly in those communities that are sensitive to impacts from drought or altered fire regimes or that are susceptible to weed establishment and spread.

4.8 AGRICULTURE

This section discusses impacts that the alternatives described in **Chapter 2** may have on agriculture. Impacts on agriculture were evaluated based on the maximum potential disturbance under each alternative.

4.8.1 Methods and Assumptions

Indicators

The indicator of impacts on agriculture is temporary and permanent reductions in farmland acres in the planning area.

Assumptions

Impacts on agriculture and farmlands were evaluated based on potential surface disturbance. Because this is a programmatic EIS, it is not possible to know the exact size and location of future oil and gas development projects.

4.8.2 Impacts Common to All Alternatives

Under all alternatives, oil and gas leasing would continue. Oil and gas development does not typically result in the irreversible conversion of farmland to other uses. Surface disturbance associated with the construction of well pads, roads, pipelines, pits, and other facilities, however, can affect soil properties, increase erosion and compaction, and alter hydrology. This would come about by reducing water infiltration, changing natural drainage and runoff patterns, and affecting water quality. Any such changes have the potential to affect the characteristics of prime or unique farmland for the duration of the project or, if the land is no longer capable of supporting agricultural use, once operations cease permanently.

Oil and gas development activities may also impact livestock by reducing forage due to vegetation removal; decreasing the quality or quantity of forage due to the establishment or spread of noxious weeds and invasive plant species; displacement from preferred pastures; increased visual and noise disturbances; and increased risk of injury or mortality due to increased vehicle traffic and exposure to hazardous chemicals or other hazards. Oil and gas development could have a beneficial impact on livestock grazing due to the construction and improvement of roads, which could provide livestock operators with better access to pastures and make it easier to maintain range improvements.

Under all alternatives, the BIA would apply COAs 1, 2, 7, 16, 19, 21, and 23 to drilling and workover permits. This would be done to reduce the impacts from development operations, prevent environmental degradation, and ensure compliance with applicable laws and regulations, such as the Farmland Protection Policy Act and American Indian Agricultural Resource Management Act. COAs may be applied to all permits or on a case-by-case basis, depending on the alternative selected.

Application and enforcement of COAs (COAs 2, 19, 21 and 23),) that reduce surface disturbance, minimize the removal of vegetation, prevent the spread of noxious weeds and invasive species, and confine vehicles to roads would reduce impacts on agricultural resources. Further mitigating potential impacts are regulatory requirements providing for lessees and surface owners to discuss routes of ingress/egress prior to the commencement of activities; the settlement of surface damages; and enclosures surrounding wells, pits, facilities, and other livestock hazards.

4.8.3 Alternative I (No Action)

Under Alternative I (No Action), the application of COAs and enforcement of regulations would continue to mitigate impacts on agriculture. COAs 3–6 would reduce potential impacts on soil properties, hydrology, and livestock forage by requiring lessees to avoid soil and vegetation disturbance, minimize alteration of the natural topography, implement erosion control measures, and confine vehicles and equipment to approved lease roads. COA 6, relating to vehicle and equipment traffic, would also reduce the risk of livestock injury or mortality due to collisions.

COAs 8–10 and 18, which prohibit lessees from having open containers of chemicals, waste, or contaminated soil on-site; require the proper enclosure of all facilities, pipes, and equipment; and implement air quality BMPs for operations in formations that may contain H_2S, would also reduce the risk of livestock injury or mortality. COAs 12 and 15, which require interim and final restoration of surface lands, would reduce livestock displacement and prevent permanent conversion of agricultural lands. COA 13, which requires that lessees minimize noise and visual disturbances, would reduce potential impacts on livestock.

4.8.4 Alternative 2

Under Alternative 2, the BIA would issue a standard list of BMPs that apply to all oil and gas development operations within the planning area. In addition, the BIA would minimize the number of COAs applied to permitted activities and would not prescribe the specific methods operators must use to comply with the BMPs or other applicable laws or regulations; operators would be given latitude to determine how best to comply. The waiver of protective COAs (COAs 3–6, 8–10, 12–13, 15, and 18) would result in increased impacts on agriculture, as compared with Alternative 1 (No Action), due to soil erosion and compaction, potential alterations in hydrology and topography, degradation and fragmentation of farmland, reduction or removal of livestock forage, and livestock disturbance, injury, or mortality.

The application of COA 27, which prohibits the land application of waste oil, wastewater, and contaminated soil without prior approval, would reduce the risk of livestock injury or mortality due to exposure, as compared with Alternative 1 (No Action). Voluntary compliance with BMPs and agreements between lessees and surface owners may mitigate some of these impacts.

4.8.5 Alternative 3

Under Alternative 3, the BIA would issue the same standardized list of BMPs and minimal COAs as Alternative 2 in sections with a high density of historical oil and gas development. The BIA would implement the same well spacing requirements and additional protective COAs as Alternative 4 in sections with a low density of historical oil and gas development. In addition, the BIA would not approve new ground-disturbing activities in the sensitive areas described in **Section 2.3.4**, Alternatives Considered for Detailed Analysis, Alternative 3—Hybrid Development.

In high-density sections, the waiver of COAs relating to soil and vegetation disturbance, alterations of hydrology, erosion control, noise and visual disturbances, livestock enclosures, interim and final restoration of surface lands, and removal of waste materials and hazardous chemicals (COAs 3–6, 8–10, 12–13, 15, and 18) would increase potential impacts on agriculture. Voluntary compliance with BMPs and agreements between lessees and surface owners may mitigate some of these impacts.

In low-density sections and sensitive areas, Alternative 3 would reduce potential impacts on agriculture, compared with Alternative 1 (No Action). In addition to all COAs applied under Alternatives 1 and 2, COAs 24, 26, 28–29, and 31 would also apply in low-density sections. COA 24 requires that lessee conduct operations in a manner that minimizes noise levels and adverse visual impacts that would be harmful to sensitive environmental receptors, which would reduce potential livestock disturbance. COA 26, which prohibits wells and pits from being located in areas subject to frequent flooding, would reduce the risk of livestock forage, pasture, farmland, and water source contamination in the event of a flood. COA 28, which requires that pits be at least 200 feet from streams and waterways, would also reduce the risk of contamination if there is a spill. COA 29, which requires lessees to avoid alterations to hydrology, would reduce potential impacts on farmland and livestock due to changes in drainage and runoff patterns or water diversion. COA 31, which requires the collocation of new and existing facilities when feasible, would reduce surface disturbance and potential conversion of agricultural lands.

Most prime farmland in the planning area is in low-density sections, where impacts of oil and gas development would be reduced under this alternative. Farmland within high- and low-density sections is shown in **Table 4-7**, below. Prime farmland is more likely to be converted or disturbed in high-density sections. This is because fewer protective COAs limiting surface disturbance would be applied, existing oil and gas development is more highly concentrated, and additional oil and gas development would be expected because these areas are where oil and gas potential is highest. There would likely be more fragmentation of productive land and pasture as well.

Table 4-7
Distribution of Prime Farmland in High- and Low-Density Sections

Farmland Classification	Acres in High-Density Wellbore Sections	Acres in Low-Density Wellbore Sections
Prime Farmland	95,000	287,400
Not Prime Farmland	298,100	793,900
Total	**393,200**	**1,081,300**

Sources: NRCS GIS 2015; BIA GIS 2017

Prime farmland located in sensitive areas where permits for new ground-disturbing activities would not be approved would be protected from the potential impacts of development. Acres of farmland that would be within these sensitive areas are shown in **Table 4-8**, below.

Table 4-8
Distribution of Prime Farmland in Sensitive Areas

Farmland Classification	Acres in Designated Sensitive Areas – Alt 3	Acres in Designated Sensitive Areas – Alt 4
Prime Farmland	62,900	124,300
Not Prime Farmland	183,900	400,100
Total	**248,800**	**524,400**

Sources: NRCS GIS 2015; OWQS GIS 2017; OK DEQ GIS 2017

In low-density sections and sensitive areas, impacts from oil and gas development on farmland and agricultural uses would likely be less than under Alternative 1 (No Action) because of the application of COAs that would incidentally reduce impacts and prevention of new oil and gas-related surface disturbance (COAs 24, 26, and 28–31). In high-density sections, impacts on farmland and agricultural uses would be greater than under Alternative 1 (No Action) because there would be fewer COAs applied that would reduce impacts.

4.8.6 Alternative 4

Under Alternative 4, the BIA would apply well spacing requirements and additional protective COAs, beyond those applied under Alternative 1, to all new development within the planning area. Further, the BIA would not approve new ground-disturbing activities in the sensitive areas identified under Alternative 3 and the additional sensitive areas described in **Section 2.3.5**, Alternatives Considered for Detailed Analysis, Alternative 4—Enhanced Resource Protection. The types of impacts on farmland would be the same as those described for Alternative 3, low-density sections. The scope of those impacts, however, would be further reduced under Alternative 4 due to the application of protective COAs (COAs 24, 26, 28–29, and 31) throughout the planning area and restrictions on ground disturbance in a larger number of sensitive areas. Preventing new ground disturbance in certain sensitive areas would protect farmland in those areas, as shown in **Table 4-8**.

Under Alternative 4, approximately 524,400 acres of sensitive areas would be protected from new ground-disturbing oil and gas development activities, reducing potential impacts on agriculture. The application of cultural resource buffers (see **Table 2-2** in **Chapter 2**) countywide under this alternative would also provide incidental protections to farmland and livestock due to the implementation of setbacks from streams, rivers, ponds, reservoirs, lakes, and wetlands. Such buffers would further limit new ground disturbance and reduce the risk that farmlands, livestock forage, and critical water sources would be contaminated in the event of a spill. Thus, Alternative 4 would afford more protections than Alternative 1 (No Action) and likely result in the greatest reduction of impacts on agriculture.

4.8.7 Cumulative Impacts

The cumulative impact analysis area for agriculture is the planning area. Past, present, and reasonably foreseeable future actions and conditions involving ground disturbance have affected, and would likely continue to affect, agriculture within the cumulative impact analysis area. Examples of such actions and conditions are set forth in **Table 4-1**. Oil and gas development activities under the alternatives would have impacts like those of past and present development and would contribute to the cumulative effects on agriculture.

The BIA currently administers 24 agricultural leases and 309 grazing leases, covering 71,632 acres. Surface disturbance from oil and gas development activities would continue to affect agriculture by temporarily converting prime or unique farmland to other uses, reducing the quality or quantity of forage, altering hydrology, displacing livestock, and increasing the risk of livestock injury or mortality. Other activities within the cumulative impact analysis area that have resulted in the conversion of farmland and contributed to these impacts are mining (other than oil or gas), wind farms, and infrastructure projects (*e.g.*, pipelines, transportation projects, and wind farms) that cross or are adjacent to agricultural lands.

4.9 CULTURAL RESOURCES

This section discusses impacts that the alternatives described in **Chapter 2** may have on cultural resources. Impacts on cultural resources were evaluated based on the maximum potential disturbance under each alternative.

4.9.1 Methods and Assumptions

Indicators

The integrity of cultural resources is assessed by the ability of the cultural, archaeological, or historic property to convey the important traditional, scientific, and public values for which it is determined to be significant.

Indicators of impacts on cultural resources are as follows:

- Damage, intentional or otherwise, resulting in a loss of significance or integrity, or both, to historic properties or sacred sites important to Tribes, as considered under NHPA or EO 13007
- Extent and relative depth of ground-disturbing activities and the potential to affect known or unknown intact cultural resources or areas of importance to traditional communities
- Extent to which an action approves the removal of existing structural features and the potential to affect known or unknown intact cultural resources or areas of importance to traditional communities
- Increased access to, or activity in, areas where cultural resources are present or anticipated
- Extent that an action increases the potential for erosion or other natural processes that could affect cultural resources
- Extent that an action alters the visual or auditory setting of cultural resources, culturally significant landscapes, or traditional cultural properties and any other sensitive sites identified by Tribes

Assumptions

- Cultural resources are nonrenewable; therefore, direct physical impacts would be long term or permanent.
- As part of the NHPA Section 106 consultation process and subsequent site-specific NEPA review for APDs, cultural resource surveys will be conducted prior to the approval or commencement of ground-disturbing activities that could impact cultural resources.

- The preparation of cultural resources surveys will generate new information about cultural resources within the planning area and help lessees avoid damaging or destroying cultural resources.
- Cultural resources that are eligible for the National Register of Historic Places and locations important to contemporary Tribal communities will be avoided, whenever possible.
- The potential visual, auditory, and atmospheric impacts on cultural resources cannot be analyzed at this time because the exact locations of future projects are unknown.

4.9.2 Impacts Common to All Alternatives

Under all alternatives, oil and gas leasing and development activities would continue. Cultural resources located within the planning area are nonrenewable, and unknown or undetected resources could be affected by oil and gas development activities, such as the construction of well pads, roads, pipelines, and other facilities, and by secondary surface activities, such as vehicle and pedestrian traffic. Cultural resources could also be impacted by vegetation removal and natural processes, such as soil erosion and weathering. While standing historic buildings or structures are typically more visible than archaeological deposits and, therefore, more easily avoided, the Osage Nation and other Tribes may attach religious significance to historic properties, including sites that are not eligible for listing on the National Register of Historic Places.

Oil and gas development activities may also have indirect effects on cultural resources, including increased risk of surface artifact collection, unauthorized excavation due to improved road access to previously remote sites, and visual or auditory intrusion. Short-term visual and auditory impacts would include visual contrasts, such as those created by drilling rigs during initial development activity, and noise disturbances from heavy equipment and increased traffic during construction. Long-term visual and auditory impacts would result from the presence of well pads, roads, and other facilities and the noise associated with the equipment used for production operations, such as compressors.

The intensity of visual impacts would depend on the size of the proposed infrastructure, design features, and proximity to cultural resources. The direct and indirect effects of oil and gas development activities could result in the loss of research potential or enhancement through scientific study or the alienation of culturally significant locations. The degree of impacts on cultural resources would depend on their location relative to the project and the efforts taken by the lessee to minimize the risk of disturbance, damage, and destruction.

Compliance with the NHPA Section 106 consultation requirements and the identification and evaluation of cultural resources as part of the site-specific NEPA review process would mitigate any significant impacts on cultural resources. Cultural resource surveys of individual well, road, and facility locations or larger areas (i.e., block surveys of 1 or more quarter-sections) are conducted by the BIA or contractors retained by lessees. Pursuant to 36 CFR 800.4, the BIA must consult with the Osage Nation to identify historic properties within the area of potential effects. Cultural resource surveys must be conducted in accordance with and must meet SOI standards for qualified personnel, methods, and reporting. Once complete, cultural resource surveys must be submitted to the Osage Nation THPO and any other interested Tribes for review, comment, and concurrence with findings.

The location and nature of all cultural resources within the planning area is unknown. Accordingly, at the planning level, it is not possible to determine whether there would be irreversible impacts on cultural resources or what those impacts would be. While all known eligible cultural resources would be avoided or appropriately mitigated, damage to buried and undetected cultural resources could occur. Under all alternatives, the BIA would apply COAs 1, 2, 7, 16, 19, 21 and 23 to drilling and workover permits. It would do this to reduce the impacts from development operations, prevent environmental degradation, and ensure compliance with applicable laws and regulations, such as the NHPA. COAs may be applied to all permits or on a case-by-case basis, depending on the alternative selected. The application of COAs that reduce surface disturbance (COAs 2, 19, 21 and 23) and require the avoidance and protection of cultural resources (COAs 1 and 2) would minimize potential impacts.

4.9.3 Alternative 1 (No Action)

Under Alternative 1 (No Action), the application of COAs and enforcement of regulations would continue to mitigate impacts on cultural resources. COAs 3–5, which require lessees to avoid soil disturbance and vegetation removal and to implement erosion control measures, would provide incidental protection to cultural resources by reducing potential impacts due to surface disturbance. COA 14, which directs lessees to avoid activities in aquatic environments, also would provide incidental protection for cultural resources by limiting surface disturbance near waterbodies, where cultural resources are often found. COA 6, which requires that lessees confine vehicles and equipment to approved lease roads, would reduce the risk of accidental destruction of undiscovered cultural resources due to trampling or traffic. COA 13, which requires lessees to minimize noise, traffic, dust, and visual disturbances, would reduce potential auditory and visual impacts that could impact the atmosphere at cultural sites and properties.

4.9.4 Alternative 2

Under Alternative 2, the BIA would issue a list of standard BMPs that apply to all oil and gas development operations within the planning area. In addition, the BIA would minimize the number of COAs applied to permitted activities and would not prescribe the specific methods operators must use to comply with the BMPs or other applicable laws or regulations; operators would be given latitude to determine how best to comply. The waiver of protective COAs that reduce surface, noise, and visual disturbances (COAs 3–6 and 13–14) would increase the potential for impacts on cultural resources.

Despite the waiver of COAs, the standard NHPA Section 106 process would still be required, and additional COAs and conservation measures could be imposed, when necessary, to ensure the protection of cultural resources. Resolving adverse effects through the NHPA Section 106 process would mitigate any significant impacts under this alternative.

4.9.5 Alternative 3

Under Alternative 3, the BIA would issue the same standard BMPs and minimal COAs as Alternative 2 in sections with a high density of historical oil and gas development. The BIA would implement the same well spacing requirements and protective COAs as Alternative 4 in sections with a low density of historical oil and gas development. In addition, the BIA would not approve new ground-disturbing activities in the sensitive areas described in **Section 2.3.4**, Alternatives Considered for Detailed Analysis, Alternative 3—Hybrid Development.

In high-density sections, the waiver of COAs relating to surface, noise, and visual disturbances (COAs 3–6 and 13–14) would increase the potential impacts on cultural resources due to accidental damage or destruction or alteration of the character of cultural sites.

In low-density sections and sensitive areas, Alternative 3 would reduce potential impacts on cultural resources, as compared with Alternative 1 (No Action). In addition to all COAs applied under Alternatives 1 and 2, COAs 28, 29, and 31 also would apply in low-density sections. COAs 28 and 29, which require that drilling pits be located at least 200 feet from streams and waterways and avoidance of new road and pipeline crossings of aquatic environments, would provide incidental protection for cultural resources by limiting surface disturbance in locations where cultural resources, sites, and properties are commonly found. COA 29, however, also provides for the burial of pipelines, which could cause additional surface, noise, and visual impacts. The BIA could waive COA 29 where necessary to protect cultural resources, which would mitigate the potential impacts associated with pipeline burial. COA 31, which requires the collocation of new and existing facilities, would also provide incidental protection for cultural resources by reducing the amount of surface disturbance.

For low-density sections, Alternative 3 would include proactive guidance on minimum expected no-drilling buffer zones for particular site types to assist in development and access road planning. These buffers would be applied based on the results of the preconstruction survey. The buffer sizes would vary based on site type and may be adjusted as necessary, based on site-specific conditions (see **Table 2-2** in **Chapter 2**). Siting in the vicinity of cultural resources would still be subject to site-specific review and approval. Applying these additional conservation measures in low-density sections would have a beneficial impact on cultural resources by providing more predictable guidance and standards for siting facilities and avoiding impacts on cultural resources.

In low-density sections, potential impacts from oil and gas development on cultural resources would likely be less than under Alternative 1 (No Action). This is because of the application of COAs that would incidentally reduce impact potential. Similar to Alternative 2, in high-density sections, potential impacts on cultural resources would be greater than under Alternative 1 (No Action). This is because there would be fewer COAs applied that would reduce impacts. While fewer COAs would apply in high-density sections of the planning area, compliance with the NHPA Section 106 process would still be required. In both high- and low-density sections, additional COAs and conservation measures could be imposed, when necessary, to ensure the protection of cultural resources. Resolving adverse effects through the NHPA Section 106 process would mitigate any significant impacts under this alternative.

Under Alternative 3, approximately 248,800 acres would be protected from new ground-disturbing oil and gas development activities, reducing potential impacts on cultural resources compared with Alternative 1 (No Action).

4.9.6 Alternative 4

Under Alternative 4, the BIA would apply well spacing requirements and additional protective COAs, beyond those applied under Alternative 1 (No Action), to all new development within the planning area. Further, the BIA would not approve new ground-disturbing activities in the sensitive areas identified in **Section 2.3.5**, Alternatives Considered for Detailed Analysis, Alternative 4—Enhanced Resource Protection. The types of impacts on cultural resources under Alternative 4 are described above for Alternative 3, low-density sections. The scope of those impacts, however, would be further reduced under Alternative 4 due to the application of protective COAs (COAs 28, 29, and 31) throughout the planning area.

Under Alternative 4, approximately 524,400 acres would be protected from new ground-disturbing oil and gas development activities, reducing the potential impacts on cultural resources. Alternative 4 would also apply cultural resource buffers (see **Table 2-2** in **Chapter** 2) countywide. Such buffers offer proactive guidance on minimum expected no-drilling buffer zones for particular types of sites to assist in development and access road planning. These buffers would be applied based on the results of the preconstruction survey. The buffer sizes would vary based on site type and may be adjusted as necessary based on site-specific conditions. Siting in the vicinity of cultural resources would still be subject to site-specific review and approval.

Applying these additional conservation measures would have a beneficial impact on cultural resources by providing more predictable guidance and standards for siting facilities and avoiding impacts on cultural resources. Additional COAs and conservation measures could be imposed, when necessary, to ensure the protection of cultural resources. Resolving adverse effects through the NHPA Section 106 process would mitigate any significant impacts under this alternative.

4.9.7 Cumulative Impacts

The cumulative impact analysis area for cultural resources is primarily the planning area. Consideration is also given to historic trails that pass through Osage County, if those trails have not been well documented as linear cultural resources. Other cumulative impacts could come from actions outside the planning area that may alter the visual, auditory, or atmospheric setting of cultural resources, culturally significant landscapes, and traditional cultural properties.

Past, present, and reasonably foreseeable future actions and conditions involving ground disturbance have affected, and would likely continue to affect, cultural resources within the cumulative impact analysis area. Examples of such actions and conditions are set forth in **Table 4-1**. Oil and gas development activities under the alternatives would have impacts like those of past and present development and would contribute to the cumulative effects on cultural resources.

The magnitude of impacts on cultural resources may increase or decrease, depending on the density of cultural resource sites near oil and gas development activities, the significance of the cultural resources, and the scope of other reasonably foreseeable actions over the next 20 years. These actions include mining (other than oil and gas), agriculture, grazing use, infrastructure development (e.g., pipelines, transportation projects, and wind farms), and residential development. It should be noted that damage or destruction to cultural resources is site specific and not additive across a landscape; however, such impacts may impede the ability to understand a region's or group's history.

Future activities that involve surface and subsurface disturbance have the highest potential to impact cultural resources. This is due to the increased risk of vandalism, illegal collection, fugitive dust, and increased erosion at sites located near well pads, roads, and facilities where vegetation has been removed. Impacts may also result from cultural resource management decisions by the Osage Nation and non-surface-disturbing activities that alter visual, auditory, or atmospheric effects.

Cultural resource sites and locations that Native American Tribes identify as sacred or traditionally important are often used in a manner that visual obstructions, increased noise levels, and atmospheric changes could infringe upon their use. These types of impacts could affect the historic setting and viewshed of culturally significant sites and properties as well as their eligibility for nomination to the National Register of Historic Places.

While the potential for adverse effects on cultural resources would likely increase commensurate with surface disturbance, impacts would be reduced by NHPA Section 106 consultation, the preparation of cultural resource surveys, and the implementation of appropriate COAs and mitigation measures. Cultural resource surveys are required prior to the approval of federal actions within the planning area. They would also be prepared for non-federal actions, when required by the Osage Nation or State of Oklahoma. As cultural resource surveys are required prior to the BIA's approval of oil and gas development activities, all sites eligible for listing on the National Register of Historic Places would be avoided or subject to mitigation measures; thus, the cumulative contribution that oil and gas development activities would have on cultural resources would likely be minimal. Beneficial cumulative impacts could also occur as previously buried and undocumented cultural resources are discovered, preserved, and studied.

4.10 Socioeconomics and Environmental Justice

This section discusses impacts that the alternatives described in **Chapter 2** may have on socioeconomics and environmental justice. Impacts on socioeconomic and environmental justice were evaluated based on the maximum potential development under each alternative.

4.10.1 Methods and Assumptions

The analysis in this section includes general information regarding direct and indirect impacts on employment and income in the oil and gas industry. Due to uncertainty regarding the levels of future development and production, this section does not provide quantitative modeling of impacts by alternative. Recent studies of economic impacts from the oil and gas industry within Oklahoma were used to provide estimates for economic outputs and economic multipliers (i.e., the factor by which the original jobs or spending in the oil and gas industry result in additional jobs gained or money spent in the economy) for a representative well. Economic multipliers vary depending on factors such as the location of jobs and technology used (Snead and Barta 2008; PWC 2011; Region Track 2017).

Indicators

Socioeconomics

Indicators of impacts on socioeconomics are as follows:

- Local area employment levels
- County population
- Local government fiscal conditions
- Local area community services
- Quality of life factors, including air and water quality, traffic, and social environment

Environmental Justice

The indicator for environmental justice is impacts in any resource area that disproportionately affect minority or low-income populations.

Assumptions

- Tax rates, royalty rates, and Osage headright payments will remain unchanged.
- The maximum number of new wells that could be drilled in Osage County between 2018 and 2037 under any alternative is 4,671.
- Oil and gas production will be affected by conditions outside the scope of this EIS, including geology, market price, and state and local regulations.
- While information is provided for Osage County, total economic impacts, including direct and indirect employment, income, and total value added, likely extend beyond this geographic area.

4.10.2 Impacts Common to All Alternatives

Socioeconomics

Under all alternatives, oil and gas leasing and development would continue. The Osage RFD (**Appendix A**) projections indicate approximately 100 oil well spuds per year in 2018 with a steady annual increase over the planning period. For gas wells, year 2018 levels for well spuds are approximately 50 per year with moderate annual increases over the planning period. The actual number of wells drilled and active wells would vary at a given time based on market conditions and site-specific resource availability and constraints. If development occurs at the maximum level projected in the RFD, there could be an 11 percent increase in the number of oil wells and a 41 percent increase in the number of gas wells by the end of planning period in 2037.

Oil and gas development result in capital costs, which contribute directly to the local economy in terms of temporary construction jobs and equipment and materials costs. Estimates for the development phase of a representative oil and gas well in Oklahoma are from $6.98 million to $9.85 million in direct economic output. Approximately 11.7 to 16.6 jobs would be created over the course of a year during the construction period, generating between $979,143 and $1,381,522 in direct labor income (Region Track

2017); however, there is considerable cost variability between individual wells depending on well depth, the number of wells per pad, technology employed, and other factors.

A portion of this spending and employment would occur in the local area, while a portion would result in spending in the wider region. The specific level of local contributions has not been determined. Based on data as presented in **Table 3-28** in **Chapter 3**, there were approximately 776 jobs in the minerals and energy sector in Osage County from 2011 to 2015. Additionally, there were 662 jobs in the construction industry, of which a portion were likely to include minerals- and energy-related construction.

It is likely that a portion of the employment generated by the maximum level of oil and gas development would be filled by individuals currently employed in the minerals and energy sector in Osage County. Jobs would also likely be filled by individuals currently employed in the minerals and energy sector outside of Osage County and those who are unemployed. The specific timing of development, market for energy products, and technology used determine how much the employment in the energy and construction sectors would increase at a given time.

As noted in the assumptions, oil and gas industry spending and employment result in additional economic contributions, including indirect spending (changes in materials and supplies in other industries as a result of the proposed action) and induced impacts (increased household spending as labor income increases). Indirect and induced impacts for a representative oil and gas well were estimated at $3.57 million to $5.04 million per well in economic output, 25.0 to 53.5 additional jobs, and $1.11 million to $1.57 million in additional labor income (Snead and Barta 2008; PWC 2011; Region Track 2017).

The level at which proposed activities would affect overall area population, as well as related demands on public services, including police services, local schools, and utilities, would depend on the timing of development and the degree to which employment demands could be met by the regional workforce. As a gradual increase in development is anticipated in Osage County, it is likely that any additional strain on housing and community services would be minimized.

There is some indication that temporary workers favor long-term hotels and may drive the construction of these facilities in areas with sustained drilling activity. In Osage County, previous drilling and pipeline construction activity resulted in increased demand for additional RV facilities. Counties can also rely on the housing stock of neighboring counties to make up for any lack in housing availability when commuting is feasible. For Osage County, the Tulsa metropolitan area represents a population within commuting distance that may provide employees, housing, and services. Commuting data indicate that the number of Osage County residents who work in neighboring counties is higher than the number of residents from neighboring counties who work in Osage County (Headwaters Economics 2017).

As discussed in the Osage RFD (**Appendix A**), production is reported by lease rather than by well in Osage County, making it impractical to generate well-specific production estimates and economic output. Based on the best available data from 2017, annual production resulted in approximately 4.2 million barrels of oil and 5.2 million mcf of natural gas. Based on projected well development levels, production would increase over the planning period as additional wells are constructed, particularly for natural gas. As represented by historical data, however, actual production is highly variable and would be determined by multiple factors, including, but not limited to, the timing of the development of wells, well success rate, number of active wells at a given time, technology employed, and oil and gas market conditions (**Appendix A**). Production levels and market prices, in turn, affect the amount of royalty revenues collected and distributed to Osage headright holders. Under all alternatives, production would continue, and royalties would be distributed to headright owners (see **Section 4.18**, Trust Assets and Osage Nation Interests).

Construction associated with oil and gas development has the potential to result in short-term impacts on local residents' quality of life due to increased potential for erosion, dust, traffic, and noise. Long-term impacts on local air, water quantity and quality, and visual setting may also occur. The level of potential impacts would be dependent upon the location and extent of development activities, drilling technology utilized, and mitigation measures employed. These impacts are discussed in detail in **Section 4.2**, Topography, Geology, Paleontology, and Soils (induced seismicity); **Section 4.3**, Water Resources; **Section 4.4**, Air Quality and Climate; **Section 4.11**, Public Health and Safety; and **Section 4.13**, Noise.

As set forth in the foregoing resource sections, oil and gas development within the planning area could affect nonmarket values. These are the benefits derived by society from the uses or experiences that are not dispensed through markets and do not require payment. Nonmarket values can include the preservation of scenery and viewsheds, plant and animal habitat, and important cultural sites for use and enjoyment by future generations.

Oil and gas development may conflict with other land uses, including agriculture, timber, and wind development. The degree to which conflict may occur depends on the degree of surface disturbance and would vary by alternative. Conflicts with other land uses could reduce the economic contributions from those resources.

Under all alternatives, the BIA would apply COAs 1, 2, 7, 16, 19, 21, and 23 to drilling and workover permits. It would do this to reduce the impacts from development operations, prevent environmental degradation, and ensure compliance with applicable laws and regulations, such as the CWA, SDWA, and CAA. The COAs set forth in this EIS, many of which are currently enforced in Osage County, are not anticipated to have a significant impact on the amount of future oil and gas development. COAs may be applied to all permits or on a case-by-case basis, depending on the alternative selected. Application and enforcement of COAs that reduce surface disturbance (COAs 2, 19, 21, and 23), visual and noise disturbances (COAs 1 and 2) and the risk of induced seismicity (COAs 19 and 23); that protect water, plant, and cultural resources (COAs 1, 2, 16, 19, 21, and 23); and that require dust abatement would minimize these impacts.

Environmental Justice

Environmental justice was analyzed at the county and census tract level, as detailed in **Section 3.10.1**, Socioeconomics and Environmental Justice, Current Conditions. The segment of the population in Osage County identified as minority was within 5 percentage points of the same demographic for the state of Oklahoma. The American Indian population in Osage County, however, was 15.1 percent, compared with 7.3 percent for the state of Oklahoma. Accordingly, the American Indian population is examined for environmental justice impacts.

As detailed in **Section 3.10.1**, Socioeconomics and Environmental Justice, Current Conditions, for all measures of poverty level examined, Osage County was similar to the state reference population; therefore, no low-income populations were identified for further consideration. In addition, Osage County contained a slightly higher population of individuals over the age of 65 than the state average. As a result, actions that affect social services for the older population could have a slightly higher degree of impacts within the planning area. Under all alternatives, oil and gas development activities are anticipated to result in minimal change to the population in the area, so social services for all groups would be unaffected (Headwaters Economics 2017).

In summary, although Osage County as a whole does not meet the standard CEQ definition for low-income or minority populations, Tribal populations in the area may represent those at differential risk for impacts. The planning area represents the cultural seat of the Osage Nation, so any activities have the potential to affect this Tribe. In addition, as noted in **Section 3.10.1**, Socioeconomics and Environmental

Justice, Current Conditions, when the population was examined at the census tracts level, 2 tracts with minority populations per CEQ guidelines were identified. As detailed in **Chapter 2**, further site-specific analysis would be required at the APD phase; such analysis would examine site-specific impacts on low-income population, minority populations, or Tribal groups.

4.10.3 Alternative 1 (No Action)

Socioeconomics

Applying the COAs (COAs 1–23) under Alternative 1 (No Action) would potentially restrict siting of oil and gas development location and operations in the planning area. However, all of the COAs under Alternative 1 (No Action) are currently applied in the planning area. Accordingly, while these COAs may inform the location and timing of development, they have not made, and are not expected to make, development within the planning area uneconomical. Economic contributions from development and production would continue at current rates or increase or decrease depending on market conditions.

Application of these COAs could minimize impacts from development on quality of life factors for area residents by reducing the likelihood of erosion and water contamination and requiring site restoration, as discussed in **Section 4.10.2**, Impacts Common to All Alternatives, and other relevant resource sections. Reducing disturbance from new development could also minimize impacts on other land uses (e.g., agriculture; see **Section 4.8**, Agriculture) and their economic contributions. Minimizing impacts on other resources, such as special status species, from new development could also help preserve these resources, thus minimizing impacts on nonmarket values, as discussed in **Section 4.10.2**, Impacts Common to All Alternatives.

The degree to which other land uses such as agriculture, and the jobs and income associated with these uses, would be affected by oil and gas development would differ from project to project based on the site-specific application of COAs. The extent of impacts cannot be known until a site-specific NEPA analysis is conducted on the specific measures to be applied at the project level. As discussed under **Section 4.10.2**, Impacts Common to All Alternatives, the level of production and economic output would also be affected by factors outside the scope of this EIS, such as market conditions.

Environmental Justice

Continued oil and gas development could benefit all populations, including identified minority and Tribal populations, by creating job opportunities and stimulating local economic growth. Royalties would continue to be paid out to headright owners, primarily Tribal citizens; however, disturbance from construction activities could have continued adverse effects on specific traditional Tribal lifeways and religious and cultural sites due to the presence of Tribal populations in the planning area.

Development could also affect the use of sites for traditional Tribal activities, such as traditional holidays observed at Tribal villages. Impacts on cultural sites would be minimized by COAs that limit surface disturbance (COAs 2–6, 12–17, 19–21, and 23), as well as Section 106 of the NHPA consultation requirements (see **Section 4.9**, Cultural Resources). Project activities would not result in disproportionate adverse impacts on identified minority or Tribal populations. Additional site-specific NEPA analysis, including evaluation of environmental justice impacts, would be required at the APD stage.

4.10.4 Alternative 2

Socioeconomics

Under Alternative 2, management actions would emphasize oil and gas development to a greater extent than under Alternative 1 (No Action), minimizing or waiving a greater number of COAs for drilling, workover, and other permitted activities. By requiring compliance with applicable laws and regulations without prescribing specific actions lessees must take in order to comply therewith, lessees would have a greater degree of flexibility in how to comply, compared with Alternative 1 (No Action).

This alternative may increase the lessee's liability or risk of noncompliance which, in turn, could cause an increase in operating costs. While the waiver of COAs would provide greater flexibility in operations, if the actions a lessee takes to comply with applicable laws and regulations are judged to be inadequate, they may be subject to the costs associated with taking the necessary corrective action and, in some cases, fines or civil penalties. With the absence of required COAs, ESA Section 7 compliance would be reinitiated, and lessees would be required to utilize ESA Section 10 until the BO is finalized. This process would likely result in increased costs for ESA compliance and/or a delay in the resumption of drilling until the new BO is issued.

In addition, with reduced standard protection measures, impacts on quality of life and on other land uses, as discussed in **Section 4.10.2**, Impacts Common to All Alternatives, would likely be increased. The actual level of development and production and related economic effects would continue to be affected by oil and gas market conditions.

Environmental Justice

Compared with Alternative 1 (No Action), there is potential for increased economic output to all populations under Alternative 2, due to the increased flexibility in complying with regulations. Potential impacts from construction activities and to quality of life, including impacts on Tribal populations as discussed under Alternative 1 (No Action), may be increased under Alternative 2. Because impacts would be spread throughout the planning area and the region, proposed oil and gas development is not anticipated to result in disproportionate adverse impacts on identified minority or Tribal populations.

4.10.5 Alternative 3

Socioeconomics

Under Alternative 3, the BIA would issue the same standard list of BMPs and minimal COAs as Alternative 2 in sections with a high density of historical oil and gas development. The BIA would apply the same additional protective COAs as Alternative 4 in sections with a low density of historical oil and gas development. In addition, the BIA would not approve new ground-disturbing activities in the sensitive areas described in **Section 2.3.4**, Alternatives Considered for Detailed Analysis, Alternative 3—Hybrid Development.

Alternative 3 could result in preferential development of high-density sections due to the waiver of many COAs therein. The potential concentration of development in these areas would concentrate impacts on soil, air, water, noise, and visual resources, as discussed under **Section 4.10.2**, Impacts Common to All Alternatives. This could reduce the overall impacts on other land uses, nonmarket values, and quality of life factors. In low-density sections, the impacts of constraints on siting and timing of development may be increased, compared with Alternative 1 (No Action). The primary impact on socioeconomics under Alternative 3 arises from the protection of approximately 248,800 acres from new ground-disturbing oil and gas development activities. The prevention of new drilling in these sensitive areas could result in less development or investment in such areas due to the increased cost of having to utilize horizontal or directional drilling to access the minerals.

Environmental Justice

Development would continue in high-density sections of the planning area, and economic contributions would be retained for all populations. Potential impacts may be more likely to occur in census tracts within high-density sections. Of the census tracts identified with minority populations, 42 percent of census tract 9400.2 and 55 percent of census tract 9400.6 are within high-density sections. Impacts would be more likely to occur on the minority populations in these areas.

The application of additional protective COAs in low-density sections and prevention of new ground-disturbing activities in sensitive areas could reduce construction impacts for populations in these portions of the planning area. They could also reduce overall impacts on any important Tribal uses or cultural sites, compared with Alternative 1 (No Action).

4.10.6 Alternative 4

Socioeconomics

Under Alternative 4, the BIA would apply well spacing requirements and additional protective COAs, beyond those applied under Alternative 1 (No Action), to all new development within the planning area. Further, the BIA would not approve new ground-disturbing activities in the sensitive areas described in **Section 2.3.5**, Alternatives Considered for Detailed Analysis, Alternative 4—Enhanced Resource Protection.

Under Alternative 4, approximately 524,400 acres would be protected from new ground-disturbing oil and gas development activities. These sensitive areas include the Tallgrass Prairie Preserve, state parks, state WMAs, US Army Corps of Engineers lakes, BLM wild horse and burrow pasture facilities, municipalities, sensitive water supply areas, wellhead protection areas, and special source groundwater areas. Approximately 352,000 acres classified as sensitive areas under Alternative 4 are "high potential" areas for oil and gas development. Accordingly, the enhanced resource protections under Alternative 4 may result in limitations on development location; actual levels of development and production, and related economic effects, however, would continue to be affected primarily by oil and gas market conditions.

Under Alternative 4, the spatial extent of long-term surface disturbance associated with oil and gas development could be reduced compared with Alternative 1 (No Action). A reduction in surface disturbance would provide increased opportunities for activities that do not involve oil and gas extraction. The application of additional COAs under this alternative would also provide additional protections for sensitive resources, thereby reducing impacts on nonmarket and quality of life factors, as discussed under **Section 4.10.2**, Impacts Common to All Alternatives.

Environmental Justice

Prevention of new ground-disturbing oil and gas development activities in sensitive areas under Alternative 4 could reduce production and economic opportunities for all populations, compared with Alternative 1 (No Action), including contributions for identified minority and Tribal populations; however, additional protections in areas where new ground disturbance will not be permitted could help reduce impacts on any important Tribal uses or cultural sites, improve recreation opportunities, and improve local water quality for Tribal populations.

As impacts would be spread throughout the county and the region, project activities are not anticipated to result in disproportionate adverse impacts on low-income, minority, or Tribal populations. Additional site-specific analysis when a lessee applies for a permit to drill would be required to identify any site-specific environmental justice impacts.

4.10.7 Cumulative Impacts

The cumulative impact analysis area for socioeconomics and environmental justice is the planning area. Past, present, and reasonably foreseeable future actions and conditions involving ground disturbance have affected, and would likely continue to affect, socioeconomics and environmental justice within the cumulative impact analysis area. Examples of such actions and conditions are set forth in **Table 4-1**. Oil and gas development activities under the alternatives would have impacts like those of past and present development and would contribute to the cumulative effects on socioeconomics and environmental justice. Impacts on economic and demographic conditions, however, are subject to underlying uncertainties regarding the timing and pace of future development. Development, in turn, is linked to factors such as the availability of equipment, labor force, operating capital, commodity prices, and market demand.

Oil and gas development activities support an important segment of the local economy within the planning area. Other economically important segments of the economic base include agriculture, grazing, construction, and recreation. Oil and gas development within the cumulative impact analysis area will continue to provide employment and income, supported by existing infrastructure. For example, increased development would likely be accompanied by investments in storage, treatment, processing, and transportation capacity. Construction will also provide employment and income in the planning area, with some overlap with the energy sector. Based on 2015 data, agriculture accounts for 15.6 percent of employment in Osage County and construction accounts for 6.1 percent (see **Table 3-28** in **Chapter 3**). There would likely be overlap in employment between the energy and construction sectors, but other current land uses, such as agriculture, could conflict with oil and gas development. For example, conflicts could arise if such development were to impact water quality or quantity or surface disturbance were to affect prime farmland.

The level of employment and cumulative number of workers needed at any point in time would vary, depending on economic conditions, timing, market prices for the oil and gas industry, and the employment needs of construction and other projects listed in **Table 4-1**; examples are the residential land use plan and Tribal transportation improvement plan. Once the development phase is complete, the incremental contribution margin attributable to oil and gas activities would likely decline in terms of employment, population, housing demand, and demand for public services.

The USFWS Oil and Gas Industry Conservation Plan Associated with Issuance of ESA Section 10(a)(1)(B) Permits for the ABB in Oklahoma (USFWS 2014a) could affect the timing or location of development on a site-specific basis. This may affect the economic contributions from this industry.

Oil and gas development activities in the planning area generate substantial revenues in the form of mineral lease royalties and gross production taxes. Continued lease bonus, rental, and royalty revenues and increased development would benefit both the Osage Nation and Osage headright holders.

The State of Oklahoma would also benefit due to the assessment of gross production taxes on oil and gas royalties. While gross production taxes accrue to the state, a portion of such taxes are used for the construction and maintenance of roads, bridges, and public schools in Osage County. Continued oil and gas development would generate these kinds of revenues over the long term, though they would fluctuate in responses to commodity prices and production levels.

Due to a lack of disproportionate impacts on minority or low-income populations, the cumulative contribution to environmental justice would be negligible at the county level, though there could be increased employment opportunities for members of the Osage Nation. Oil and gas development activities could have beneficial impacts on employment and income but could also result in adverse impacts on quality of life for Osage County residents, as discussed in **Section 4.10.2**, Impacts Common to All Alternatives.

While there is significant variability in the potential for future oil and gas development, a growing inventory of producing wells and facilities can support workforces for a generation or longer. The Osage Mineral Estate has done so for over 100 years. Continued oil and gas development would likely add stability to the population in the planning area.

4.11 Public Health and Safety

This section discusses impacts that the alternatives described in **Chapter 2** may have on public health and safety. Impacts on public health and safety were evaluated based on the maximum potential disturbance under each alternative.

4.11.1 Methods and Assumptions

Indicators

Indicators of impacts on public health and safety are as follows:

- A substantial hazard to people or the environment through the routine transport, use, or disposal of hazardous materials or as a result of an accidental release of hazardous materials
- Emissions from, or handling of, hazardous or acutely hazardous materials, substances, or waste
- Exposure of people or structures to a risk of loss, injury, or death involving wildland fires

Assumptions

- Oil and gas development will continue to introduce risks to public health and safety in Osage County. The risk level depends on such factors as the amount of development and nature and type of mitigation measures implemented.
- Adhering to applicable laws and regulations will reduce the risk of H_2S gas exposure under all alternatives.

4.11.2 Impacts Common to All Alternatives

Under all alternatives, oil and gas leasing and development would continue. Oil and gas development activities would increase the risk of public health and safety impacts, as identified in **Section 3.11**, Public Health and Safety.

Produced water or flowback from wells contains high levels of sodium and is often contaminated with petroleum, chemicals, or naturally occurring radioactive isotopes. If released into the environment by a spill, this contamination could threaten public health by contaminating soil and drinking water. Hydraulic fracturing results in significantly higher quantities of produced water than conventional drilling. The handling and disposal of water increases the chances of unintentional discharge. Disposal of flowback in underground injection wells has the potential to increase the rate of seismicity in Osage County; under all alternatives, new wells are projected to increase, which is anticipated to increase the amount of wastewater requiring disposal.

H_2S is a toxic gas that could be released from geologic formations during oil and gas development activities. H_2S is known to occur in Osage County. Exposure to high concentrations of H_2S could cause health problems, injury, or death. The exposure limit recommended by the Occupational Safety and Health Administration is 10 ppm; concentrations greater than 100 ppm are considered immediately dangerous to life and health (OSHA 2017).

Oil and gas development activities have the potential to affect human health due to changes in air and water quality as well as noise and visual disturbances. Impacts on air quality are described in **Section 4.4**, Air Quality and Climate; impacts on visual resources are described in **Section 4.12**, Visual Resources; and impacts on noise are described in **Section 4.13**, Noise. The primary sources of airborne emissions associated with oil and gas development are from dust, vehicles and equipment, and venting and flaring of gas. Limited information exists to estimate air quality impacts at the planning level; site-specific analysis would be performed at the time a project is proposed. This would be done to determine potential impacts at sensitive receptor locations and to identify mitigation measures necessary to reduce impacts on air quality and public health, if any. The primary sources of noise from development activities are from equipment, construction of well pads and lease roads, and vehicle traffic. Visual impacts that affect public health would primarily stem from the use of lights to conduct operations or activities at night.

Impacts on water quality are described in **Section 4.3**, Water Resources. Oil and gas development increases the risk of accidental spills or releases of deleterious substances. Changes in water quality could affect the health of residents in Osage County if drinking water is contaminated.

Oil and gas production and transportation could potentially spark a grass, brush, or wildland fire. In the event of any fire, wells, storage tanks, pipelines, and other facilities could be damaged and could release chemicals, hazardous materials, or other deleterious substances into the environment. Increased oil and gas development activities could increase vehicle traffic and therefore traffic accidents in Osage County; however, the risk is generally low. Artificial lighting or noise from operations and equipment could be a nuisance to nearby residents, particularly those with health conditions that make them particularly sensitive to such impacts.

Under all alternatives, the BIA would apply COAs 1, 2, 7, 16, 19, 21, and 23 to drilling and workover permits to reduce the impacts from development operations, prevent environmental degradation, and ensure compliance with applicable laws and regulations, such as the CWA, SDWA, and CAA.

The COAs set forth in this EIS, many of which are currently enforced in Osage County, are not anticipated to have a significant impact on the amount of future oil and gas development. COAs may be applied to all permits or on a case-by-case basis, depending on the alternative selected. Application and enforcement of COAs that reduce surface, visual, and noise disturbances (COAs 1–2, 19, 21, and 23); minimize the risk of induced seismicity (COAs 19 and 23); require prior approval for all venting and flaring (COA 7); and protect water resources from contamination (COAs 16 and 19) would reduce the potential impacts on public health and safety. The EPA's regulations of disposal wells under the UIC Program would also reduce the risk of induced seismicity, further mitigating impacts on public health and safety.

4.11.3 Alternative 1 (No Action)

Under Alternative 1 (No Action), the application of COAs and enforcement of regulations would mitigate potential impacts on public health and safety. COAs 8, 9, and 11 require the proper storage and labeling of chemicals and removal of chemicals that are not in use, removal and disposal of waste and contaminated soil, preparation of SPCC plans, and secondary containment around tank batteries and facilities. These requirements would reduce the risk of hazardous chemicals being released into the environment where groundwater could be contaminated or the public could consume contaminated agricultural products.

COA 13 reduces potential impacts on surface owners by requiring that lessees minimize noise disturbances. It should be noted that many sources of noise associated with oil and gas development activities are temporary (*i.e.*, drilling rigs, construction of well pads and lease roads, installation of facilities and pipelines, interim restoration of surface lands) or otherwise short term in nature (*i.e.*, well, vegetation, road, and pipeline maintenance and removal of production). COA 13 also requires that lessees minimize fugitive dust. COA 18 requires that lessees implement air quality BMPs listed in the approved site-specific EA when operations will penetrate formations that contain, or are anticipated to contain, H_2S in concentrations of 100 ppm or greater. COAs 13 and 18 reduce potential impacts on air quality within the planning area and protect both workers and the general public from fugitive dust and the risk of exposure to H_2S gas. Other potential impacts on health and safety, described in **Section 4.11.2**, Impacts Common to All Alternatives, would continue.

4.11.4 Alternative 2

Under Alternative 2, the BIA would issue a standard list of BMPs that apply to all oil and gas development operations within the planning area. In addition, the BIA would minimize the number of COAs applied to permitted activities and would not prescribe the specific methods operations must use to comply with the BMPs or other applicable laws and regulations; operators would be given latitude to determine how best to comply. The waiver of protective COAs (COAs 8–11, 13, and 18) would increase the risk of exposure to chemicals, H_2S, and contaminated substances as well as potential air and water quality impacts within the planning area. Lessees would still be required to comply with Occupational Safety and Health Administration (OSHA) regulations and other applicable laws, such as the SDWA and CAA, which would mitigate some of these impacts. Consultation between lessees and surface owners regarding the timing of certain operations could also reduce potential impacts on public health and safety.

The application of COAs 24 and 27 under Alternative 2 would reduce impacts on public health and safety, compared with Alternative 1 (No Action). COA 24, which requires that lessees conduct operations in a manner that minimizes disturbance due to noise levels and adverse visual impacts, would reduce the potential for impacts on public health. COA 27, which prohibits the land application of waste oil, wastewater, and contaminated soil without the BIA Osage Agency Superintendent's prior approval, would reduce the risk that hazardous chemicals or deleterious substances may be released, contaminating groundwater and agricultural products the public consumes.

4.11.5 Alternative 3

Under Alternative 3, the BIA would issue the same standardized list of BMPs and minimal COAs as Alternative 2 in sections with a high density of historical oil and gas development. The BIA would implement the same well spacing requirements and additional protective COAs as Alternative 4 in sections with a low density of historical oil and gas development. In addition, the BIA would not approve new ground-disturbing activities in the sensitive areas described in **Section 2.3.4**, Alternatives Considered for Detailed Analysis, Alternative 3—Hybrid Development. In high-density sections, the waiver of COAs relating to the storage of chemicals, disposal of waste and contaminated soil, SPCC plans and secondary containment for tank batteries and facilities, noise and visual disturbances, and H_2S (COA 8–11, 13, and 18) would increase the risk of potential impacts on public health and safety. This is due to changes in air and water quality, potential exposure to hazardous materials, and disturbances relating to the conduct of operations. As discussed above for Alternative 2, the application of additional protective COAs (COAs 24 and 27), enforcement of applicable laws, and consultation between lessees and surface owners regarding the timing of operations could mitigate some of these impacts.

In low-density sections and sensitive areas, Alternative 3 would reduce potential impacts on public health and safety, compared with Alternative 1 (No Action). In addition to all COAs applied under Alternatives 1 and 2, COAs 25 and 28 also would apply in low-density sections. COA 25 requires that lessees conduct initial tests of H_2S concentration for each well and production facility and, if there the concentration of H_2S is 100 pm or greater, requires lessees to calculate the 100 ppm and 500 ppm radius of exposure and post appropriate warning signs. This COA, combined with COA 18, would significantly reduce the risk of exposure to H_2S gas. COA 28, which requires that drilling pits be at least 200 feet from streams and waterways, would also reduce the risk of surface water or groundwater contamination due to leaks or spills. The implementation of cultural resource buffers in low-density sections, which impose setbacks from certain surface waters (see **Table 2-2** in **Chapter 2**), would further reduce the risk of changes in water quality.

Under Alternative 3, approximately 248,800 acres would be protected from new ground-disturbing oil and gas development activities, which would reduce potential impacts on public health and safety, compared with Alternative 1 (No Action). Potential impacts would decrease due to both the reduction in surface disturbance and the limitation on operations in wellhead protection areas, Class 1 special source groundwater areas, and sensitive water supply areas.

4.11.6 Alternative 4

Under Alternative 4, the BIA would apply well spacing requirements and additional protective COAs, beyond those applied under Alternative 1 (No Action), to all new development within the planning area. Further, the BIA would not approve new ground-disturbing activities in the sensitive areas identified under Alternative 3 and the additional sensitive areas described in **Section 2.3.5**, Alternatives Considered for Detailed Analysis, Alternative 4—Enhanced Resource Protection. The types of impacts on public health and safety under Alternative 4 are described above for Alternative 3, low-density sections. The scope of those impacts, however, would be further reduced under Alternative 4 due to the application of protective COAs (COAs 24–25 and 27–28) throughout the planning area and restrictions on ground disturbance in a larger number of sensitive areas.

Under Alternative 4, approximately 524,000 acres would be protected from new ground-disturbing oil and gas development activities, reducing potential impacts on public health and safety. The application of cultural resource buffers (see **Table 2-2** in **Chapter 2**) countywide under this alternative would also provide incidental protections due to the implementation of setbacks from streams, rivers, ponds, reservoirs, lakes, and wetlands. Such buffers further limit new ground disturbance and reduce the risk of changes in water quality due to contamination resulting from leaks and spills.

Permits for new ground-disturbing activities would not be approved in certain sensitive areas, including wellhead protection areas, Class 1 special source groundwater areas, sensitive water supply areas, and other areas. Compared with Alternative 1 (No Action), this would reduce the risk of drinking water source contamination and subsequent exposure to or consumption of contaminated water by the public.

4.11.7 Cumulative Impacts

The cumulative impact analysis area for public health and safety is the planning area. Past, present, and reasonably foreseeable future actions and conditions involving ground disturbance have affected, and would likely continue to affect, public health and safety within the cumulative impact analysis area. Examples of such actions and conditions are set forth in **Table 4-1**. Oil and gas development activities under the alternatives would have impacts like those of past and present development and would contribute to the cumulative effects on public health and safety. In particular, oil and gas development activities increase the risk of impacts on air and water quality as well as the risk of exposure to hazardous conditions and materials, H_2S gas, increased traffic, wildland fire, and induced seismicity.

Cumulative impacts would include both short-term impacts, such as increased air emissions from diesel generators and engines during drilling, and long-term impacts, such as the risk of leaks or spills from oil and gas pipelines.

4.12 VISUAL RESOURCES

This section discusses impacts that the alternatives described in **Chapter 2** may have on visual resources. Impacts on visual resources were evaluated based on the maximum potential development under each alternative.

4.12.1 Methods and Assumptions

Indicators

The indicator of impacts on visual resources is changes in the characteristic landscape (e.g., form, line, color, and texture), compared with current conditions.

Assumption

The severity of a visual effect depends on a variety of factors, including the size of a project (i.e., area disturbed and physical size of structures), the location and design of access roads, the overall visibility of disturbed areas, and the proximity to the viewer. Features with concentrated recreation, such as lakes and rivers, are more sensitive to landscape changes, which could affect visual qualities.

4.12.2 Impacts Common to All Alternatives

Under all alternatives, oil and gas leasing would continue. Such leasing can reasonably be expected to result in oil and gas development. Temporary direct effects on visual resources would occur from construction and ground disturbance at well pads, access roads, and pipelines. The effects would occur for a short period, such as weeks or months. Construction would disturb the ground surface and remove vegetation. This would affect visual resources by denuding the land. Also, ground disturbances would affect visual resources by creating exposed soil with a different texture and color than undisturbed soil. Depending on growing conditions, trees and shrubs may not regenerate quickly, which would affect the timeline for reclaiming disturbed areas.

During dry periods, ground disturbance, vehicles, and excavation activities can generate dust that is blown across exposed soil, especially on windy days. According to data from the Wynona Mesonet Site weather station in Osage County, from 1994 to 2001, the average wind speed was 9.2 miles per hour, with maximum sustained winds at 49 miles per hour and maximum gust at 73.3 miles per hour (OCS 2013). Fugitive dust would affect visual resources by diminishing atmospheric clarity. This effect would persist until the dust settles or is blown elsewhere.

Construction lighting would reduce nighttime darkness, which would affect nighttime activities, such as stargazing, camping, wildlife observation, and sleeping. Flaring of gas would also be visible during the nighttime depending on the location of the flare and topography. Reflective surfaces on construction equipment and vehicles create glare. The intensity and amount of glare would vary, depending on the intensity of sunlight and the time of day. This would affect visual resources by adding artificial points of illumination not found naturally in the landscape.

During construction, a project area would likely be cluttered with equipment, pipes, pits, colored flagging, and other temporary support infrastructure, in contrast with the surrounding natural terrain and vegetation. This can be a visual distraction and often creates new focal points that are not consistent with the color, shape, or form of the natural vegetation and landscape, whether the surrounding area is flat, rolling hills, grassland, or wooded areas. The color of construction equipment and vehicles would not resemble the muted tans and greens of the terrain and vegetation.

Similarly, well pads and facilities, such as pits and compressor stations, would add artificial elements to undeveloped areas. These areas would be cleared of vegetation, thereby leaving a clearing that contrasts with the surrounding landscape. The form, line, color, and texture of these facilities would not resemble nearby structures, unless they were collocated with similar existing industrial facilities. Also, the well pads and facilities would be sources of activity that are not typically found in undeveloped areas.

Long-term effects are those associated with oil and gas development operations on leased tracts. Long-term, direct effects on visual resources would occur from operating and maintaining sites and facilities. The effects on visual resources would remain through the life of the operations, until a site is abandoned and restored. The visibility of the features described below would vary, depending on viewer distance and location, topography, color and composition of facilities, and screening vegetation.

New roads would add artificial elements to undeveloped areas. Improving roads typically enhances the contrast of the road with the adjacent landscape. Roads lack vegetation and create an abrupt vegetation edge along the roadside. Smooth roads would stand out against the moderately coarse texture of the terrain. This would affect visual resources by dividing the landscape with areas that lack vegetation and by altering the natural topography and the texture and color of the land surface.

New pipelines and electrical lines would add artificial elements to undeveloped areas. The form, line, and texture of these structures would not resemble nearby structures, unless they were collocated with similar structures. In particular, pipelines would divide the landscape with strips of land lacking vegetation, and electrical lines would introduce prominent vertical elements.

Under all alternatives, the BIA would apply COAs 1, 2, 7, 16, 19, 21, and 23 to drilling and workover permits to reduce the impacts from development operations, prevent environmental degradation, and ensure compliance with applicable laws and regulations. COAs may be applied to all permits or on a case-by-case basis, depending on the alternative selected. Application and enforcement of COAs that reduce surface disturbance (COAs 2, 19, 21, and 23), require prior approval for venting and flaring (COA 7), or that result in placement of facilities in less visually intrusive locations could reduce impacts on visual resources. The application of COAs that protect cultural resources (COAs 1 and 2) would also provide incidental protection to visual resources by reducing impacts on the form, line, color, and texture of the landscape.

4.12.3 Alternative 1 (No Action)

Under Alternative 1 (No Action), the application of COAs and enforcement of regulations would continue to mitigate impacts on visual resources. COAs 3–6, which require that lessees avoid soil and vegetation disturbance, minimize alteration of natural topography, implement erosion control measures, and confine vehicles and equipment to existing lease roads, would reduce potential impacts associated with vegetation removal, the exposure of soil, and fugitive dust. COA 9, which requires that lessees keep the lease free of trash and contaminated soil, remove equipment that is old or not necessary for operation of the lease, and properly dispose of waste, would reduce the impacts on visual resources by preventing clutter and littering, reducing potential glare from equipment, and limiting contrasts with the natural terrain. COAs 12 and 15, which require interim and final restoration of surface lands, would reduce impacts on visual resources by returning the topography and vegetation as close as possible to their natural state. COA 13, which requires that lessees minimize fugitive dust, would reduce the risk of airborne dust affecting visual clarity.

It should be noted that COA 10, which requires lessees to enclose equipment and facilities with fencing, and COA 22, which requires the screening or netting of open-top tanks, could contribute to long-term visual impacts on landscapes that do not have similar forms, lines, colors, or textures.

4.12.4 Alternative 2

Under Alternative 2, the BIA would issue a list of standard BMPs that apply to all oil and gas development operations within the planning area. In addition, the BIA would minimize the number of COAs applied to permits and would not prescribe the specific methods operators must use to comply with the BMPs or other applicable laws and regulations; operators would be given latitude to determine how best to comply. The waiver of protective COAs (COAs 3–6, 9, 12–13, and 15) would result in increased potential for surface disturbance, soil exposure and disturbance, vegetation removal, erosion, glare, alteration of topography, and dust. Voluntary compliance with BMPs and agreements between lessees and surface owners regarding the siting of wells and lease roads and restoration of surface lands could mitigate some of these impacts.

The application of COAs 24 and 27 would reduce impacts on visual resources, compared with Alternative 1 (No Action). COA 24, which requires lessees to minimize adverse visual impacts that may be harmful to people or sensitive environmental receptors, would reduce potential impacts due to oil and gas development activities. COA 27, which prohibits the land application of waste oil, wastewater, and contaminated soil without the BIA Osage Agency Superintendent's prior approval, would reduce the risk of changes in soil composition or appearance and vegetation loss due to contamination. Overall, however, Alternative 2 would likely result in the most impacts on visual resources of all the alternatives.

4.12.5 Alternative 3

Under Alternative 3, the BIA would issue the same standardized list of BMPs and minimal COAs as Alternative 2 in sections with a high density of historical oil and gas development. The BIA would implement the same well spacing requirements and additional protective COAs as Alternative 4 in sections with a low density of historical oil and gas development. In addition, the BIA would not approve new ground-disturbing activities in the sensitive areas described in **Section 2.3.4**, Alternatives Considered for Detailed Analysis, Alternative 3—Hybrid Development. Applying COAs based on the density of well development would result in location-specific visual impacts.

In high-density sections, the waiver of COAs relating to soil and vegetation disturbance, alteration of topography, erosion control, removal of waste and unnecessary equipment, interim and final restoration of surface lands, and dust abatement (COAs 3–6, 9, 12–13, and 15) would increase the potential impacts on visual resources. Voluntary compliance with BMPs and agreements between lessees and surface owners regarding the siting of wells and lease roads and restoration of surface lands could mitigate some of these impacts.

In low-density sections and sensitive areas, Alternative 3 would reduce potential impacts on visual resources, compared with Alternative 1 (No Action). In addition to all COAs applied under Alternatives 1 and 2, COAs 29–31 also would apply in low-density sections. COAs 29 and 30, which require lessees to avoid new road and pipeline crossings of aquatic environments and burial of pipelines, would reduce potential visual distractions and maintain the appearance of the natural terrain and vegetation at scenic waterbodies. COA 31, which requires the collocation of new and existing facilities when feasible, would reduce surface disturbance, alteration of topography, and disturbance of soil and vegetation by protecting these more pristine areas that have a higher visual quality. The implementation of cultural resource buffers (see **Table 2-2** in **Chapter 2)** and well spacing requirements in low-density sections would further reduce surface disturbance and, therefore, visual impacts from oil and gas development.

Under Alternative 3, approximately 248,800 acres would be protected from new ground-disturbing oil and gas development activities, reducing potential impacts on visual resources compared with Alternative 1 (No Action). The application of additional protective COAs in the Tallgrass Prairie Preserve, state parks, and WMAs would minimize the impacts on these important visual resources and preserve their visual quality. Approximately 24.8 miles of the Osage Nation Heritage Trail Byway are in high-density sections of the planning area. As a result, visual resources in these areas could be affected by the waiver of protective COAs, altering the natural terrain and impacting scenic qualities. Approximately 40.4 miles of the Osage Nation Heritage Trail Byway are in low-density sections. In these areas, visual resources would be preserved not only by COAs directly associated with limiting visual disturbances, but also COAs aimed at protecting other resource values associated with the planning area.

VRI components in high- and low-density sections are shown in **Table 4-9**, below. Most highly sensitive and scenic areas in the planning area are in low-density sections. As previously described, in low-density sections, impacts on visual resources would be less than under Alternative 1 (No Action). This is because COAs would be applied to incidentally reduce impacts on visual resources. In high-density sections, impacts on visual resources would be greater than under Alternative 1 (No Action). This is because fewer COAs would be applied to reduce impacts on visual resources.

Visual resources would be more threatened in high-density sections, because COAs that are less protective would be applied. The magnitude of these impacts would be greatest where scenic quality or sensitivity is higher. Furthermore, the creation of any new access roads could affect the distance zone of the area. If development were to occur in a seldom seen area, new public access roads could make the development more accessible and thus more visible to the public. This could change the distance zone from seldom seen to background or foreground-middle ground.

Table 4-9
Visual Resource Inventory Component Distribution in High- and Low-Density Sections

Visual Resource Inventory Component	Acres in High-Density Sections	Acres in Low-Density Sections
Scenic Quality		
A	393,200	1,081,300
B	N/A	N/A
C	N/A	N/A
Sensitivity		
High	125,800	532,600
Moderate	267,300	548,700
Low	N/A	N/A
Distance Zones		
Foreground/middle ground	2,000	15,400
Background	4,400	19,200
Seldom seen	386,800	1,046,600
VRI Class		
Class I	N/A	N/A
Class II	393,200	1,081,300
Class III	N/A	N/A
Class IV	N/A	N/A

Source: BLM GIS 2016
Note: N/A = Not applicable. There were no lands in the planning area found to be in these VRI components.

4.12.6 Alternative 4

Under Alternative 4, the BIA would apply well spacing requirements and additional protective COAs, beyond those applied under Alternative 1 (No Action), to all new development within the planning area. Further, the BIA would not approve new ground-disturbing activities in the sensitive areas identified under Alternative 3 and the additional sensitive areas described in **Section 2.3.5**, Alternatives Considered for Detailed Analysis, Alternative 4—Enhanced Resource Protection. The types of impacts on visual resources are described above for Alternative 3, low-density sections. The scope of those impacts, however, would be further reduced under Alternative 4. This is due to the application of protective COAs planning-area wide (COAs 29–31) and restrictions on ground disturbance in a larger number of sensitive areas.

Under Alternative 4, approximately 524,400 acres of the planning area would be protected from new ground-disturbing oil and gas development activities, reducing potential impacts on visual resources. The application of cultural resource buffers (see **Table 2-2** in **Chapter 2**) countywide would also provide incidental protections for visual resources due to the implementation of setbacks from streams, rivers, ponds, reservoirs, lakes, and wetlands, which would reduce surface disturbance and protect scenic waterfront areas. Like Alternative 3, visual impacts would be reduced in these areas; however, because new disturbance would be prevented in more areas under this alternative, overall impacts would be further reduced.

4.12.7 Cumulative Impacts

The cumulative impact analysis area for visual resources is the planning area. Past, present, and reasonably foreseeable future actions and conditions involving surface disturbance creating large human-made modifications to the landscape have affected, and would likely continue to affect, visual resources within the cumulative impact analysis area. Examples of such actions and conditions are set forth in **Table 4-1**.

Oil and gas development activities under the alternatives would have impacts like those of past and present development and would contribute to the cumulative effects on visual resources.

4.13 NOISE

This section discusses impacts that the alternatives described in **Chapter 2** may have on noise. Impacts on noise were evaluated based on the maximum potential development under each alternative.

4.13.1 Methods and Assumptions

Indicators

The indicator of impacts on noise is the level of noise generated by oil and gas development.

Assumptions

Noise from developing and operating gas wells and constructing associated infrastructure could affect sensitive land uses and users in the planning area. The population change between 2000 and 2015 was 8.1 percent (US Census Bureau 2015, as cited in Headwaters Economics 2017). This is a slower rate than in Oklahoma and the US as a whole (see **Table 3-24** in **Chapter 3**). This slow growth indicates that the number of sensitive receptors is not likely to increase significantly in the near future.

Additional assumptions are as follows:

- Actual noise levels at sensitive receptor locations will depend on the exact locations of wells and related infrastructure, the level of development, and the local topography.
- The duration of noise impacts is based on the following estimated average drilling times observed by BIA Osage Agency staff:
  - A 4,500-foot horizontal well (the average length of horizontal wells in Osage County) will take 5 to 21 days drilling time, running 12-hour shifts, depending on equipment used and downtime due to problems encountered.
  - A 4,200-foot vertical well drilled to a formation slightly above the granite layer in the western side of the county (the deepest part of Osage County) will take 3 to 14 days drilling time, running 12-hour shifts.
  - Most disposal wells are drilled to a formation slightly above the granite layer and so will take 7 to 14 days to drill, running 12-hour shifts.
  - A vertical well in the eastern part of the county (the shallowest part of Osage County) can be drilled in a 3 to 7 days, running 12-hour shifts.

4.13.2 Impacts Common to All Alternatives

Under all alternatives, oil and gas leasing could occur. Such leasing can reasonably be expected to result in oil and gas development. Noise resulting from oil and gas production could affect sensitive receptors in the planning area, including residents, recreationists, and wildlife (the potential noise impacts on wildlife are addressed separately in **Section 4.5**, Fish, Wildlife, and Migratory Birds). The magnitude of the effect would depend on the distance between the receptor and the noise source, the duration and frequency of the noise, and the time of the noise (noise is viewed as more disruptive at night). In addition, individuals react differently to changes in ambient noise levels and to various types of sound; therefore, the perceived level of impact may vary by receptor.

Noise under all alternatives would occur from construction and operations. Construction would increase short-term, localized, and intermittent ambient noise levels, while operations may increase long-term ambient noise levels over the life of the project.

Sources of noise are construction (earth-moving equipment for well drilling, roads, well pads, compressor stations, electrical lines, and pipelines), vehicle traffic, and operation (production). **Table 4-10** shows typical noise levels associated with oil and gas development. Actual noise levels at a given location depend on the topography, atmospheric conditions (temperature, wind speed and direction, and humidity), the vegetation in the vicinity (which can absorb sound), and any structures between a noise source and a noise receptor.

Table 4-10
Noise Levels for Oil and Gas Development

Noise Source	Noise Level
Typical compressor station	50 dBA (375 feet from property boundary)
Pumping units	50 dBA (325 feet from well pad)
Fuel and water trucks	68 dBA (500 feet from source)
Crane for hoisting drilling rigs	68 dBA (500 feet from source)
Concrete pump used during drilling	62 dBA (500 feet from source)
Average well construction site	65 dBA (500 feet from source)

Source: Earthworks 2015

Construction would require the use of earth-moving equipment (*e.g.*, bulldozers, graders, and backhoes), heavy trucks (*e.g.*, dump trucks and water trucks), generators, and air compressors at the construction site. Noise from construction is assumed to be short term but would be loud and constant. In addition, heavy truck and personal vehicle traffic would increase along area roadways to bring personnel and supplies to the staging and construction sites.

Noise from these activities would be short term and intermittent. For access roads, electrical lines, and pipelines, the construction equipment would not remain in 1 location for a long period, given the linear nature of this type of development. These facilities would be constructed during working hours, which would not affect nighttime ambient noise levels.

The primary noise sources associated with drilling are large diesel engines that power the rotary rig and pumps and the large diesel-driven air compressors. This noise would increase dramatically where hydraulic fracturing is used, due to the increased truck traffic and intensity of operations at the well site.

The primary sources of noise during operation are natural gas or electric pumps at each well, natural gas-fired internal combustion engines to power the compressors at each compressor station, and intermittent traffic related to operations and maintenance. In addition, periodic workovers would be needed for maintenance and to correct problems with producing wells, and road maintenance would occur to replace surface materials and apply dust abatement.

Approximately 84 percent of the planning area has high or moderate-to-high oil and gas potential (BLM GIS 2015). Based on this potential and predicted long-term nationwide price increases (discussed further in **Section 3.16**, Mineral Extraction), the number of oil and gas wells in the planning area is expected to increase over the next 20 years (**Appendix A**); therefore, noise associated with this industry is also expected to increase.

Under all alternatives, the BIA would apply COAs 1, 2, 7, 16, 19, 21, and 23 to drilling and workover permits to reduce the impacts from development operations, prevent environmental degradation, and ensure compliance with applicable laws and regulations. COAs may be applied to all permits or on a case-by-case basis, depending on the alternative selected.

4.13.3 Alternative 1 (No Action)

Under Alternative 1 (No Action), the application of COAs and enforcement of regulations would continue to mitigate impacts on noise due to oil and gas development operations. COAs 3 and 4, which require lessees to minimize soil and vegetation disturbance and minimize alteration of the natural topography, would incidentally reduce potential noise impacts by limiting surface disturbance that involves the use of heavy equipment. COA 6, which requires that lessees confine all vehicles and equipment to approved lease roads, would also reduce potential noise impacts by concentrating traffic in those areas and avoiding widespread vehicle and equipment traffic across all areas of the lease. COA 13, which requires lessees to minimize disturbance to surface owners and wildlife caused by noise and excessive traffic, would also limit noise impacts by ensuring that operations are conducted in a manner that minimizes the risk of auditory disturbance. COAs 12 and 14–15, which require the interim and final restoration of surface lands and the avoidance of operations in aquatic environments, would provide an incidental reduction in noise impacts due to the reduction in overall surface disturbance.

4.13.4 Alternative 2

Under Alternative 2, the BIA would issue a list of standard BMPs that apply to all oil and gas development operations within the planning area. In addition, the BIA would minimize the number of COAs applied to permits and would not prescribe the specific methods operators must use to comply with the BMPs or other applicable laws and regulations; operators would be given latitude to determine how best to comply. The waiver of protective COAs (COAs 3–4, 6, and 13) and COAs limiting surface disturbance (COAs 12 and 14–15) would result in increased potential for noise impacts within the planning area. This is because operational impacts would not be discouraged, vehicles and equipment would not necessarily be confined to lease roads, and surface disturbance could increase.

The application of COA 24, however, would reduce noise impacts, as compared with Alternative 1 (No Action). COA 24 specifically prohibits disturbance through noise levels that may constitute a public nuisance that is harmful to people or sensitive environmental receptors. Overall noise impacts could still increase because of the lack of COAs restricting vehicles and traffic or because of increased activity. Voluntary compliance with BMPs and agreements between lessees and surface owners regarding the timing of operations and restoration of surface lands could mitigate some of these impacts.

4.13.5 Alternative 3

Under Alternative 3, the BIA would issue the same standardized list of BMPs and minimal COAs as Alternative 2 in sections with a high density of historical oil and gas development. The BIA would implement the same well spacing requirements and additional protective COAs as Alternative 4 in sections with a low density of historical oil and gas development. In addition, the BIA would not approve new ground-disturbing activities in the sensitive areas described in Section 2.3.4, Alternatives Considered for Detailed Analysis, Alternative 3—Hybrid Development. Applying COAs based on the density of well development would result in location-specific noise impacts.

In high-density sections, the waiver of COAs relating to soil and vegetation disturbance, alterations of topography, noise and traffic, and otherwise limiting surface disturbance (COAs 3–4, 6, and 12–15) would increase potential noise impacts compared with Alternative 1 (No Action).

In low-density sections and sensitive areas, Alternative 3 would reduce potential noise impacts compared with Alternative 1 (No Action). In addition to all COAs applied under Alternatives 1 and 2, COAs 28, 29, and 31 also would apply in low-density sections. COAs 28, 29, and 31 require drilling pits to be located 200 feet from streams and waterways, collocation of new and existing facilities, and the avoidance of new road and pipeline crossings of aquatic environments, all of which reduce surface disturbance and the noise associated therewith. It should be noted, however, that COA 30 also would apply in low-density sections.

COA 30, which requires the burial of pipelines to protect aquatic environments, would result in increased noise impacts due to the need for the use of heavy equipment for both installation and potentially maintenance of buried pipelines.

Section 3.13.2, Noise, Current Conditions, identifies towns and cities as sensitive receptors in the planning area since they are concentrated population centers. **Table 4-11**, below, identifies which of these sensitive population areas would be in areas subject to the more stringent COAs of low-density sections (thus having less impacts from noise) and to the less stringent COAs of high-density sections (thus having more impacts from noise). In certain areas, including municipalities and sensitive water supply and groundwater areas, permits for new ground-disturbing activities would not be approved regardless of density. In these areas, noise impacts from oil and gas development would be reduced or eliminated.

Table 4-11
Cities and Towns in High- and Low-Density Sections

Location	Acres in High-Density Sections	Acres in Low-Density Sections
Cities		
Barnsdall	0	400
Bartlesville	200	200
Hominy	0	1,300
Pawhuska	200	2,200
Sand Springs	0	2,400
Shidler	0	500
Tulsa	0	7,000
Towns		
Avant	0	200
Burbank	0	200
Fairfax	0	500
Foraker	0	100
Grainola	0	200
Osage	0	200
Prue	0	300
Skiatook	100	3,000
Sperry	0	100
Webb City	200	0
Wynona	0	300

Source: US Census GIS 2017, BIA GIS 2017

4.13.6 Alternative 4

Under Alternative 4, the BIA would apply well spacing requirements and additional protective COAs, beyond those applied under Alternative 1 (No Action), to all new development within the planning area. Further, the BIA would not approve new ground-disturbing activities in the sensitive areas identified under Alternative 3 and the additional sensitive areas described in **Section 2.3.5**, Alternatives Considered for Detailed Analysis, Alternative 4—Enhanced Resource Protection. The types of noise impacts from oil and gas development activities are described above for Alternative 3, low-density sections. The scope of those impacts, however, would be further reduced under Alternative 4. This is due to the application of protective COAs (COAs 28–29 and 31) throughout the planning area and restrictions on ground disturbance in a larger number of sensitive areas.

Under Alternative 4, approximately 524,400 acres would be protected from new ground-disturbing oil and gas development activities, reducing potential noise impacts. In certain areas, including municipalities, the Tallgrass Prairie Preserve, BLM wild horse and burro holding facilities, state parks and WMAs, and sensitive water supply and groundwater areas, permits for new ground-disturbing activities would not be approved. In these areas, noise impacts from oil and gas development would be reduced or eliminated. The application of well spacing orders and cultural resource buffers (see **Table 2-2** in **Chapter 2**) countywide would also reduce potential noise impacts due to the reduction in surface disturbance.

4.13.7 Cumulative Impacts

The cumulative impact analysis area for noise impacts is the planning area. Past, present, and reasonably foreseeable future actions and conditions involving surface and subsurface disturbance have affected, and would likely continue to affect, noise within the cumulative impact analysis area. Examples of such actions and conditions are set forth in **Table 4-1**. Oil and gas development activities under the alternatives would have impacts like those of past and present development and would contribute to the cumulative effects on noise.

The construction of proposed wind farms, transportation routes, and buildings would have short-term but loud and constant noise impacts on the planning area. New transportation routes and wind farms would have long-term impacts on the planning area by expanding the area for noise-emitting vehicles. These actions, in addition to the continued oil and gas development proposed under all alternatives, would cumulatively exaggerate noise impacts in the planning area.

4.14 Land Use Plans, Utilities, and Timber Harvesting

This section discusses impacts that the alternatives described in **Chapter 2** may have on land use plans, utilities, and timber harvesting. Impacts on land use plans, utilities, and timber harvesting were evaluated based on the maximum potential development under each alternative.

4.14.1 Methods and Assumptions

Indicators

Indicators of impacts on land use plans, utilities, and timber harvesting are as follows:

- Actions that influence the ability to carry out land use planning described in existing land use plans
- Actions that increase, reduce, or eliminate the demand for new utilities (*e.g.*, from oil and gas development)
- Actions that increase, reduce, or eliminate opportunities for timber harvesting

Assumptions

Land Use Plans

- Future land uses in the planning area will continue to include rural residential developments, agriculture (primarily for field crops and tame pastures), oil and gas development, and wind energy generation.
- Land use planning authority on trust and restricted Indian land resides with the Osage Nation; Osage County maintains authority on non-Indian land.
- Osage County will continue to maintain and refine the Osage County Comprehensive Plan.

Utilities

- All future utility development on non-Indian lands will be consistent with existing state and local plans, such as the 2030 Osage County Comprehensive Plan (Osage County 2011).
- The demand for new utilities, especially underground pipeline infrastructure, will increase over time as new oil and gas wells are developed.
- The demand for new electrical transmission infrastructure will increase in response to new wind energy development in and next to the planning area.

- Residential and commercial development will continue to be rural, except for the far southeastern portion of the planning area.
- The demand for new utility development in the far southeastern portion of the planning area near Tulsa, Oklahoma, will be greater, compared with the remainder of the planning area.

Timber Harvesting

- The availability of and demand for timber for harvesting will remain steady or will gradually decline over time.

4.14.2 Impacts Common to All Alternatives

Under all alternatives, oil and gas leasing would continue. Such leasing can reasonably be expected to result in oil and gas development. Osage County would retain land use planning authority for non-Indian lands in the planning area, while the Osage Nation would retain such authority on trust and restricted lands. Within its jurisdiction, the BIA would continue to oversee the administration of trust and restricted Indian land.

As discussed in **Section 3.14**, Land Use Plans, Utilities, and Timber Harvesting, lands within the planning area are generally rural, with small farming communities and rural residences scattered throughout. Areas where future oil and gas development might occur are currently used for a variety of activities, including recreation, hunting, wind energy development, livestock grazing, and ROW corridors (e.g., roads, pipelines, and transmission lines). Oil and gas development could have a direct effect on these uses, displacing them from the areas being leased and developed. Likewise, currently established uses may also prevent or modify oil and gas development in the planning area.

Indirect impacts of oil and gas development would be associated with changing existing off-lease land uses, including conversion of land in and around local communities from existing agricultural, open space, or other uses to provide services in support of further oil and gas development. Increases in traffic, increased access to previously remote areas, and development of oil and gas facilities in currently undeveloped areas would continue to change the overall landscape character.

Renewable energy projects could be incompatible with oil and gas development, and future development could be excluded by oil and gas development. Future renewable energy development in the planning area would be evaluated on a site-specific, case-by-case basis with consideration of established oil and gas areas and oil and gas development potential. The specific impacts on land use, and their magnitude, would depend on future development location; size and scale of operations; proximity to roads, transmission lines, and pipelines; and development technology.

Utility development would continue to be allowed according to the existing land use plans under all alternatives. Although transmission and pipeline ROWs associated with oil and gas development would not necessarily preclude other land uses, they would result in both direct and indirect impacts.

Direct impacts (e.g., the loss of available lands to physical structures, maintenance of ROWs free of major vegetation, maintenance of service roads, and noise and visual impacts on recreational users along the ROWs) would last as long as the transmission lines and pipelines were in place. Indirect impacts, such as the introduction of or increase in recreational use in new areas due to improved access, or, alternatively, avoidance of existing recreational use areas near transmission corridors for aesthetic reasons, and increased traffic, could occur and be long term.

Hydraulic fracturing could occur in combination with conventional oil and gas development techniques under all alternatives; however, as discussed in the Osage RFD (**Appendix A**), the majority of new wells drilled during the life of this EIS are anticipated to be conventional wells. Hydraulic fracturing typically uses water from available groundwater and/or surface water resources located near hydraulically fractured oil and gas production wells (EPA 2016e). Hydraulic fracturing also typically uses more water than conventional oil and gas development. This would affect water utilities more than conventional oil and gas development by reducing the amount of available water in lakes, rivers, and reservoirs for municipal uses.

Direct impacts of oil and gas development on timber harvesting for all alternatives include the removal of wood, plants, and seeds; construction of roads and trails for vehicle and equipment traffic; increased traffic on roads from the transportation of products; trampling of understory vegetation by foot and vehicle traffic; and compacting soil. Indirect impacts of oil and gas development on timber harvesting would increase the spread of invasive or noxious weeds (colonization of bare mineral soil), reduce regeneration rates where seed material has been removed, and increase the abundance of native understory vegetation. However, because at the time of writing this EIS, Osage County has not had any timber sales since 2004, impacts of oil and gas development on timber harvesting would be minimal under all alternatives.

Under all alternatives, the BIA would apply COAs 1, 2, 7, 16, 19, 21, and 23to drilling and workover permits to reduce the impacts from development operations, prevent environmental degradation, and ensure compliance with applicable laws and regulations. The application of COAs that reduce surface disturbance and require lessees to obtain the BIA Osage Agency Superintendent's approval prior to conducting operations outside of those in the approved APD (COAs 2, 21, and 23) would reduce potential impacts on, and conflicts with, other land uses, utilities, and timber harvesting. COAs may be applied to all permits or on a case-by-case basis, depending on the alternative selected. Application and enforcement of COAs that reduce surface disturbance or development would minimize these impacts.

4.14.3 Alternative 1 (No Action)

Under Alternative 1 (No Action), the application of COAs and enforcement of regulations would continue to mitigate impacts on land use and timber harvesting. COAs 3–5, which require lessees to minimize soil and vegetation disturbance, avoid alterations of topography, and implement erosion control measures, would reduce potential impacts on other land uses, such as recreation, due to changes in the landscape. These COAs would also reduce potential impacts on timber harvesting by requiring the avoidance of tree removal and preventing changes in soil characteristics or compaction due to erosion. COAs 9 and 11, which require that lessees remove and properly dispose of trash, contaminated soil, and other waste; prepare SPCC plans, and construct secondary containment at tank batteries and facilities, would reduce potential impacts on other land uses by minimizing the risk that the land, vegetation, or water will be contaminated due to leaching, leaks, or spills.

COA 13, which requires that lessees minimize noise and traffic disturbances, would reduce potential impacts on recreation and other land uses. COAs 12 and 15, which require the interim and final restoration of surface lands, would reduce potential impacts on land uses other than oil and gas extraction, including timber harvesting, by ensuring that lands that are no longer being used for oil and gas development are returned as closely as possible to their original state so that they are available for other land uses and development opportunities.

4.14.4 Alternative 2

Under Alternative 2, the BIA would issue a list of standard BMPs that apply to all oil and gas development operations within the planning area. In addition, the BIA would minimize the number of COAs applied to permits and would not prescribe the specific methods operators must use to comply with the BMPs or other applicable laws and regulations; operators would be given latitude to determine how best to comply. The waiver of protective COAs (COAs 3–5, 9, 11–13, and 15) would result in increased potential for impacts on other land uses and timber harvesting due to soil, vegetation, and surface disturbance and potential spills of deleterious substances.

The application of COAs 24 and 27, however, would reduce impacts on land use and timber harvesting, compared with Alternative 1 (No Action). COA 24, which requires lessees to minimize noise and visual disturbances, would reduce the potential for impacts on recreation and other land uses. COA 27, which prohibits the land application of waste oil, wastewater, or contaminated soil without the BIA Osage Agency Superintendent's approval, would reduce the risk of potential impacts on other land uses and timber harvesting due to contamination of soil, vegetation, and water sources.

Overall, this alternative would apply the fewest COAs, resulting in similar impacts on land use plans and utilities as described in **Section 4.14.2**, Impacts Common to All Alternatives, but to a lesser degree compared with Alternative 1 (No Action) due to fewer COAs applied to land use. Voluntary compliance with BMPs and agreements between surface owners and lessees regarding the timing of operations, well and road siting, and restoration of surface lands may provide additional mitigation of impacts in some situations.

4.14.5 Alternative 3

Under Alternative 3, the BIA would issue the same standardized list of BMPs and minimal COAs as Alternative 2 in sections with a high density of historical oil and gas development. The BIA would implement the same well spacing requirements and additional protective COAs as Alternative 4 in sections with a low density of historical oil and gas development. In addition, the BIA would not approve new ground-disturbing activities in the sensitive areas described in **Section 2.3.4**, Alternatives Considered for Detailed Analysis, Alternative 3—Hybrid Development.

In high-density sections, the waiver of protective COAs (COAs 3–5, 9, 11–13, and 15) would increase potential impacts on land use plans, utilities, and timber harvesting. In low-density sections and sensitive areas, Alternative 3 would reduce potential impacts on other land uses, utilities, and timber harvesting, compared with Alternative 1 (No Action). In addition to all COAs applied under Alternatives 1 and 2, COAs 28–31 also would apply in low-density sections.

COA 28, which requires that drilling pits be at least 200 feet from streams and waterways, reduces the risk of potential impacts on other land uses and timber harvesting due to contamination in the event of a spill. COA 30, which requires the burial of pipelines, could create more permanent corridors that other utilities could use, reducing overall surface disturbance. COA 31, which requires the collocation of new and existing facilities, would further reduce surface disturbance by concentrating operations in certain areas. COA 29, however, requires that lessees avoid new road and pipeline crossings of aquatic environments, which could result in increased tree clearing and surface disturbance if lessees must find alternative routes for lease roads and pipelines to avoid sensitive resources. The implementation of cultural resource buffers (see **Table 2-2** in **Chapter 2**) and well spacing requirements in low-density sections would further reduce surface disturbance and, therefore, potential conflicts between land uses.

4.14.6 Alternative 4

Under Alternative 4, the BIA would apply well spacing requirements and additional protective COAs, beyond those applied under Alternative 1 (No Action), to all new development within the planning area. Further, the BIA would not approve new ground-disturbing activities in the sensitive areas identified under Alternative 3 and the additional sensitive areas described in **Section 2.3.5**, Alternatives Considered for Detailed Analysis, Alternative 4—Enhanced Resource Protection. The types of impacts on land use, utilities, and timber harvesting are described above for Alternative 3, low-density sections. The scope of those impacts, however, would be further reduced under Alternative 4 due to the application of protective COAs throughout the planning area (COAs 28 and 30–31) and restrictions on ground disturbance in a larger number of sensitive areas.

Under Alternative 4, approximately 524,400 acres would be protected from new ground-disturbing oil and gas development activities, reducing potential impacts on other land uses, utilities, and timber harvesting. Under this alternative, the application of cultural resource buffers (see **Table 2-2** in **Chapter 2**) countywide would provide incidental protections for other land uses, such as recreation, by implementing setbacks from streams, rivers, ponds, reservoirs, lakes, and wetlands and limiting new ground disturbance.

4.14.7 Cumulative Impacts

The cumulative impact analysis area for land use plans, utilities, and timber harvesting is the planning area. Past, present, and reasonably foreseeable future actions and conditions involving surface and subsurface disturbance have affected, and would likely continue to affect, land use plans, utilities, and timber harvesting within the cumulative impact analysis area. Examples of such actions and conditions are set forth in **Table 4-1**. Oil and gas development activities under the alternatives would have impacts like those of past and present development. They would contribute to the cumulative effects on land use plans, utilities, and timber harvesting, including the need for additional land use authorizations and potentially new or revised local land use planning documents.

4.15 Traffic and Transportation

This section discusses impacts that the alternatives described in **Chapter 2** may have on traffic and transportation. Impacts on traffic and transportation were evaluated based on the maximum potential development under each alternative.

4.15.1 Methods and Assumptions

Indicators

Indicators of impacts on traffic and transportation are as follows:

- Conditions on public roadways, such as roadway surface conditions, roadway design, sight distances, parking supply, and the presence of slow-moving vehicles, that may influence access for all travel modes
- Degree of consistency with an applicable plan, ordinance, or policy establishing measures of effectiveness for the performance of the circulation system, considering all modes of transportation, including mass transit and nonmotorized travel, and relevant components of the circulation system, including intersections, streets, highways and freeways, pedestrian and bicycle paths, and mass transit

Assumptions

- Traffic and transportation trends will likely mirror population changes.
- Population growth will likely increase the number of vehicles on roads in Osage County, especially near Tulsa.
- New road development and traffic associated with oil and gas development will increase, as exploration and production increases.
- Roads used for oil and gas exploration and development will continue to provide access for other uses, such as ranching, after oil and gas development is complete (Storer et al. 2016).

4.15.2 Impacts Common to All Alternatives

Under all alternatives, oil and gas leasing and development would continue. An increase in the number of wells drilled would lead to an increase in the number of work vehicles and trucks transporting supplies and equipment to well pads, which would result in higher traffic volumes on local and regional roadways networks. These changes would deteriorate the physical condition of roadway surfaces and increase the risk of vehicle collisions.

Wells proposed in or directly adjacent to existing transportation ROWs would be required to obtain encroachment permits or other required authorizations from the applicable transportation agency. Any future increase in the width of roads or ROWs would result in the need to plug or abandon wells within the ROW expansion footprint. Future road expansion could decrease oil and gas development potential if it results in the abandonment of existing wells; however, higher-capacity roadways would increase access to operational wells.

Under all alternatives, the BIA would apply COAs 1, 2, 7, 16, 19, 21, and 23 to drilling and workover permits. It would do this to reduce the impacts from development operations, prevent environmental degradation, and ensure compliance with applicable laws and regulations. COAs may be applied to all permits or on a case-by-case basis, depending on the alternative selected. Application and enforcement of COAs that require access protocols and road maintenance and require measures for safe and efficient access for all travel modes would minimize these impacts.

Under all alternatives, compatibility with applicable traffic and transportation plans, ordinances, and policies would be determined on a case-by-case basis. Implementing COAs would not affect the eligibility of roads for inclusion in the Tribal Transportation Program.

4.15.3 Alternative 1 (No Action)

Under Alternative 1 (No Action), the application of COAs and enforcement of regulations would continue to mitigate impacts on traffic and transportation within the planning area. COA 6, which requires that lessees confine all vehicles and equipment to approved lease roads and maintain and upgrade roads as directed by the BIA Osage Agency Superintendent, would reduce potential impacts on traffic and transportation. It would do this by limiting off-road traffic on leases and ensuring adequate standards to facilitate current and anticipated traffic levels and reduce damage to public roads. COA 13, which requires that lessees minimize disturbance to surface owners, wildlife, and natural resources due to excessive traffic and dust, would reduce potential impacts by limiting the amount of traffic on lease roads and ensuring appropriate dust abatement, which can impact visibility.

Because COA 29, which limits new road crossings of streams or wetlands, is not applied under Alternative 1 (No Action), there would continue to be flexibility for new roadways to support expanded oil and gas development; however, new road construction in riparian and other areas subject to frequent inundation could subject roadways and bridges to flooding, which would decrease access during flood events. Infrastructure in areas subject to the continuous erosive forces of water are more likely to experience potholes, cracking, and subgrade deterioration. In the long term, constructing roadway infrastructure over streams and in riparian areas would require regular maintenance to avoid roadway infrastructure deterioration and related access declines.

4.15.4 Alternative 2

Under Alternative 2, the BIA would issue a list of standard BMPs that apply to all oil and gas development operations within the planning area. In addition, the BIA would minimize the number of COAs applied to permits and would not prescribe the specific methods operators must use to comply with the BMPs or other applicable laws and regulations; operators would be given latitude to determine how best to comply. The waiver of protective COAs (COAs 6 and 13), which impose restrictions on traffic and require proper maintenance of lease roads, would result in increased impacts on traffic and transportation compared with Alternative 1 (No Action). The lack of road maintenance requirements, in particular, would allow roadways to deteriorate over time, which, in the long term, would reduce access for all transportation modes.

Voluntary compliance with BMPs and agreements between lessees and surface owners regarding lease road siting and maintenance could mitigate some of these impacts. Although impacts would be determined on a case-by-case basis, the amount of traffic and maintenance required to maintain desired levels of service in the planning area under Alternative 2 could exceed the planned improvements in the adopted Osage Nation and ODOT long-range transportation plans (Osage Nation 2017d; ODOT 2015). An inability to provide adequate infrastructure and maintenance would decrease access for all modes of transportation. In the long term, reduced access for all travel modes would not be consistent with adopted transportation plans and policies. The exact location, type, and degree of any inconsistencies are unknown.

4.15.5 Alternative 3

Under Alternative 3, the BIA would issue the same standardized list of BMPs and minimal COAs as Alternative 2 in sections with a high density of historical oil and gas development. The BIA would implement the same well spacing requirements and additional protective COAs as Alternative 4 in sections with a low density of historical oil and gas development. In addition, the BIA would not approve new ground-disturbing activities in the sensitive areas described in **Section 2.3.4**, Alternatives Considered for Detailed Analysis, Alternative 3—Hybrid Development. Applying COAs based on the density of well development would result in location-specific traffic and transportation impacts.

In high-density sections, the waiver of COAs relating to traffic and road maintenance (COAs 6 and 13) would increase the potential impacts on traffic and transportation, compared with Alternative 1 (No Action). Voluntary compliance with BMPs and agreements between lessees and surface owners regarding lease road siting and maintenance could mitigate some of these impacts.

In low-density sections and sensitive areas, the reduction of traffic and transportation impacts under Alternative 3 is the same as under Alternative 1 (No Action). In addition to the COAs applied under Alternatives 1 and 2 (COAs 6 and 13), COAs 29 and 31 also would apply under Alternative 3. COA 29 limits new road crossings of streams, waterways, and other areas susceptible to inundation. Where such crossings are unavoidable, lessees must design and construct crossings to minimize impacts on riparian and aquatic habitats. Restricting the construction of new roadways in these locations would maintain short- and long-term access by avoiding the siting of roads in areas that would be subject to flooding and roadway infrastructure deterioration, but could in some cases require lessees, purchasers, service companies, and other vehicles to travel farther to access wells and facilities on leases. The extent of the change from Alternative 1 (No Action) is unknown and would depend on the number, type, and location of new wells. COA 31, which requires collocation of new and existing facilities when feasible, could reduce the amount of surface disturbance associated with road construction but increase maintenance needs on existing roads that would receive additional traffic.

Under Alternative 3, approximately 248,800 acres would be protected from new ground-disturbing oil and gas development activities, reducing potential impacts associated with the construction of new lease roads, as compared with Alternative 1 (No Action). The inability to construct new lease roads in sensitive areas, however, would require that lessees use existing roads, potentially increasing traffic and the rate of road wear.

4.15.6 Alternative 4

Under Alternative 4, the BIA would apply well spacing requirements and additional protective COAs, beyond those applied under Alternative 1 (No Action), to all new development within the planning area. Further, the BIA would not approve new ground-disturbing activities in the sensitive areas identified under Alternative 3 and the additional sensitive areas described in **Section 2.3.5**, Alternatives Considered for Detailed Analysis, Alternative 4—Enhanced Resource Protection. The types of impacts on traffic and transportation under Alternative 4 are described above for Alternative 3, low-density sections. The scope of those impacts, however, would be further reduced under Alternative 4 due to the application of protective COAs throughout the planning area (COAs 29 and 31) and restrictions on ground disturbance in a larger number of sensitive areas.

As noted above for Alternative 3, low-density sections, the application of COA 29, which restricts new road and pipeline crossings of aquatic environments, would reduce potential road and roadway deterioration due to inundation; but, it could result in vehicles having to travel farther to access wells and facilities on leases. Similarly, COA 31, which requires the collocation of new and existing facilities when feasible, could increase maintenance needs on existing roads that receive additional traffic. These potential travel and road maintenance impacts would increase under Alternative 4 due to application of the COA countywide.

Under Alternative 4, approximately 524,400 acres would be protected from new ground-disturbing oil and gas development activities. The expansion of sensitive areas under Alternative 4 would result in lessees having to use existing roads in some areas, which would reduce surface disturbance associated with the construction of new lease roads, but could also potentially increase traffic on existing roads and increase the rate of road wear. The application of cultural resource buffers (see **Table 2-2** in **Chapter 2**) prohibiting surface disturbance within buffer zones near streams, rivers, reservoirs, lakes, and wetlands countywide could further impact road construction, routes of travel, and traffic in some locations.

4.15.7 Cumulative Impacts

The cumulative impact analysis area for traffic and transportation is the planning area. Past, present, and reasonably foreseeable future actions and conditions involving surface and subsurface disturbance have affected, and would likely continue to affect, traffic and transportation within the cumulative impact analysis area. Examples of such actions and conditions are set forth in **Table 4-1**. Oil and gas development activities under the alternatives would have impacts like those of past and present development and would contribute to the cumulative effects on traffic and transportation.

An increase in oil and gas development-related traffic in Osage County could also be expected to result in increased traffic in surrounding counties as vehicles carrying supplies and equipment pass through on the way to Osage County.

4.16 Mineral Extraction

4.16.1 Methods and Assumptions

This section discusses impacts that the alternatives described in **Chapter 2** may have on mineral extraction. Impacts on mineral extraction were evaluated based on the maximum potential development under each alternative.

Indicators

Indicators of impacts on mineral extraction are as follows:

- Applying COAs to drilling that restrict the timing, location, or methods of oil and gas development
- Changes in the accessibility or availability of mineral resources

Assumptions

- Oil and gas leasing and development in the planning area is expected to continue for the duration of the planning period (2018–2037).
- Management actions proposed under the alternatives will apply to oil and gas development throughout the planning area, regardless of surface ownership.
- Surface use associated with oil and gas development will be subject to COAs, which could be applied, modified, or waived on a site-specific basis where necessary to protect sensitive resources or facilitate diligent lease development.
- Lessees have the right to develop and produce oil and gas from any valid existing lease, and the application of COAs will not eliminate all reasonable opportunity to do so.

- Future development is expected to follow the same patterns as current development, with most development located in areas of high or moderate-to-high oil and gas potential.

4.16.2 Impacts Common to All Alternatives

Under all alternatives, oil and gas leasing and development would continue. The Energy Information Administration (EIA) predicts that between 2012 and 2040, nationwide oil prices will rise by between 0.8 and 1.4 percent per year and natural gas prices will rise by 3.7 percent per year (in 2012 dollars) (Energy Information Administration 2014). Considering the oil and gas development potential of the Osage Mineral Estate and the prediction of favorable trends in market pricing, development activity within the planning area is expected to increase over the course of the planning period.

Potential impacts on mineral extraction include depletion of oil and gas resources and interference with the mining of solid minerals within the planning area. The ultimate recovery of oil and gas from the Osage Mineral Estate at full development is unknown. In general, however, the removal of nonrenewable oil and gas resources would reduce the amount of recoverable resources that could be extracted at a future date.

Surface-disturbing activities associated with development activities are not anticipated to have an impact on subsurface reserves or extraction. Oil and gas development would have a beneficial impact on royalty revenues and the availability of these resources for human use.

Localized, minor, potential impacts on subsurface reserves could result from drilling through the geologic formations above the targeted formation, fracturing of the targeted formation to enhance recovery, physical intrusions from wellbores, and obstructions from materials installed to maintain the integrity of the wellbore during and after the productive life of wells (*i.e.*, well casings and cement plugs). Future development would likely involve continued injection of water and gas into the field to maintain reservoir pressure. The disposal of produced water, wastewater, and drilling fluids through Class II injection wells is also expected. The injection of such substances at high volumes and pressures increases the potential for induced seismicity, as described in **Section 4.2**, Topography, Geology, Paleontology, and Soils. The EPA's oversight of such injection as part of the UIC Program, however, significantly reduces the risk of induced seismicity through monitoring, reporting, and compliance activities.

Oil and gas development have the potential to conflict with future development of sand, gravel, sandstone, limestone, dolomite, and other salable minerals within the planning area. Oil and gas development could impact these other minerals due to contamination resulting from accidental spills of deleterious substances, physical obstruction by wellbores and casings, and surface disturbance on lands available for surface mining leases. Except for accidental spills, which are highly unpredictable, these impacts would occur under all alternatives to varying degrees, depending on the number of wells drilled. Considering the availability of other salable minerals throughout the planning area and the limited amount of surface acreage required for oil and gas development activities (typically 2 acres or less per well), overall impacts on the extraction of other minerals are expected to be minimal.

Under all alternatives, the BIA would apply COAs 1, 2, 7, 16, 19, 21, and 23 to drilling and workover permits. It would do this to reduce the impacts from development operations, prevent environmental degradation, and ensure compliance with applicable laws and regulations, such as the CWA, SDWA, NHPA, and NEPA. The COAs set forth in this EIS, many of which are currently enforced in Osage County, are not anticipated to have a significant impact on the level of future oil and gas development. COAs may be applied to all permits or on a case-by-case basis, depending on the alternative selected.

The application of COAs that reduce surface disturbance or impose setbacks (COAs 1, 2, 16, 19, and 21) could affect siting considerations for mineral extraction but would not prohibit the development of leases.

Such COAs, however, would minimize the potential impacts of mineral extraction on environmental and water quality, cultural resources, and public health and safety.

4.16.3 Alternative 1 (No Action)

Under Alternative 1 (No Action), the application of COAs would reduce surface disturbance (COAs 3–6, 12–15, and 23), implement requirements for interim and final restoration of surface lands (COAs 12 and 15), impose safety measures (COAs 8–11, 18, and 22), and comply with the terms of the USFWS BO (COAs 17 and 20). While these COAs impose requirements on lessees regarding the conduct of operations, they do not prohibit mineral extraction or the diligent development of leases.

4.16.4 Alternative 2

Under Alternative 2, the BIA would issue a list of standard BMPs that apply to all oil and gas development operations within the planning area. In addition, the BIA would minimize the number of COAs applied to permits and would not prescribe the specific methods operators must use to comply with the BMPs or other applicable laws and regulations; operators would be given latitude to determine how best to comply.

The waiver of many COAs would provide lessees with more flexibility regarding how to comply with applicable laws, which could reduce the time required for permitting, scheduling, and site preparation; but, could increase potential liability for inadequate compliance with BMPs and the costs associated with taking necessary corrective action. In some cases of noncompliance, fines or civil penalties could also be assessed. The application of COAs 24 and 27, which require that lessees conduct operations in a manner that minimizes disturbance due to noise and adverse visual impacts and prohibit the land application of waste oil, wastewater, contaminated soil, or other deleterious substance without the BIA Osage Agency Superintendent's prior approval, would not prevent or limit mineral extraction.

Due to the waiver of certain COAs under Alternative 2, the BIA would likely need to submit a revised BA to the USFWS and reinitiate formal consultation on a new BO. Until a new BO is issued, lessees would be solely responsible for documenting compliance under ESA Section 10. Oil and gas operations could not proceed until a 45-day wait period has elapsed, unless there is no suitable habitat and the BIA is willing to make a "no effect" determination for the ABB. This could delay oil and gas development in the planning area, compared with Alternative 1 (No Action).

4.16.5 Alternative 3

Under Alternative 3, the BIA would issue the same standardized list of BMPs and minimal COAs as Alternative 2 in sections with a high density of historical oil and gas development. The BIA would implement the same well spacing requirements and additional protective COAs as Alternative 4 in sections with a low density of historical oil and gas development. In addition, the BIA would not approve new ground-disturbing activities in the sensitive areas described in **Section 2.3.4**, Alternatives Considered for Detailed Analysis, Alternative 3—Hybrid Development. Applying COAs based on the density of well development would result in location-specific impacts on mineral extraction.

Under Alternative 3, high-density sections would encompass approximately 393,200 acres, and low-density sections would encompass approximately 1,081,300 acres. In high-density sections, the waiver of COAs would provide lessees with more discretion regarding the means by which they comply with applicable laws, but would also potentially increase liability for inadequate compliance with BMPs and the costs associated therewith. In addition, as discussed under Alternative 2, the BIA would likely need to reinitiate consultation with the USFWS to obtain a new BO, which could increase the time required to process permits and delay development compared with Alternative I (No Action).

In low-density sections and sensitive areas, lessees would be subject to all COAs applied under Alternatives I and 2 as well as COAs 25–26 and 28–31. COA 25 requires lessees to conduct an initial test of the H_2S concentration of the gas stream for each well or production facility and, if a well or facility has a concentration of 100 ppm or greater, to determine the 100 ppm and 500 ppm radius of exposure and post appropriate signage. This requirement is the industry standard and protects both the general public and the lessee, their employees, field technicians, first responders, and other individuals that may be present on a lease site. COA 25 does not prohibit mineral extraction and would not cause significant delays in development operations. COAs 26, 28–29, and 31 impose limitations on the location of wells, pits, roads, and pipelines, which could potentially affect decisions regarding the location of development or methods of construction, but they would not prevent mineral extraction. COA 30, which requires the burial of pipelines to protect aquatic environments or sensitive areas when appropriate, would not prohibit development but could impose additional costs and affect the timing of development.

In addition to the application of protective COAs countywide, the BIA would also implement cultural resource buffers (see **Table 2-2** in **Chapter 2**) and well spacing requirements in low-density sections. Cultural resource buffers impose setbacks from streams, rivers, ponds, reservoirs, lakes, and wetlands; these setbacks would affect the location of development in those areas. Well spacing requirements would affect both the location and amount of development in low-density sections, as requiring lessees to maintain a certain distance between wells restricts the number of wells that can be drilled in a certain section. Well spacing may also impact recovery by increasing the chance that productive rock in between wells may not be stimulated.

As shown in **Table 4-12**, below, under Alternative 3, approximately 248,800 acres would be protected from new ground-disturbing oil and gas development activities. As surface disturbance would be restricted in these areas, lessees would need to use directional or horizontal drilling to access the minerals located therein unless they obtain a variance from the BIA Osage Agency Superintendent. As discussed in **Sections 3.3.2** and **3.16.2**, the cost of directional and horizontal drilling is typically significantly higher than the cost of drilling a conventional or vertical well. Of the 248,800 acres of sensitive areas, approximately 168,800 acres have high oil and gas development potential (BIA GIS 2017). Accordingly, restrictions on drilling in sensitive areas would impact the location of new development and potentially increase the costs associated with mineral extraction in certain locations.

Table 4-12
Alternative 3 No New Ground Disturbance Areas by Oil and Gas Potential

Potential	Acres	Percentage of Total Potential Level
High Potential	168,800	17%
Moderate to High Potential	33,500	12%
Moderate Potential	46,100	20%
Low to Moderate Potential	300	23%
Grand Total*	**248,800**	

Source: BIA GIS 2017
*Due to rounding of acreages in GIS the sum of acres may not equal the grand total

4.16.6 Alternative 4

Under Alternative 4, the BIA would apply well spacing requirements and additional protective COAs, beyond those applied under Alternative 1 (No Action), to all new development within the planning area. Further, the BIA would not approve new ground-disturbing activities in the sensitive areas identified under Alternative 3 and the additional sensitive areas described in **Section 2.3.5**, Alternatives Considered for Detailed Analysis, Alternative 4—Enhanced Resource Protection. The types of impacts on mineral extraction are described above for Alternative 3, low-density sections. The scope of those impacts, however, would increase under Alternative 4 due to the application of protective COAs and cultural resource buffers (see **Table 2-2** in **Chapter 2**) throughout the planning area (COAs 25–26 and 28–31) and restrictions on ground disturbance in a larger number of sensitive areas.

As shown in **Table 4-13**, below, under Alternative 4, approximately 524,400 acres would be protected from new ground-disturbing oil and gas development activities. As surface disturbance would be restricted in these areas, lessees would need to use directional or horizontal drilling to access the minerals located therein unless they obtain a variance from the BIA Osage Agency Superintendent. Of the 524,400 acres of sensitive areas, 352,000 acres have high oil and gas development potential (BIA GIS 2017). Accordingly, restrictions on drilling in sensitive areas would impact the location of new development and potentially increase the costs associated with mineral extraction in certain locations. Overall, Alternative 4 would impose the most restrictions on mineral extraction of all the alternatives.

Table 4-13
Alternative 4 No New Ground Disturbance Areas by Oil and Gas Potential

Potential	Acres	Percentage of Total Potential Level
High Potential	352,000	36%
Moderate to High Potential	86,500	32%
Moderate Potential	85,700	37%
Low to Moderate Potential	300	23%
Grand Total*	**524,400**	

Source: BIA GIS 2017
*Due to rounding of acreages in GIS the sum of acres may not equal the grand total

4.16.7 Cumulative Impacts

The cumulative impact analysis area for mineral extraction is the planning area. Past, present, and reasonably foreseeable future actions and conditions involving surface and subsurface disturbance have affected, and would likely continue to affect, mineral extraction within the cumulative impact analysis area. Examples of such actions and conditions are set forth in **Table 4-1**. Oil and gas development activities under the alternatives would have impacts like those of past and present development and would contribute to the cumulative effects on mineral extraction.

The impacts of oil and gas development on mineral extraction include the extraction of oil and gas resources, which would deplete recoverable resources that could be extracted at a future date, and potential conflicts with the extraction of other salable minerals, such as sand, gravel, sandstone, limestone, and dolomite.

Oil and gas development is historically prevalent within the planning area and is expected to continue. Because such resources are nonrenewable, future extraction of oil and gas would cumulatively and incrementally affect total reserves within the planning area. Other projects within the cumulative impact analysis area that may affect mineral extraction include infrastructure projects (*e.g.*, pipelines, transportation projects, and wind farms), quarries, and residential and commercial development.

Oil and gas development would likely increase the density and quantity of surface disturbance within the planning area. Other salable minerals in the planning area are recovered through mining of the surface. As a result, surface disturbance from well pads, roads, pipelines, and other facilities could impact the timing, location, and recovery of other mineral resources. Considering the relatively low amount of surface acreage disturbed for oil and gas development, however, such impacts are not expected to be significant.

4.17 Recreation and Special Use Areas

This section discusses impacts that the alternatives described in **Chapter 2** may have on recreation and special use areas. Impacts on recreation and special use areas were evaluated based on the maximum potential development under each alternative.

4.17.1 Methods and Assumptions

Indicators

Indicators of impacts on recreation and special use areas are as follows:

- Short- or long-term elimination or reduction of recreation opportunities, activities, or experiences throughout the planning area
- Inability of special use areas (*e.g.*, state parks and WMAs) to provide desired recreation activities, experiences, and opportunities

Assumptions

- Recreation in the planning area will continue as populations grow, with an anticipated increase in motorized recreation, swimming, boating, fishing, wildlife viewing, hiking, and camping. The estimated population of Osage County slightly decreased from 2015 to 2016 (0.17 percent decrease), whereas surrounding communities, such as Tulsa, expanded at a rate of approximately 0.58 percent, between 2015 and 2016 (US Census Bureau 2016).
- Osage County will continue to maintain and refine the Osage County Comprehensive Plan and to implement the objectives listed for parks, recreation, trails, and open space.
- Impacts on recreation primarily occur from
  - Management actions related to other resources
  - Resource uses that result in both short- and long-term elimination or reduction of recreation opportunities
  - Resource uses that diminish the quality of the recreation setting and experience (*e.g.*, reduced access, displacement of recreation activities, and the reduction of opportunities for primitive- and solitude-oriented recreation due to the increased presence of human-made facilities, noise, and roads)

4.17.2 Impacts Common to All Alternatives

Impacts on recreation primarily occur from management actions related to other resources or resource uses that result in both short- and long-term elimination or reduction of recreation opportunities, or that diminish the quality of the recreation setting and experience (*e.g.*, reduced access, displacement of recreation activities, and the reduction of opportunities for primitive- and solitude-oriented recreation due to the increased presence of human-made facilities, noise, and roads).

Under all alternatives, oil and gas leasing and development would continue. Continued and increased oil and gas production would include increasing developments and infrastructure that could conflict with opportunities for recreation. For example, oil and gas development could degrade hunting opportunities by introducing noise and fragmenting wildlife habitat and could adversely affect fishing due to brine spills and stream degradation.

Surface disturbance from oil and gas development could reduce the naturalness of the landscape, reduce the scenic and acoustic quality of the recreation setting, and diminish the recreation experience for those seeking solitude and semiprimitive, nonmotorized recreation opportunities.

Hydraulic fracturing could occur in combination with conventional oil and gas development techniques under all alternatives; however, as discussed in the Osage RFD (**Appendix A**), the majority of new wells drilled during the life of this EIS are anticipated to be conventional wells. Hydraulic fracturing typically uses water from available groundwater and/or surface water resources located near hydraulically fractured oil and gas production wells (EPA 2016e), which would affect recreation more than conventional oil and gas development by reducing water levels in lakes, rivers, and reservoirs.

The development of access roads could increase the numbers of other recreationists in the area, including off-highway vehicle users and hunters. This increase could indirectly lead to an increase in undesignated, user-created travel routes and allow for increased opportunities for illegal dumping. An increase in noise associated with oil and gas well development and increased truck traffic on additional access roads could also diminish the recreation experience for those seeking solitude-based and primitive-oriented recreation opportunities. Development of additional access roads could also increase road-based recreation opportunities.

Any surface-disturbing activities that displace or otherwise disrupt the normal distribution and movement patterns of big game wildlife, or affect big game wildlife habitat, would affect hunting quality. Impacts on wildlife are discussed in detail in **Section 4.5**, Fish, Wildlife, and Migratory Birds.

Under all alternatives, the BIA would apply COAs 1, 2, 7, 16, 19, 21, and 23 to drilling and workover permits to reduce the impacts from development operations, prevent environmental degradation, and ensure compliance with applicable laws and regulations. COA 2, which prohibits expansion or relocation of well pads and access roads not included in the approved EA for the APD, would continue to limit surface-disturbing activities. This, in turn, would protect the naturalness of the landscape and the recreation experience for those seeking solitude and semiprimitive, nonmotorized recreation.

COAs may be applied to all permits or on a case-by-case basis, depending on the alternative selected. Application and enforcement of COAs that relocate surface disturbance away from recreation and special use areas would minimize these impacts.

4.17.3 Alternative 1 (No Action)

Under Alternative 1 (No Action), the application of COAs and enforcement of regulations would continue to mitigate impacts on recreation and special use areas. COAs 3–5, 12, and 15, which require lessees to minimize soil and vegetation disturbance, avoid alteration of the natural topography, implement erosion control measures, and conduct interim and final restoration of surface lands, would reduce surface disturbance within the planning area and minimize displacement of recreational activities by protecting the natural landscape. COAs 6 and 13, which require lessees to confine vehicles and equipment to approved lease roads and minimize disturbances caused by noise and traffic, would reduce potential impacts from changes in the scenic or acoustic quality of natural areas. Together, COAs 3–6, 12–13, and 15, which reduce surface disturbance and minimize impacts on wildlife and natural resources from noise and traffic, also would reduce the potential for habitat avoidance and behavioral impacts on fish, game species, and migratory birds as well as the risk of habitat loss, degradation, or fragmentation. Thus, these COAs would help preserve fishing, nature watching, and hunting opportunities.

COA 9, which requires lessees to keep leases free of litter, trash, old equipment, and contaminated soil and properly dispose of waste, would reduce potential impacts on recreation and special use areas by preserving the naturalness of those areas and helping prevent the creation of illegal dump sites. COAs 11 and 14, which require preparation of SPCC plans, secondary containment at tank batteries and other facilities, avoidance of activities in aquatic environments, and prohibit discharges of deleterious substances to surface waters, would reduce the risk of changes in water quality due to contamination or spills.

4.17.4 Alternative 2

Under Alternative 2, the BIA would issue a list of standard BMPs that apply to all oil and gas development operations within the planning area. In addition, the BIA would minimize the number of COAs applied to permits and would not prescribe the specific methods operators must use to comply with the BMPs or other applicable laws and regulations; operators would be given latitude to determine how best to comply. The waiver of protective COAs (COAs 3–6, 9, and 11–15) would result in increased potential for surface, soil, vegetation, noise, and traffic disturbances; displacement of wildlife and recreation; and changes in water quality.

The application of COAs 24 and 27 under Alternative 2, however, would reduce impacts on recreation and special use areas, compared with Alternative 1 (No Action). COA 24, which requires lessees to minimize noise and visual disturbances that may be a nuisance to people or sensitive environmental receptors, would reduce the potential for changes in the auditory or scenic quality of natural and recreational areas as well as the risk of behavioral impacts on fish, game species, and migratory birds. COA 27, which prohibits the land application of waste oil, wastewater, or contaminated soil without the BIA Osage Agency Superintendent's prior approval, would keep injurious material out of important fish and wildlife habitat, such as wetlands and riparian zones, thereby reducing impacts on recreation opportunities such as boating, fishing, and wildlife viewing.

Overall, the potential impacts of oil and gas development on recreation and special use areas would increase under Alternative 2 compared with Alternative 1 (No Action). Voluntary compliance with BMPs and agreements between lessees and surface owners regarding restoration of surface lands may mitigate some of these impacts.

4.17.5 Alternative 3

Under Alternative 3, the BIA would issue the same standardized list of BMPs and minimal COAs as Alternative 2 in sections with a high density of historical oil and gas development. The BIA would implement the same well spacing requirements and additional protective COAs as Alternative 4 in sections with a low density of historical oil and gas development. In addition, the BIA would not approve new ground-disturbing activities in the sensitive areas described in **Section 2.3.4**, Alternatives Considered for Detailed Analysis, Alternative 3—Hybrid Development.

In high-density sections, the waiver of COAs relating to soil, vegetation, noise, and traffic disturbances; alteration of topography; interim and final restoration of surface lands; pollution control; disposal of waste; SPCC plans and secondary containment measures; and the discharge of deleterious substances to surface waters (COAs 3–6, 9, and 11–15) would increase potential impacts on recreation and special use areas, as described under Alternative 2. Voluntary compliance with BMPs and agreements between lessees and surface owners regarding restoration of surface lands may mitigate some of these impacts.

In low-density sections and sensitive areas, Alternative 3 would reduce potential impacts on recreation and special use areas compared with Alternative 1 (No Action). In addition to all COAs applied under Alternatives 1 and 2, COAs 26 and 28–31 also would apply in low-density sections. COA 26, which prohibits lessees from siting wells or pits in areas subject to frequent flooding according to the NRCS Soil Survey, would reduce the risk that a flood event may result in the release of deleterious substances and contamination of vegetation, wildlife habitat, and surface waters. COA 28, which requires that drilling pits be at least 200 feet from streams and waterways, would also reduce the risk that leaks or spills of deleterious substances may contaminate the environment and surface waters. COA 29, which requires that lessees avoid new road and pipeline crossings of aquatic environments and alterations of hydrology, would reduce surface disturbance; preserve the naturalness of wetlands, streams, and other water sources; and minimize the risks of behavioral impacts on fish and wildlife as well as habitat loss, degradation, or fragmentation.

COA 30, which requires the burial of pipelines to protect important aquatic environments and sensitive areas when appropriate, would preserve aquatic habitat and the naturalness of wetlands, streams, and other water sources; but, it would temporarily increase surface disturbance, noise, and traffic in these areas due to the need for heavy equipment. Such disturbances could cause habitat avoidance or other behavioral impacts that could affect wildlife viewing and, depending on the time of year, hunting opportunities. The burial of pipelines would also likely require soil and vegetation disturbance, which could change the scenic quality of the subject area and result in habitat loss or degradation. COA 31, which requires the collocation of new and existing facilities when feasible, would reduce surface disturbance but could result in increased noise and traffic on lease roads, which may change the auditory quality of natural areas within the vicinity.

The implementation of cultural resource buffers (see **Table 2-2** in **Chapter 2**) and well spacing requirements in low-density sections would further reduce surface disturbance. Such buffers require setbacks from streams, rivers, ponds, reservoirs, lakes, and wetlands, which would provide incidental protection for wildlife and recreation in those areas. Well spacing requirements, however, could result in wells and facilities being sited closer to natural or sensitive areas due to lessees having to maintain a certain distance between wells within the low-density sections.

Under Alternative 3, approximately 248,800 acres would be protected from new ground-disturbing oil and gas development activities, reducing potential impacts on recreation and special use areas, compared with Alternative 1 (No Action). Regardless of the density of wells in each section, new ground-disturbing activities would not be permitted in sensitive areas, significantly reducing surface disturbance, preserving the naturalness of special use areas, and protecting water quality and quantity.

4.17.6 Alternative 4

Under Alternative 4, the BIA would apply well spacing requirements and additional protective COAs, beyond those applied under Alternative 1 (No Action), to all new development within the planning area. Further, the BIA would not approve new ground-disturbing activities in the sensitive areas identified under Alternative 3 and the additional sensitive areas described in **Section 2.3.5**, Alternatives Considered for Detailed Analysis, Alternative 4—Enhanced Resource Protection. The types of impacts on recreation and special use areas are described above for Alternative 3, low-density sections. The scope of those impacts, however, would be further reduced under Alternative 4 due to the application of protective COAs throughout the planning area (COAs 26 and 28–31) and restrictions on ground disturbance in a larger number of sensitive areas.

Under Alternative 4, approximately 524,400 acres would be protected from new ground-disturbing oil and gas development activities, reducing potential impacts on recreation and special use areas. New drilling would not be permitted in certain sensitive areas, including the Tallgrass Prairie Preserve, BLM wild horse and burrow pasture facilities, drinking water and groundwater protection areas, and state parks and WMAs; recreation opportunities would be enhanced in these areas, compared with Alternative 1 (No Action) due to reduced noise and adverse visual impacts. The application of cultural resource buffers (see **Table 2-2** in **Chapter 2**) countywide would provide incidental protections for recreation and special use areas due to the implementation of setbacks from streams, rivers, ponds, reservoirs, lakes, and wetlands. Such buffers further limit new ground disturbance and reduce the risk of noise and visual disturbances, habitat loss or degradation, wildlife behavioral impacts, and contamination due to leaks or spills.

4.17.7 Cumulative Impacts

The cumulative impact analysis area for recreation and special use areas is the planning area and all WMAs that intersect it. The cumulative impact analysis area also extends along major roads, trails, and rivers where management inside the planning area could affect use outside the planning area boundary.

Past, present, and reasonably foreseeable future actions and conditions involving surface and subsurface disturbance have affected, and would likely continue to affect, recreation and special use areas in the cumulative impact analysis area. Examples of such actions and conditions are set forth in **Table 4-1**. Oil and gas development activities under the alternatives would have impacts like those of past and present development and would contribute to the cumulative effects on recreation and special use areas. These activities have the potential to affect game populations, which in turn would affect potential recreation benefits (*e.g.*, wildlife viewing and hunting) because of the loss or gain of the number of animals.

Management of vegetation and wildlife that implements strategies to protect or rehabilitate areas would serve to maintain recreation experiences but could also restrict recreation access. In general, cumulative impacts on recreation and special use areas would likely be the lowest under Alternative 4. This would be due to the application of the most COAs over the greatest area and the greatest acreage of areas where permits for new ground-disturbing activities would not be approved. This would reduce conflicts with recreation and enhance recreation experiences.

4.18 Trust Assets and Osage Nation Interests

This section discusses impacts that the alternatives described in **Chapter 2** may have on trust assets and social, cultural, and economic interests specific to the Osage Nation. General cultural resource impacts are addressed in **Section 4.9**, Cultural Resources, and general social and economic impacts are addressed in **Section 4.10**, Socioeconomics and Environmental Justice.

4.18.1 Methods and Assumptions

Indicators

Indicators of impacts on trust assets and Osage Nation interests are as follows:

- Extent to which actions improve or impose restraints upon use and development of the Osage Mineral Estate, including constraints on the timing, location, and methods of oil and gas development utilized
- The value of royalty revenues derived from the Osage Mineral Estate
- Extent to which required environmental compliance processes and resource protection measures can be addressed more efficiently and with more certainty for lessees
- Access to and continued use of locations, sacred sites, resources, and settings that are traditionally important to the Osage Nation

Assumptions

- Demand for development of the Osage Mineral Estate will continue but will be affected by market forces.
- Revenues from the Osage Mineral Estate will continue to be distributed to Osage headright holders, in accordance with the 1906 Act.
- Gross production tax will continue to be assessed on oil and gas royalty revenues at the statutory rate.
- As part of the NEPA review and NHPA compliance processes, locations, sites, and resources important to the Osage Nation will be avoided, whenever possible.

4.18.2 Impacts Common to All Alternatives

Under all alternatives, oil and gas leasing and development would continue. The production of oil and gas from the Osage Mineral Estate would result in the collection of rental and royalties that would be distributed to Osage headright holders on a quarterly, pro rata basis, with interest. This would happen after the gross production tax and Tribal operating expenses are deducted, as described in **Section 3.18**, Trust Resources and Osage Nation Interests. The demand for commodities and market prices are uncertain and would vary independent of the alternative selected. Market forces, whether positive or negative, would affect royalty revenues and, therefore, the amount of quarterly Osage headright payments.

The EIS would replace the existing leasing and workover PEAs. It would serve as the NEPA review for the approval leases and workover permits that do not require new ground disturbance, regardless of the alternative selected. Site-specific EAs would still be required for drilling permits and workover permits requiring new ground disturbance. Site-specific EAs would be tiered to the analysis in the EIS, reducing the time and cost associated with preparation of the EAs and the length of the documents. Efficiencies gained by streamlining the NEPA review process will expedite lease and permit processing.

As part of that process, the BIA would continue to comply with NHPA Section 106, as described in **Section 4.9**, Cultural Resources. During the Section 106 consultation process, the Osage Nation THPO would review projects for effects on locations, sacred sites, resources, and settings that are traditionally important to the Osage Nation. In addition, COAs 1 and 2, which require the avoidance of cultural sites and procedures for handling unanticipated discoveries during development activities, apply under all alternatives.

4.18.3 Alternative 1 (No Action)

Under Alternative 1 (No Action), management actions would support development levels at projections outlined in the Osage RFD (**Appendix A**). The application of COAs 1–23 under Alternative I (No Action) would impose procedural and operational requirements on lessees. As outlined in **Section 4.10.3**, Alternative 1 (No Action), COAs may represent site-specific constraints and changes in siting or timing of development. Overall, however, the COAs would not prohibit development of the Osage Mineral Estate, nor are they anticipated to make development uneconomical. Royalty revenues from the Osage Mineral Estate would continue to accrue; however, as noted in **Section 4.18.2**, Impacts Common to All Alternatives, the actual levels of development, production, and revenues would depend primarily on market conditions outside the control of the BIA or lessees.

COAs 1–23 under Alternative 1 (No Action) specify review of actions that may affect locations, sacred sites, resources, and settings that are traditionally important to the Osage Nation. These reviews may reduce impacts on these resources by ensuring that potential impacts are identified and mitigated.

4.18.4 Alternative 2

Under Alternative 2, the BIA would issue a list of standard BMPs that apply to all oil and gas development operations within the planning area. In addition, the BIA would minimize the number of COAs applied to permits and would not prescribe the specific methods operators must use to comply with the BMPs or other applicable laws and regulations; operators would be given latitude to determine how best to comply. As outlined in **Section 4.10.4**, Alternative 2, some additional liability may exist for lessees in the absence of protective COAs (COAs 3–6, 8–15, 17–18, 20, and 22), particularly with respect to ESA compliance. Overall, economic benefits from oil and gas development for the Osage Nation and Osage headright holders would be the same as those under Alternative 1 (No Action); the actual levels of development, production, and revenues would be primarily dependent upon market conditions outside the control of the BIA or lessees.

The waiver of COAs and emphasis on oil and gas development under Alternative 2 could increase the potential for oil and gas-related impacts on locations, sacred sites, resources, and settings that are traditionally important to the Osage Nation. Many of the COAs that reduce or minimize surface disturbance would not apply under this alternative. NHPA Section 106 would still provide protections for cultural resources; however, the potential for conflicts with locations important to the Osage Nation would be greater than under Alternative 1 (No Action) based on increased surface disturbance.

4.18.5 Alternative 3

Under Alternative 3, the BIA would issue the same standardized list of BMPs and minimal COAs as Alternative 2 in sections with a high density of historical oil and gas development. The BIA would implement the same well spacing requirements and additional protective COAs as Alternative 4 in sections with a low density of historical oil and gas development. In addition, the BIA would not approve new ground-disturbing activities in the sensitive areas described in **Section 2.3.4**, Alternatives Considered for Detailed Analysis, Alternative 3—Hybrid Development.

Management actions under this alternative would support a varied level of development in identified high- and low-density sections. As outlined in **Section 4.10.5**, Alternative 3, management may result in preferential development in high-density sections. Overall, economic benefits from oil and gas development for the Osage Nation and Osage headright holders would be similar to those under Alternative 1 (No Action); the actual levels of development, production, and revenues primarily would be dependent upon market conditions outside the control of the BIA or lessees.

Alternative 3 would allow higher-density surface disturbance in high-density sections and, therefore, increase the potential for impacts on culturally important locations, sacred sites, resources, and settings within these areas. In low-density sections, the application of protective COAs, cultural resource buffers, and well spacing requirements would reduce surface disturbance and decrease potential impacts on locations, sacred sites, resources, and settings. In addition to all COAs applied under Alternatives 1 and 2, COAs 25–26 and 28–31 would apply in low-density section. The implementation of cultural resource buffers (see **Table 2-2** in **Chapter 2**) and well spacing requirements would further reduce surface disturbance and provide direct protection for culturally important locations, sacred sites, resources, and settings by imposing setbacks therefrom.

Under Alternative 3, approximately 248,800 acres would be protected from new ground-disturbing oil and gas development activities, reducing potential impacts on culturally important locations, sacred sites, resources, and settings. This prohibition on new surface disturbance in sensitive areas, however, may adversely impact development. As discussed in **Section 4.16.5**, Alternative 3, while lessees would still be able to extract oil and gas from sensitive areas, they would have to utilize directional or horizontal drilling to do so unless they receive a variance from the BIA Osage Agency Superintendent. As directional and horizontal drilling typically cost more than conventional drilling, this could impact the timing, location, and level of new development within sensitive areas, some of which may have high oil and gas potential (see **Table 4-12**, Alternative 3 No New Ground Disturbance Areas by Oil and Gas Potential). As previously noted, actual levels of development, production, and revenues would be primarily dependent upon market conditions outside the control of the BIA or lessees.

4.18.6 Alternative 4

Under Alternative 4, the BIA would apply well spacing requirements and additional protective COAs, beyond those applied under Alternative 1 (No Action), to all new development within the planning area. Further, the BIA would not approve new ground-disturbing activities in the sensitive areas identified under Alternative 3 and the additional sensitive areas described in **Section 2.3.5**, Alternatives Considered for Detailed Analysis, Alternative 4—Enhanced Resource Protection. The types of impacts on trust assets and Osage Nation interests under Alternative 4 are described above for Alternative 3, low-density sections.

The scope of the impacts described would be further reduced for culturally important locations, sacred sites, resources, and settings under Alternative 4 due to the application of protective COAs (COAs 25–26 and 28–31), cultural resource buffers (see **Table 2-2** in **Chapter 2**), and well spacing requirements throughout the planning area. These additional protections and reductions in surface disturbance, however, would likely increase the scope of the impacts on development of the Osage Mineral Estate, though actual levels of development, production, and revenues would depend primarily on market conditions outside the control of the BIA or lessees.

Under Alternative 4, approximately 524,400 acres would be protected from new ground-disturbing oil and gas development activities, reducing potential impacts on culturally important locations, sacred sites, resources, and settings. The prohibition on surface disturbance in a larger number of sensitive areas, however, may adversely impact development. As discussed in **Section 4.16.6**, Alternative 4, while lessees would still be able to extract oil and gas from sensitive areas, they would have to utilize directional or horizontal drilling to do so unless they receive a variance from the BIA Osage Agency Superintendent. As directional and horizontal drilling typically cost more than conventional drilling, this could impact the timing, location, and level of new development within sensitive areas, some of which may have high oil and gas potential (see **Table 4-13**, Alternative 4 No New Ground Disturbance Areas by Oil and Gas Potential).

4.18.7 Cumulative Impacts

The cumulative impact analysis area for trust assets and Osage Nation interests is the planning area. Past, present, and reasonably foreseeable future actions and conditions involving surface disturbance have affected, and would likely continue to affect, trust assets and Osage Nation interests within the cumulative impact analysis area. Examples of such actions and conditions are set forth in **Table 4-1**. Oil and gas development activities under the alternatives would have impacts like those of past and present development and would contribute to the cumulative effects on trust assets and Osage Nation interests.

Oil and gas development would continue to provide royalty revenues for the benefit of the Osage Nation and Osage headright holders. Other projects within the cumulative impact analysis area that may affect trust assets and the Osage Nation's social, cultural, and economic interests include mining (other than oil and gas), agriculture, infrastructure projects (e.g., pipelines, transportation projects, and wind farms), and residential or commercial development. The timing or location of oil and gas development activities on a site-specific basis could be affected by the USFWS Oil and Gas Industry Conservation Plan associated with issuance of ESA Section 10(a)(1)(B), permits for the ABB in Oklahoma (USFWS 2014), and associated guidelines for ABB surveys. Such constraints could impact the timing of subsequent economic contributions from the Osage Mineral Estate.

Under all alternatives, the BIA would apply COAs to drilling and workover permits. It would do this to reduce the impacts from development operations, prevent environmental degradation, and ensure compliance with applicable laws and regulations, such as the 1906 Act and NHPA. The COAs set forth in this EIS, many of which are currently enforced in Osage County, are not anticipated to have a significant impact on the level of future oil and gas development. COAs may be applied to all permits or on a case-by-case basis, depending on the alternative selected.

The application of COAs that reduce surface disturbance or impose setbacks could affect siting considerations but would not prohibit the development of leases. The application of COAs that protect cultural resources would minimize impacts on the Osage Nation's social and cultural interests.

Chapter 5. Consultation and Coordination

5.1 Introduction

In accordance with requirements set forth in NEPA, 40 CFR 1506.3(c), and by the CEQ, the BIA conducted consultation and coordination when preparing this EIS. This was done to ensure that appropriate members of the public, Tribes, and federal, state, and local agencies were contacted, consulted, and given an adequate opportunity to be involved in the process.

This chapter describes the internal and public scoping process, Tribal consultation, cooperating agency involvement, and additional consultations and public involvement activities.

5.2 Public Scoping

The BIA held 2 formal scoping periods to involve the public in identifying significant issues related to its potential land use management actions. The first public scoping period was completed as part of the OKT Joint EIS/BLM RMP/BIA Integrated RMP scoping period. Osage County is in the planning area for this joint document.

The subject of the Osage County Oil and Gas EIS—oil and gas development in Osage County—was part of the OKT Joint EIS/BLM RMP/BIA Integrated RMP scoping. The scoping period began on July 26, 2013, with the publication of a NOI in the *Federal Register*, and concluded on January 31, 2014. As part of the scoping period, the BIA held a public meeting in Pawhuska, Oklahoma, on January 15, 2014. The final scoping report for this first public scoping period is available at the public website for the OKT Joint EIS/BLM RMP/BIA Integrated RMP, https://eplanning.blm.gov/epl-front-office/eplanning/planAndProjectSite.do?methodName=renderDefaultPlanOrProjectSite&projectId=72142.

Following the first public scoping period, the Osage Minerals Council requested that the analysis of oil and gas development in Osage County be expedited. As a result, the BIA removed the Osage County Oil and Gas EIS from the OKT Joint EIS/BLM RMP/BIA Integrated RMP and prepared the EIS as a separate document. In November 2015, the BIA published the Osage County Oil and Gas Draft EIS. Following the public comment period, the BIA determined that the 2015 Draft EIS should be revised in order to address comments received and to take additional information into consideration.

On April 11, 2016, the BIA published the NOI to revise the 2015 Draft EIS. This initiated the second formal scoping period, which concluded on May 8, 2016. During this scoping period, a public scoping meeting was held in Pawhuska, Oklahoma, on April 28, 2016. Meeting materials and the final scoping report for this second public scoping period are available at the project website, https://www.bia.gov/regional-offices/eastern-oklahoma/osage-agency/osage-oil-and-gas-eis.

The scoping periods provided an opportunity for individuals from federal, state, and local agencies; Tribes; interest groups; and the general public to express their comments and to provide meaningful input via email, letters, and participation in the public scoping meetings. The BIA used the information collected during the second scoping period to formulate the alternatives for this EIS.

5.3 Collaboration

Federal laws require the BIA to consult with certain federal and state agencies and entities and Native American Tribes (40 CFR 1502.25) during the NEPA decision-making process. The BIA is also directed to integrate NEPA requirements with other environmental review and consultation requirements to reduce paperwork and delays (40 CFR 1500.4-5).

The BIA will also hold a Draft EIS meeting with the public and cooperating agencies. The BIA will continue to meet with interested agencies and organizations throughout the planning process, as appropriate, and will continue coordinating closely with cooperating agencies.

5.3.1 Tribal Consultation

The Osage were invited to participate on a variety of issues related to the EIS, including mineral development and cultural concerns. Government-to-government consultation between the BIA and the Osage Nation has been ongoing since November of 2014 for the Osage County Oil and Gas EIS, but was initiated in September of 2013 while still part of the Oklahoma, Kansas, and Texas Joint EIS/ BLM RMP and BIA Integrated RMP. Consultation will continue through implementation of the decision.

5.3.2 Cooperating Agency Involvement

In March 2014, the BLM and BIA wrote to appropriate local, state, federal, and Tribal representatives, inviting them to participate as cooperating agencies for the OKT Joint EIS/BLM RMP/BIA Integrated RMP. At the time these invitations were sent, oil and gas leasing and development in Osage County was within the scope of the joint document.

After deciding to separate and accelerate the Osage County Oil and Gas EIS, the BIA sent separate written invitations to 7 eligible federal agencies, state and local governments, the Osage Nation, and the Osage Minerals Council to participate as cooperating agencies during the development of the EIS. These invitations were sent on January 2, 2015. Those who accepted cooperating agency status for this EIS are the following:

- EPA Region 6
- The Osage Minerals Council
- The Osage Nation
- The US Geological Survey

Cooperating agencies are engaged throughout the planning process, including participating in alternatives development and reviewing and commenting on draft sections of this Draft EIS. They were invited to attend all public meetings, as described in **Section 5.4.1**, Public Meetings. A briefing on the revisions required by the DOI Review Team was provided to the Osage Nation on November 7, 2018. On April 30, 2020, the Preliminary Final EIS and comments received during the Draft EIS Public Comment Period relevant to each Cooperating Agency's expertise were provided for review and comment.

5.3.3 National Historic Preservation Act Section 106 Consultation

The BIA is also engaging in NHPA Section 106 consultation with the SHPO and the Osage Nation THPO.

On January 15, 2015, the BIA notified by mail the Osage Nation THPO, Deputy SHPO, and the State Archeologist (at the Oklahoma Archeology Survey) of the EIS. This letter invited comment on the potential for historic properties and sensitive cultural properties that may be affected by planning decisions in the EIS.

In addition, on March 9, 2015, and at the suggestion of the SHPO, the BIA contacted Preservation Oklahoma, Inc., and the Osage County Historical Museum to notify them of the EIS and request information.

Consultation continued and information was requested throughout the development of the Draft EIS, including input on planning actions and alternatives and assessment of the potential effects. The BIA will continue consultation as needed through the completion of the EIS. In accordance with the NHPA, the BIA will make a determination of effect for the planning actions considered in the EIS and will notify the OAS, SHPO, and Osage Nation THPO for review.

5.3.4 Endangered Species Act Section 7 Consultation

To comply with Section 7(c) of the ESA, the BIA is conducting ESA Section 7 consultation with the USFWS through the development of a BA. The BIA submitted a BA to the USFWS in July 2017, and the USFWS issued a BO and letter of concurrence with the BIA's effects determinations in July 2018 (see **Appendix B**, Osage County Oil and Gas Biological Opinion and Biological Assessment).

5.4 Additional Public Involvement and Scoping

5.4.1 Public Meetings

In addition to the scoping meetings described in **Section 5.2**, Public Scoping, the BIA hosted additional public meetings to offer the public the opportunity to provide input throughout the EIS process.

As part of the 2015 Draft EIS, the BIA hosted a public listening session on March 9, 2015, at the Wah-Zha-Zhi Cultural Center (1449 W. Main, Pawhuska, Oklahoma). As part of the process to prepare a new EIS, the BIA held a second alternatives listening session on April 6, 2017, at the same location. The listening session began with a short presentation providing background information on the EIS process and additional detail on the COAs that were being considered under each alternative. Following the presentation, the BIA invited written comment and verbal input on the draft alternatives from members of the public.

The revised Draft EIS was released to the public for comment on November 22, 2019, initiating the formal 45-day public comment period; however, the fact that the comment period fell over the holiday season and the BIA received multiple requests for extension, the BIA extended the comment period to February 21, 2020. The BIA held a public comment session on the Draft EIS on December 12, 2019, at the Wah-Zha-Zhi Cultural Center in Pawhuska, Oklahoma.

5.4.2 Project Website and Email Address

The BIA maintains an interactive website to provide the public with the latest information about the EIS process (https://www.bia.gov/regional-offices/eastern-oklahoma/osage-agency/osage-oil-and-gas-eis). The website provides background information about the project, a public comment card, information on involvement opportunities, and copies of public information documents, such as the NOI and newsletter.

The BIA also created a project email address (osagecountyoilandgaseis@bia.gov) for the public to use to offer comments and subscribe to the project mailing list.

5.4.3 Mailing List

The BIA maintains a mailing list that includes individuals who attend public meetings, those who request to be on the mailing list, and relevant agencies and organizations, including those that were contacted for possible cooperating agency status. Requests to be added to or to remain on the mailing list will continue to be accepted throughout the EIS process.

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Appendix A
Reasonably Foreseeable Development Scenario

Reasonably Foreseeable Development Scenario

Osage County, Oklahoma

Photo by Nate Billings, The Oklahoman

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I. Summary

The subsurface mineral estate in Osage County, Oklahoma (“Osage Mineral Estate”) is held in trust by the United States for the benefit of the Osage Nation. Act of June 28, 1906, 34 Stat. 539, as amended. The planning area for the Osage County Oil and Gas Environmental Impact Statement (EIS) includes the entire Osage Mineral Estate, which is approximately 1,474,500 acres.

This Reasonably Foreseeable Development Scenario (“RFD”) for Osage County analyzes historical oil and gas well activity and prices to project drilling activity and surface disturbance in the planning area for the next 20 years (2018-2037). Oil and gas price data for Osage County is available through 2015. The data indicates that since 2011, there has been a decline in new well activity in Osage County, despite the fact that oil prices continued to rise through 2014. This decline roughly coincides with an increase in environmental protections resulting from the identification of endangered species habitat in Osage County, regulatory uncertainty, a rise in litigation relating to oil and gas operations, and a significant drop in oil prices nationwide. Other external factors may have also contributed to this decline. For these reasons, the RFD does not analyze the correlation between well activity and pricing beyond the year 2010.

Assuming that the oil and gas markets normalize and that external factors are neutral, it is reasonably foreseeable that 4,761 new wells could be drilled in Osage County between 2018 and 2037. With an estimated surface disturbance of 2 acres per well, the county can expect a gross disturbance of 9,522 acres during this time frame. Taking into account potential interim reclamation, the net surface disturbance is estimated to be approximately 3,571 acres.

Though Osage County has historically been dominated by oil fields, newer gas fields have provided a significant contribution to the county’s development. Historically, oil wells accounted for over 80 percent of the total wells drilled in Osage County, while gas wells made up less than 10 percent. Injection, disposal and service wells accounted for the remaining wells drilled. Since 2000, the number of gas wells drilled has increased due to the development of coal-bed methane and shale gas formations. Gas wells have accounted for 32 percent of the total wells drilled in Osage County from 2000 through 2016, while oil wells have accounted for just over 61 percent. Though not as dominant in recent years, oil wells remain the majority of new wells drilled as development continues in the same formations that have been major producers for the past century.

While activity has declined in Osage County, oil and gas resources remain in the ground and approximately 823,301 acres remain available for lease. Although recent drilling rates are below the anticipated RFD projection, operators continue to negotiate leases of the Osage Mineral Estate. It is expected that activity will gradually resume and approach the projected figures as commodity prices increase and regulatory processes become more efficient.

II. Introduction

A. Background

In July 2013, the Bureau of Land Management (BLM) issued a Notice of Intent to partner with the Bureau of Indian Affairs (BIA) in preparation of a joint Environmental Impact Statement for the Oklahoma, Kansas, and Texas planning area ("OKT Joint EIS"). When scoping for the OKT Joint EIS began, analysis of the Osage County oil and gas program was contemplated as part of the project. However, in response to issues raised during scoping, and at the request of the Osage Nation, in 2014, BIA decided to prepare the Osage County Oil and Gas EIS separate from the OKT Joint EIS, on an expedited basis.

In November 2015, the BIA published the Draft Osage County Oil and Gas EIS ("2015 DEIS"). Thereafter, the BIA determined that the 2015 DEIS needed to be re-scoped and revised to address public comments received and take additional information into consideration. The BIA reinitiated public scoping for the Osage County Oil and Gas EIS in April 2016. This RFD was prepared at the request of the BIA to provide analysis in support of the new Draft Osage County Oil and Gas EIS.

B. Purpose and Scope of the RFD

The RFD is a long-term, reasonable projection of anticipated oil and gas development and surface disturbance expected to occur on lands within the planning area over a specific period of time. These projections are technical approximations based on the best available information regarding geology and past and present development in the planning area. The RFD provides basic technical information that is used to perform a thorough environmental analysis of the direct, indirect, and cumulative effects that could reasonably be expected as a result of the Osage oil and gas program. The baseline information presented in the RFD will facilitate consideration of the potential effect of various management alternatives set forth in the Osage County Oil and Gas EIS.

Since the majority of the Osage Agency's oil and gas records have not been digitized, the primary source of historical well and producing formation data for the RFD analysis was the IHS Enerdeq (IHS) online oil and gas database. IHS provides a variety of information and analytics solutions across numerous industries, and is a well-known source for oil and gas information. The Osage Agency provided internally verified geographic information system (GIS) well location data, which was used to cross check and verify the IHS well data.

Prior to comparing the IHS and Osage Agency well data, both data sets were reviewed to identify and remove wells that were not actually drilled. As a result of this review, abandoned locations, canceled permits, and permitted wells lacking spud dates were removed from the IHS data. In addition, wells with the status indicating location only and that showed zero well depth were removed from the Osage Agency data. When comparing the two data sets, the numbers of total wells were within 1.6 percent of one another.

The number of oil wells and gas wells in the IHS and Osage Agency data sets was also similar, though an accurate comparison ratio could not be determined due to differences in the way each data set reports well status, particularly with respect to abandoned wells. Osage Agency data has a larger number of abandoned wells than IHS data. Further, the Osage Agency data has more abandoned wells that have not been segregated and identified as either oil or gas wells. This discrepancy between the two data sets does not affect the analysis and projections set forth in the RFD however. The similarity in well production types and small difference in the number of total wells between each data set provides confidence in the overall trends derived from the IHS data. Accordingly, it is reasonable to assume that if all abandoned wells were segregated, both oil wells and gas wells would correlate closely between the two data sets, as was the case with the total number of wells.

The well locations from each data set were then plotted to visually compare the distribution of wells across the county. The two maps showed very similar concentrations, which reinforced the confidence in the IHS data. The maps can be seen in Figure 10 and 11 in the Appendix. Some variation between the maps may be due to differences in the size of well location symbols and their order of overlay.

All price data used throughout the RFD was pulled from the U.S. Energy Information Administration (EIA) website. Annual historical data includes the Cushing, Oklahoma West Texas Intermediate (WTI) Spot Price Free On Board (FOB) and the Henry Hub Natural Gas Spot Price. FOB refers to the shipment of goods, in which the seller is responsible for the costs of transporting the goods to the port of shipment and loading. The buyer is responsible for costs from that point on. Both the WTI oil price and Henry Hub natural gas price are linked to the New York Mercantile Exchange, Inc. (NYMEX), the world's largest physical commodity futures exchange. Price projections for oil and natural gas came from EIA's, Annual Energy Outlook 2017.

III. Description of Geology

The Cherokee Basin or Cherokee Platform Province is located in the Mid-Continent region, stretching from southeastern Kansas and part of southwestern Missouri down into northeastern Oklahoma. The Province is 235 miles long by 210 miles wide, and consists of 37 counties with an area of 26,500 square miles (Charpentier et al., 1995). Osage County, which consists of 2,303.8 square miles, or roughly 1.5 million acres, lies in the lower half of the Province, located in northeastern Oklahoma. Figure 1 from the Oklahoma Geological Survey (Northcutt, Campbell, 1998) shows the location of Osage County within the state of Oklahoma and within the lower portion of the Cherokee Platform Province.

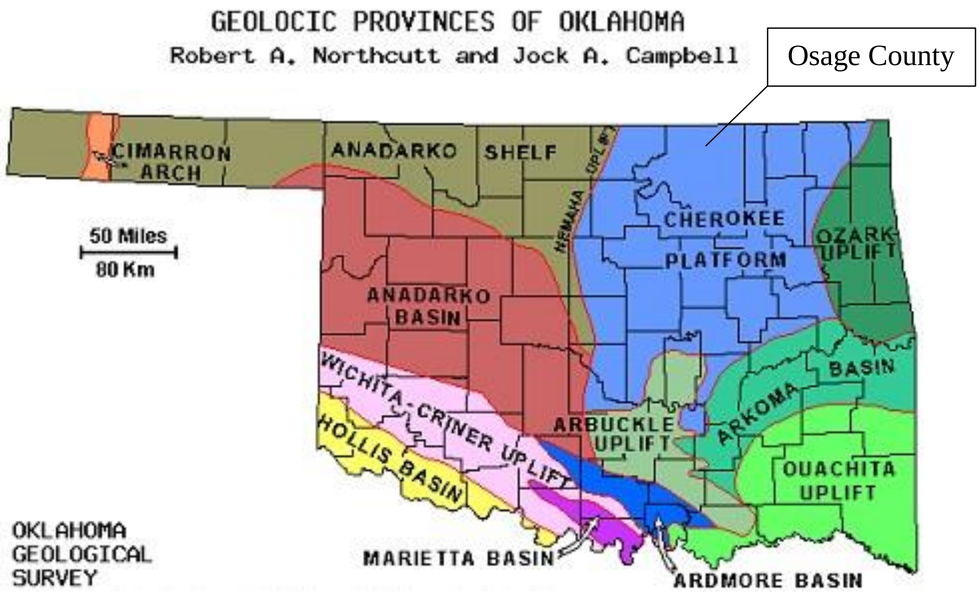


Figure 1. Map of Oklahoma Showing Oil and Gas Basins and County Outlines.

The United States Geological Survey (USGS) published an assessment of the Cherokee Platform Province Area in September 2015 (Drake II et al., 2015). Within that area, three total petroleum systems (TPS) were defined: Paleozoic Composite TPS, Woodford/Chattanooga TPS, and Desmoinesian Coal TPS. The Paleozoic Composite TPS contains conventional hydrocarbon resources and draws most of those hydrocarbons from the Woodford/Chattanooga Shale. Minor sources also include the Middle Ordovician shale and limestone, and Middle and Upper Pennsylvanian marine black shale. The Woodford/Chattanooga Shale TPS and Desmoinesian Coal TPS both contain continuous or unconventional resources.

Within the three TPS's the USGS identified four assessment units (AUs): Paleozoic Conventional AU, Woodford Biogenic AU, Woodford Shale Oil AU and Desmoinesian Coalbed Gas AU. All of Osage County lies within the Paleozoic Conventional and Woodford Shale Oil AUs. Other than a small portion in the northwest, the majority of Osage County falls within the Desmoinesian Coalbed Gas AU. The Woodford Biogenic AU lies east of the county, containing no Osage minerals. Figure 2, from the USGS Cherokee Platform Assessment, shows the AU boundaries relative to Osage County.

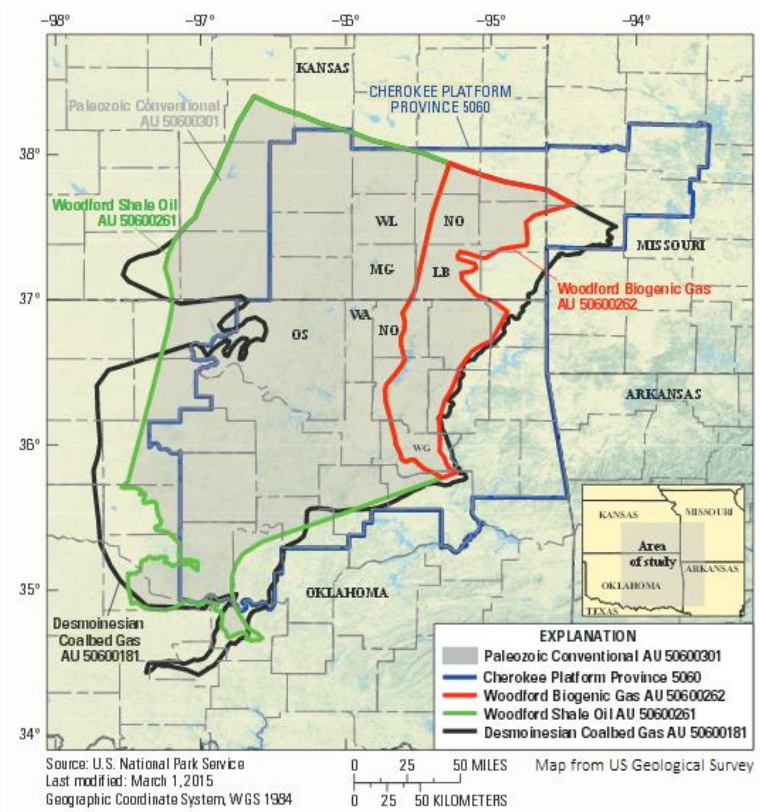


Figure 2. Location of the Cherokee Platform Province and the USGS Oil and Gas Assessment Unit Boundaries. Osage County is marked, OS.

The primary discussion for activity and development will focus on the Pennsylvanian, Mississippian and Ordovician systems. These systems represent geologic periods, which are subdivisions of the Paleozoic era. Systems are further subdivided into series. The Ordovician period dates from over 485 million years to over 440 million years ago (Cohen et al., 2017). From the Oklahoma Geological Survey's Stratigraphic Guide to Oklahoma Oil and Gas Reservoirs (stratigraphy chart), the system primarily contains sections of sandstone with thinner carbonate formations above and below (Boyd, 2008). The Arbuckle, a carbonate formation that sits at the very bottom of the Ordovician, has been the largest producing formation within that system for Osage County. Most of the formation is Ordovician, Canadian series, though the lower portion falls within the Croixan series of the Cambrian system.

The Mississippian and Pennsylvanian systems are within the Carboniferous period, beginning nearly 359 million years ago and lasting 60 million years (Cohen et al., 2017). The Mississippian system contains mostly carbonate formations as well as a couple of shales. The Mississippian formations, which include the Mississippian, Mississippian Lime, Mississippian Solid, Mississippian Chat, Mississippian Chert, and Chat fall within the Meramecian and Osagean series and have been among the most targeted and produced formations in the county. Though this is not a comprehensive list of all formations within the Mississippian system, for purposes of this RFD, this list will be referred to as the Mississippian formations.

The Pennsylvanian system sits above the Mississippian and consists of many alternating layers of sandstone, carbonate, shale and coal bed formations. Similar to the Mississippian, some of these formations have been among the most targeted and produced in the county throughout the last century. The most active of these formations lie within the Desmoinesian series and include the Bartlesville, Burbank and Wayside formations. The depths of these formations vary widely throughout Osage County.

A comparison of each well's drilled total depth (TD) to the formation at TD in the IHS well data indicated that the Arbuckle had depths ranging from nearly 1,700 feet to over 6,000 feet, with most TDs occurring in the 2,000 to 3,000 feet range. Mississippian system TDs varied from less than 1,000 feet to more than 8,000 feet, with most TDs falling between 1,000 and 3,000 feet. Pennsylvanian system TDs varied from the low hundreds to over 5,000 feet. Similar to the Mississippian system, most TDs in the Pennsylvanian system were between 1,000 and 3,000 feet.

IV. Past and Present Oil and Gas Exploration Activity

Osage County exploration began in the late 1890's, and major producing formations continued to be discovered through the first half of the twentieth century. The height of activity came in 1920 with 2,044 well spuds during the Burbank discovery. Drilling activity spiked again in 1956 with 1,586 well spuds. The last major spike occurred in 1980 when 1,116 wells were spudded. Over the years, exploration slowed as operator activity focused more on developing the county's proven formations.

Success rates in Osage County have been good historically and have improved over time. The historical success rate from the late 1890's through 2016 is approximately 78 percent. However, the success rate from 2000 through 2016 is over 95 percent. To calculate success rates, the number of wells intended to produce but listed in the IHS data as "drilled and abandoned," was subtracted from the total number of wells intended to produce, for the relevant time period. The resulting ratio of those wells to the total wells intended to produce was used to calculate a percentage of successful wells.

Relatively recent exploration of gas producing formations occurred primarily in the southern part of the county beginning in the mid-to-late 1990's. Most of these formations have been Pennsylvanian Desmoinesian coal beds producing methane gas. Notable formations include the Bluejacket, Dawson, Mulky, Iron Post, and Weir-Pittsburgh coal beds. The story is very similar for each of these formations in that activity began in the mid-to-late 1990's and increased during the 2000's until natural gas prices fell in 2008. There has been little to no new activity in any of these formations since.

One notable non-coal bed target has been the Nuyaka Creek black shale bed. The Nuyaka is also a gas producing formation, often produced along with the coal beds discussed above. It is also within the Pennsylvanian system, just above the Desmoinesian series in the Missourian series. Nuyaka activity began in 2004 and increased over the next few years until 2008 when natural gas prices fell. There has been no new activity in the shale formation since.

The most recent significant development in Oklahoma has been the Woodford Shale play. Though the Woodford Shale was first produced in 1939 in southeast Oklahoma, historically, it was a very rarely targeted formation (Vulgamore et al., 2007). New completion techniques and increased gas prices in the early 2000's made the Woodford Shale a much more attractive play. While the Woodford has been a major gas play in other parts of Oklahoma, it also produces oil depending on location. This can be seen in neighboring counties to the southwest. The thermal maturity of the Woodford under Osage County makes it more suited for producing oil than gas. Unfortunately, Osage County is located in an area where the Woodford is thin and lacks necessary biogenic silica. The silica makes the shale brittle and creates natural fractures crucial for oil extraction (Cardot, 2015). As a result, there has been very little Woodford exploration in the county.

V. Past and Present Oil and Gas Development Activity

A. Leasing Activity and Spacing

Currently, according to Osage Agency data, approximately 651,199 acres are leased for oil and/or gas development, or otherwise held by concession agreements, with 823,301 acres still available for leasing. The BIA does not have specific spacing orders in Osage County. However, pursuant to 25 C.F.R. § 226.33, drilling is not permitted within 300 feet of the lease boundary, and no wells or tanks can be sited within 200 feet of a public highway, established watering place, or any building used as a dwelling, granary or barn, except with written permission of the Osage Agency Superintendent.

B. Concession Agreements

Through the years, the Osage Tribal Council, and later the Osage Minerals Council, entered into a number of oil and gas concession agreements. These written agreements provide exclusive rights for a company to conduct exploration and development activities including geophysical surveys, leasing, and drilling within the designated concession area for the life of the agreement. The terms and conditions in concession agreements were previously negotiated by the Osage Tribal Council and are currently negotiated by the Osage Minerals Council, which may amend and modify all existing concession agreements and grant extensions of the original terms thereof. There are presently six active concession agreements in Osage County. Due to multiple extensions of the original terms, these six concession agreements have been in effect for an average of 13 years. The net effect of these agreements is a significant reduction in the acreage available for leasing through open competition among oil and gas operators. As seen in Figure 9 in the Appendix, Osage Agency data indicates that the six active concession agreements cover approximately half of Osage County's total acreage.

C. Drilling Activity by Well Type

Based on IHS data, between the late 1890's and 2016, over 42,000 wells have been drilled and completed in Osage County. Drilling activity was divided into three separate categories for the purpose of analysis and discussion in the RFD: (1) well type; (2) producing formations; and (3) hole direction. To facilitate this analysis, the wells were plotted on separate county maps for each of these three categories. These maps are included in the Appendix and will be referenced in the following discussion.

Well types were divided into wells reported as oil wells, gas wells, both oil and gas wells, injection/disposal/service (IDS) wells, abandoned wells and unknown/unreported wells. Oil wells dominate the county accounting for over 62 percent of all drilled wells. Gas wells account for just over 7 percent, and IDS wells for 6.5 percent. These percentages do not include abandoned wells, which were not divided by original well type for the purpose of this section, or unknown/unreported wells, for which information regarding original well type is not available.

To account for the well type distribution within the abandoned and unknown/unreported wells groups, the ratios of oil, gas, and IDS wells listed above were applied to the total numbers of abandoned and unknown/unreported wells. With the addition of abandoned and unknown/unreported wells to the calculation of total well type distribution in Osage County, oil wells account for nearly 82 percent of all wells drilled, gas wells for over 9 percent, and IDS wells for approximately 8.5 percent. Wells listed as both oil and gas accounted for less than half a percent of the total wells.

Figure 10 in the Appendix shows a map of all wells drilled in the county by well type. The geographical distribution shows the historical dominance of oil focused activity throughout the county. The high concentration of IDS wells in the northwest is mainly due to injection wells being used to flood the Burbank formation as part of secondary and enhanced oil recovery (EOR) projects. Phillips Petroleum Corp. used water injection wells in the late 1950's, and Chaparral Energy, Inc. began using CO_2 injection wells in 2013 to recover additional oil trapped in the ground (Wilmoth, 2013).

Focusing on recent activity, though the majority of new wells drilled in Osage County are oil wells, the ratio of new oil wells to total wells drilled has dropped. Oil wells make up just over 61 percent of all wells drilled since 2000, while gas wells have increased to over 32 percent and IDS wells account for less than 6 percent. The higher number of new gas wells is likely due to an increase in natural gas prices between 2000 and 2008, and exploration and development of the coal-bed methane (CBM) and shale gas formations previously discussed. It should be noted that while there was a decline in the number of new oil wells drilled in Osage County beginning in 2010, oil prices remained high into 2014. Accordingly, it is possible that in the absence of the external factors that influenced drilling during that time, oil wells would account for a higher percentage of wells drilled. Figures 3 and 4 show the trends of new drilling activity in relation to commodity prices.

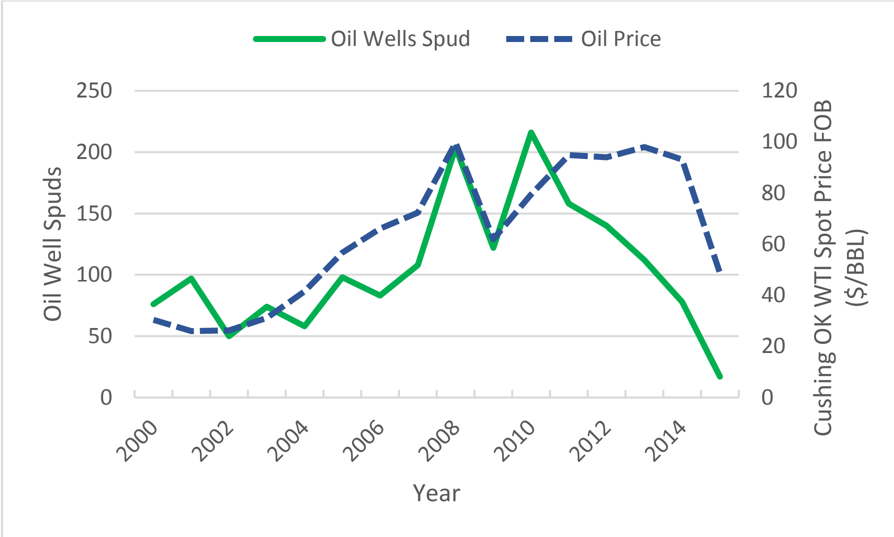


Figure 3. Oil Well Spuds compared to WTI Oil Price from 2000 through 2015.

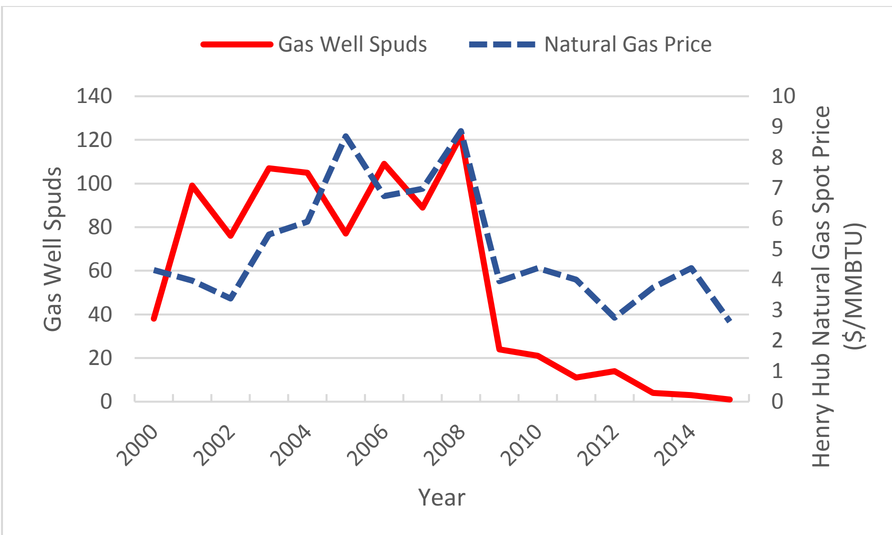


Figure 4. Gas Well Spuds compared to Henry Hub Natural Gas Price from 2000 through 2015.

D. Drilling Activity by Formation

Consistent with well type data, producing formations in Osage County have historically been primarily oil producing. The ranking of formations varies whether looking at production zone or initial production (IP) formation data. These two categories were pulled from two different data reports within the IHS database, and while both are valuable, there is significantly more data available for IP formation. Therefore, the RFD relies primarily on IP formation to assess formation activity. Regardless of the exact rank, the same formations are among the top of the lists in both reports.

The most targeted formations have clearly been Pennsylvanian, Desmoinesian sandstones, and Mississippian, Meramecian and Osagean carbonates. The Bartlesville has been by far the most targeted formation in Osage County with over 3.5 times the activity of the next most active Pennsylvanian formation, the Burbank, and over 1.5 times the Mississippian formations combined. The Mississippian Chert, listed second to the Bartlesville, has been the most targeted Mississippian formation.

Figure 12 in the Appendix shows a map of well spuds for the top five formations in terms of initial production formation. Though the lithology, reservoir characteristics and trapping mechanisms for each Mississippian formation may differ, they have been grouped together for simplicity. The stratigraphy chart referenced in this RFD groups them together as well. While IP formation data was not available for all wells, the map effectively shows the bigger picture development trend for the most targeted formations as well as the dominance of those formations in different parts of Osage County. While activity in the Bartlesville and Mississippian formations has been spread out over large areas of the county, the Burbank has a much tighter, denser concentration of activity.

Though Pennsylvanian and Mississippian wells have been drilled throughout the county, many have been concentrated in a couple of major fields. The Burbank and the Domes-Pond Creek fields have each had more than three times the activity of any other fields in the county. The Burbank field, located in the northwestern quarter of the county, has been a major field for the Burbank formation, as the name would suggest. The Domes-Creek field in the northeast has been a productive area for the Bartlesville and Mississippian formations in particular.

Many of the county's most targeted formations historically have remained heavily targeted in recent years. From IP formation data, the top five remain Pennsylvanian and Mississippian formations. While there is more variation in formation rankings between production zone and IP formation data after 2000, looking at the top 10 to 15 formations on each list, there is a consistent trend in the overall recent development. As with well type, higher gas prices and new gas exploration had a significant impact on the development picture in Osage County.

CBM and shale development made the Osage City field the most active field in Osage County since 2000. The Osage City field is located on the southeastern edge of the county. Further demonstrating the recent significance of gas production, both the Arbuckle and Bartlesville, traditionally more focused on oil production, have shown much higher ratios of gas wells to total wells since 2000. While the CBM and shale formations have played a vital role in the county's oil and gas development, they have not eclipsed the dominance of the top Pennsylvanian and Mississippian oil formations that have continued to produce over the course of the last century.

E. Drilling Activity by Hole Direction

Horizontal and directional wells are typically used to reach minerals where the surface above is inaccessible, in order to reduce the surface footprint while developing a larger producible area, or to take advantage of geological features such as natural fractures and faults. Horizontal and directional drilling methods did not gain prominence until the early to mid-2000's, although such methods existed well before that time. As would be expected due to the age of the oil fields in Osage County, vertical wells make up the vast majority of wells drilled in the county. Figure 13 in the Appendix shows a map of wells in Osage County represented by drilled hole direction.

Looking more recently, from 2000 through 2016, vertical wells account for the majority of the 2,753 new well spuds. Over 91 percent of wells spudded since 2000 have been vertical, with just over 7 percent horizontal, and just under 1.4 percent directional. Potential reasons for the low numbers of horizontal wells include lack of available unconventional resource plays, and higher drilling and completion costs for horizontal wells.

The Woodford Shale is an example of a popular unconventional resource play in other parts of Oklahoma, where horizontal drilling has been an economic way of exploiting that resource. Noble County is a neighboring county to the southwest where the Woodford is thicker, making it more producible, and horizontal drilling has been used almost exclusively to develop it. Since 2000, 77 of 79 Noble County Woodford wells have been horizontal. As discussed in Section IV, geologic conditions in Osage County make it very difficult to produce the Woodford and provide little incentive to drill horizontal wells.

Horizontal wells in Osage County have typically targeted the Mississippian formations, followed by shale gas and CBM formations. According to the Osage Agency, horizontal wells in Osage County have had little success. As reported by Osage News, two large operators, Encana Corporation and Chaparral Energy, LLC, shut down their expensive horizontal well operations in Osage County due to poor returns. The article further noted that drilling and completion of horizontal wells can cost up to $2.8 million (Shaw Duty, 2013).

A 2012 drilling program presentation by Constellation Energy Partners estimated their vertical wells targeting Pennsylvanian and Mississippian formations in the Cherokee Basin would cost between $175,000 and $375,000 each (Constellation, 2012). Given these dollar figures, horizontal well costs could be up to 16 times the vertical well costs. Vertical wells have proven capable of producing Osage minerals for more than a century. Accordingly, the high drilling costs associated with horizontal wells, when coupled with the low success rates of such wells in Osage County, provide little incentive for new horizontal drilling operations absent future discoveries, technological advancements, or other catalysts.

F. Production

Analyzing production for Osage County is difficult due to the lack of data in a useable digital format. In addition, production is reported by lease rather than by well in Osage County, making it impractical to generate well or formation specific decline curves. If a decline curve could be generated, it would be difficult to know how representative of the field it was. For these reasons, it is not practical to calculate estimated ultimate recoveries for the various targeted formations. The Osage Agency did have countywide useable monthly data from 2007 through 2015 for oil, and from 2007 through March 2016 for gas and natural gas liquids. That data is plotted below in Figure 5.

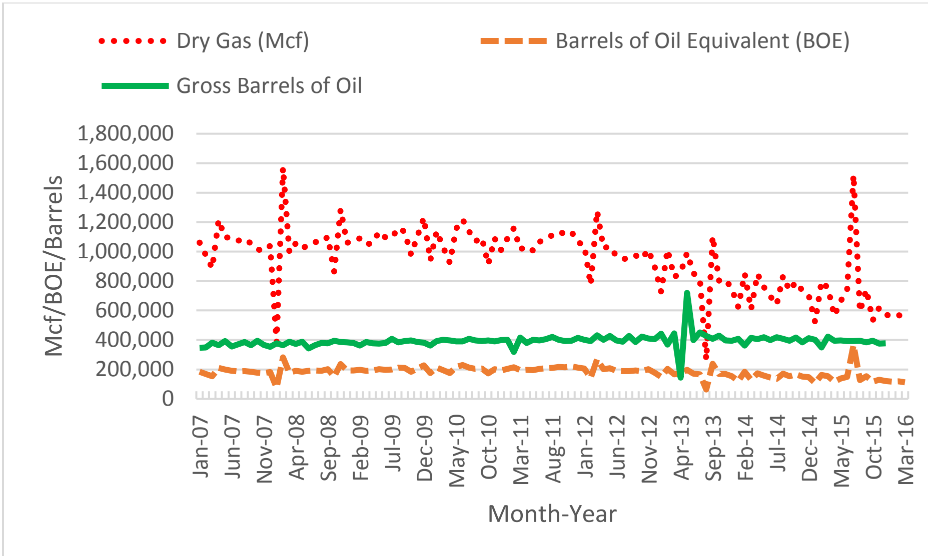


Figure 5. Monthly Production for Oil and Gas in Osage County.

Oil production has remained consistent through 2015, staying close to 400,000 barrels per month despite the drop off in new activity since 2010. Dry gas production has been in a downtrend since 2010, falling from a peak of over 1,000,000 Mcf per month to less than 600,000 Mcf per month. This trend is expected given the fall in natural gas price in 2008. A conversion to barrels of oil equivalent (BOE) is a way to combine more than one product type (e.g. oil, gas and natural gas liquids) into one equivalent measurement. In Figure 5, BOE is representative of dry gas combined with natural gas liquids. This is in a downtrend as well since late 2012, falling from around 200,000 BOE per month to less than 125,000 BOE per month. The large fluctuation spikes may be due to reporting discrepancies and subsequent corrections.

G. Infrastructure

With the long history of development in Osage County, there is an existing network of oil and gas pipelines and infrastructure. Today, virtually all oil purchased in Osage County is transported by truck to nearby Oklahoma and Kansas refineries or to pipeline facilities located within the county. In light of Osage County's proximity to major oil refineries, lack of transport capability is not expected to be an obstacle to future oil development. Osage County gas infrastructure is more complicated however.

While there are existing gas pipelines in Osage County, as seen in Figure 14 of the Appendix, much of this infrastructure is currently owned by one operator. Osage County gas producers and the Osage Minerals Council have expressed concern that the existing gas pipeline infrastructure is insufficient and that producers have experienced difficulty negotiating contracts with pipeline operators due to the small number of such operators present in Osage County, prohibitive infrastructure costs, and low production volumes, among other things. Despite these longstanding issues, gas development in Osage County has continued to increase over time. Accordingly, since this RFD does not project that future development will exceed historical levels, these issues are not expected to pose a significant barrier to future development.

VI. Oil and Gas Occurrence and Development Potential

Occurrence potential is the potential for oil and gas resources to be present in a certain area. Development potential is the potential for economic development of those resources. To demonstrate the difference, oil and gas may exist in an area where, due to various economic and/or geologic factors, the resources are not recoverable. If this were the case, occurrence potential may be high while development potential would be low. Development potential can change over time with the advent of new technology and increased commodity prices. Owing to extensive oil and gas exploration and development over the past century, occurrence and development potential in Osage County are well known and highly correlated. Therefore, this section will focus solely on development potential.

The BLM Oklahoma Field Office prepared a RFD for all of Oklahoma, Kansas, and Texas ("OKT RFD") as part of the OKT Joint EIS discussed in Section II.A. (Stong, 2015). In the OKT RFD, the BLM classified areas throughout the three states based on their oil and gas development potential. The methodology used to classify the different levels of potential was as follows: identify and map all wells drilled in the planning area, select wells that have been tested or have produced, select wells currently producing, and establish buffer areas around the selected wells, identifying them either as "hydrocarbon potential emplacement footprint" or "currently producing." Areas were then classified in a range from "no potential" to "high potential" based on where they fell in relation to the wells and their buffer areas.

Figure 15 in the Appendix, taken from the OKT RFD, shows a map of oil and gas development potential in Oklahoma, Kansas and Texas. Looking specifically at Osage County, the entire county is within the "moderate potential" to "high potential" range, with most of the county in the "high potential" range. A band stretching vertically through the middle of the county represents "moderate to high potential." "Moderate potential" has some scattered sections with the highest concentration in the northwest. However, much of that northwest "moderate potential" area is held by concession agreement or heavily populated by Burbank IDS wells.

Minerals in the northwest may have more potential than previously realized. According to an online article on Oil & Gas 360, Petro River Oil Company, a publicly traded oil company, has plans to continue drilling in Osage County (Enercom, 2016). The company has conducted 3D seismic analysis, which it believes shows abundant oil potential in the Pennsylvanian and Mississippian systems in the northwestern part of the county. There are currently plans to drill four initial wells with a potential 60-well conventional drilling program to follow. There are also plans to permit additional acreage for further seismic testing. Petro River estimates around 2.8 million barrels of oil could be recovered from the targeted formations.

As the previous example shows, there are resources remaining in the ground and companies willing to extract those resources. Horizontal wells may not have much current potential in Osage County, but cheaper conventional plays are still available. The county will likely see continued development in its existing major producing formations, as well as the newer CBM and shale gas formations.

VII. RFD Baseline Scenario

The RFD baseline scenario assumes all potentially productive areas in Osage County are open under standard lease terms and conditions, except those areas designated as closed to leasing by law, regulation, or executive order. According to the Osage Agency, no areas are currently closed to leasing, and approximately 823,301 acres are available for new leasing. For the RFD, commodity prices and well spud activity were analyzed from 2000 to 2010. As previously noted, the RFD does not analyze the correlation between well activity and pricing beyond the year 2010 due to the known divergence between well activity and pricing from 2011-2014. That divergence can be seen in Figure 3, which shows that the overall oil well spud trend follows oil price until 2010, when it declines.

The RFD also assumes the Osage County Oil and Gas EIS will be completed and ready to implement by the beginning of 2018, and furthermore, that operators will increase activity following implementation. Delayed implementation of the EIS, depressed commodity prices, or other negative external forces have the potential to result in less well spuds than this scenario projects.

It is difficult to say how factors such as technological and political developments will shape future oil and gas activity. Price, however, has been a fairly consistent indicator of activity in the past and is assumed to continue to be an indicator over the next 20 years. The activity projections in this RFD cover a 20-year period from 2018 through 2037. Figures 6 and 7 plot IHS-reported oil and gas well spuds versus commodity price data between 2000 and 2010. The data plotted was used to generate a linear trend-line, which provided a slope equation that could then be used to estimate future well spuds based on future price estimates. Oil wells and gas wells were plotted separately to more accurately evaluate activity based on the associated commodity prices. Wells listed as both "oil and gas" were categorized by assigning the most commonly produced commodity from the listed target formation.

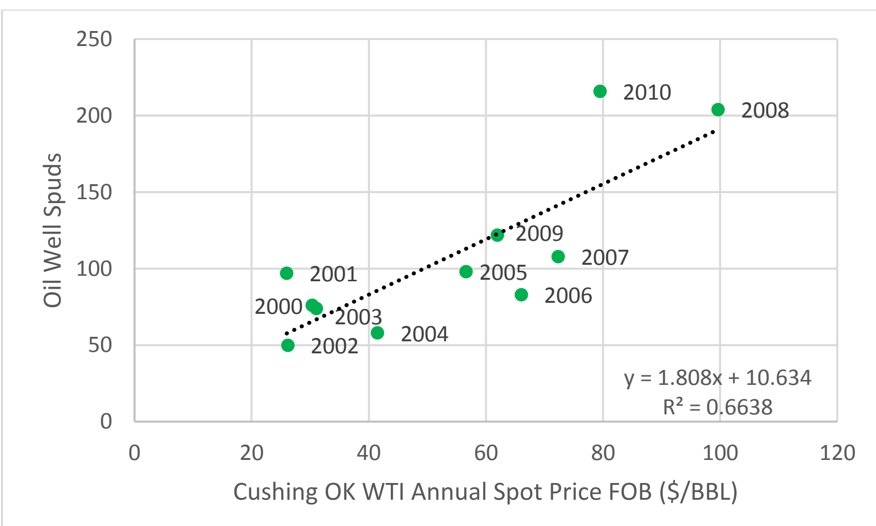


Figure 6. Oil Well Spuds versus WTI Oil Price from 2000 through 2010.

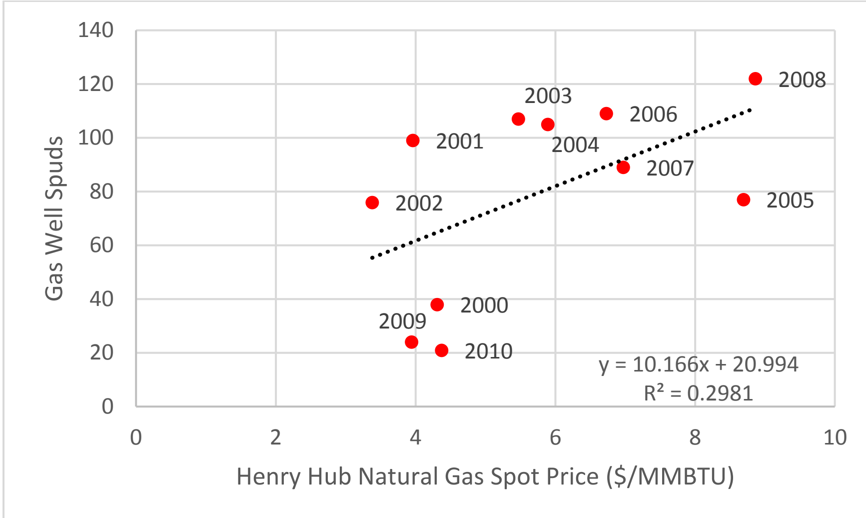


Figure 7. Gas Well Spuds versus Henry Hub Natural Gas Price from 2000 through 2010.

Figure 8 shows oil and gas well-spud projections compared to actual spuds beginning in 2000. Though well spuds for 2017 were not included in the final cumulative projections, they are shown in the graph for continuity. Actual future well spuds will likely deviate from the graphed projections below. There may be more spuds than projected in some years, and less than projected in other years. The potential well spuds are based on current EIA reference or baseline price projections. Future projections will vary with the development of new techniques and technology, and changes in the national and global political climates. Actual well spuds may vary based on a variety of factors. The goal is to provide an overall estimate of new activity over several years.

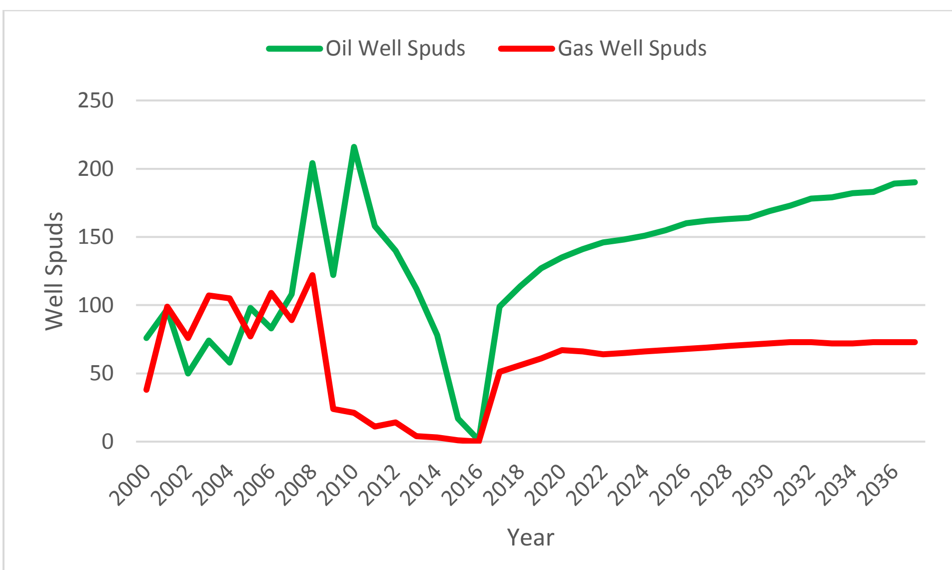


Figure 8. Actual Past and Potential Future Oil and Gas Well Spuds.

The potential new oil and gas well spuds between 2018 and 2037 are estimated to be 3,208 oil wells and 1,369 gas wells for a total of 4,577 producing wells. IDS wells made up about 4 percent of the total wells drilled from 2000 through 2010. Though new IDS well activity may not directly correlate with new well spuds, it is reasonable to assume new well activity would increase production and lead to further potential need for IDS wells. All IDS well types were grouped together for simplicity since they account for a small fraction of overall activity. However, the amount was large enough to justify its inclusion in an overall well count. Therefore, the percentage of IDS well spuds to total well spuds was used to calculate a future estimate of 184 IDS well spuds. This brought the total number of projected well spuds to 4,761 wells. Table 1 summarizes the results for projected well spuds.

Table 1. Potential Well Spuds in Osage County between 2018 and 2037.

Oil Wells	Gas Wells	IDS Wells	Total Wells
3,208	1,369	184	4,761

VIII. Surface Disturbance Due to Oil and Gas Activity

It is extremely difficult to estimate the current surface disturbance in Osage County given the limited data available. For many years the Osage Tribal Council, and later the Osage Minerals Council, considered every wellbore an asset, advancing a policy of leaving orphaned and abandoned wells unplugged with the expectation that they may later be returned to production. Accordingly, there are many wells in Osage County that have not been plugged, nor have all of the well sites and brine scars been reclaimed. Formal records regarding historical reclamation activity in Osage County are not available. In addition, oil and gas exploration in Osage County began before 1900, prior to the enactment of modern environmental laws and regulations.

The current regulations governing oil and gas development of the Osage Mineral Estate do not allow well pad disturbance to exceed 1.5 acres unless authorized by the Superintendent. *See* 25 C.F.R. § 226.19(b). With the inclusion of roads and other infrastructure, the Osage Agency estimates 2 acres of total gross surface disturbance per well. While the regulations have allowed only 1.5 acres of well pad disturbance for over the past 75 years, accurate historical data regarding gross surface disturbance is limited. It is, however, possible to provide a reasonable estimate of the future surface disturbance, given the current regulations and the projected well spuds estimate.

Applying 2 acres of disturbance for 4,761 wells, the gross surface disturbance totals 9,522 acres. With gross disturbance determined, interim surface reclamation was considered to estimate the net surface disturbance. Final reclamation was not factored in because it is not required in Osage County until all production on a lease has ceased, rather than after each individual well is plugged. According to the Osage Agency, though their regulations do not specify a set acreage or time frame for completion, interim reclamation is now a common practice in the county. The agency estimates, based on field observation, that an average of 1.25 acres are reclaimed per well. Subtracting the reclaimed acreage from the gross disturbance provides a net long term surface disturbance of approximately 3,571 acres. Table 2 summarizes the results for potential gross and net surface disturbance.

Table 2. Potential gross and net surface disturbance for total potential well spuds in Osage County between 2018 and 2037.

Total Wells	Gross Surface Disturbance (acres)	Net Surface Disturbance (acres)
4,761	9,522	3,571

IX. Conclusion

This RFD is limited to providing oil and gas development projections for the Osage Mineral Estate. These projections are based on the best available data and information; however actual future activity may vary based on any number of factors. Additional analysis regarding surface disturbance and the potential impacts associated with development is provided in the Osage County Oil and Gas EIS.

X. References

Boyd, Dan T. (2008). Oklahoma Geological Survey Stratigraphic Guide to Oklahoma Oil and Gas Reservoirs. Retrieved from http://www.ogs.ou.edu/fossilfuels/pdf/StratChartfr.pdf

Cardot, Brian J. (2015, November 5). Woodford Shale Thermal Anomaly in Osage County, Oklahoma. *Oklahoma Geological Survey Presentation for Osage Oil & Gas Summit*.

Charpentier, Ronald R., Rice, Dudley D., Finn, Tom (1995). Cherokee Platform Province. Retrieved from https://certmapper.cr.usgs.gov/data/noga95/prov60/text/prov60.pdf

Cohen, K.M., Harper, D.A.T., Gibbard, P.L., (2017, February; updated) The International Commission on Statigraphy International Chronostratigraphic Chart. Retrieved from http://www.stratigraphy.org/ICSchart/ChronostratChart2017-02.pdf

Constellation Energy Partners LLC (2012, July). 2012 Drilling Update.

Cuzella, Jerome., Lloyd, Ron., McLean, Janelle., Frazier, Fionna., Knight, Roger. (2016, November). Draft Osage Mineral Assessment. Prepared by Division of Energy and Mineral Development.

Drake II, Ronald M., Hatch, Joseph R., Schenk, Christopher J., Charpentier, Ronald R., Klett, Timothy R., Le, Phuong A., Leathers, Heidi M., Brownfield, Michael E., Gaswirth, Stephanie B., Marra, Kristen R., Pitman, Janet K., Potter, Christopher J., and Tennyson, Marilyn E. (2015). Assessment of Undiscovered Oil and Gas Resources in the Cherokee Platform Province Area of Kansas, Oklahoma, and Missouri, 2015. U.S. Geological Survey Fact Sheet 2015-3054. Retrieved from https://pubs.usgs.gov/fs/2015/3054/fs20153054.pdf

Enercom, (2016, December 15). Oklahoma's Osage Nation wants Oil & Gas Development to Hit the Accelerator-Now. *Oil & Gas 360.* Retrieved from http://www.oilandgas360.com/oklahomas-osage-nation-wants-oil-gas-development-to-hit-the-accelerator-now/

IHS Enerdeq Browser. (2017, March). *Osage County Well and Production Data.* Retrieved from IHS Website https://my.ihs.com/Energy/Products

Northcutt, Robert A., Campbell, Jock A. (1998). Geologic Provinces of Oklahoma. Hogan, John P., Gilbert, M.C. (Ed.). *Basement Techtonics 12.* (Vol 6 pp.29-37). Kluwer Academic Publishers. Retrieved from https://www.sec.gov/Archives/edgar/data/1514994/000109690612000417/ex99-1.htm

National Pipeline Mapping System Public Viewer. Map of Osage County Oil and Gas Pipelines. Retrieved May 2017 from https://pvnpms.phmsa.dot.gov/PublicCiewer/

Shaw Duty, Shannon (2013, July 25). Horizontal wells too costly for two companies in Osage County. *Osage News*. Retrieved from http://osagenews.org/en/article/2013/07/25/horizontal-wells-too-costly-two-companies-osage-county/

Stong, Patrick (2015, December 28). *Reasonable Foreseeable Development Scenario Kansas Oklahoma, & Texas.* Bureau of Land Management Oklahoma Field Office prepared Document.

U.S. Energy Information Administration. (2017). Annual Historical Cushing, OK WTI Spot Price FOB. Retrieved March 2017 from https://www.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=pet&s=rwtc&f=a. Annual Historical Henry Hub Natural Gas Spot Price. Retrieved March 2017 from https://www.eia.gov/dnav/ng/hist/rngwhhdA.htm. Annual Energy Outlook 2017. Retrieved March 2017 from https://www.eia.gov/outlooks/aeo/data/browser/#/?id=1-AEO2017&region=0-0&cases=ref2017~ref_no_cpp&start=2015&end=2035&f=A&linechart=~~~~~~ref2017-d120816a.44-1-AEO2017~ref2017-d120816a.42-1-AEO2017&ctype=linechart&sid=~&sourcekey=0

Vulgamore, Travis B., Clawson, Timothy D., Pope, Charles D., Wolhart, Stephen L., Mayerhofer, Michael J., Machovoe, Sean R., Waltman, Charles K. (2007). Applying Hydraulic Fracture Diagnostics to Optimize Stimulations in the Woodford Shale. Society of Petroleum Engineers. https://doi.org/10.2118/110029-MS. *Paper presented at SPE Annual Technical Conference and Exhibition*. 11-14 November, Anaheim, CA.

Wilmoth, Adam (2013, June 25). Back to the Future: Chaparral hopes to recover 77 million barrels of oil from one of Oklahoma’s oldest oil fields. *NewsOK*. Retrieved from http://newsok.com/article/3855899

XI. Appendix

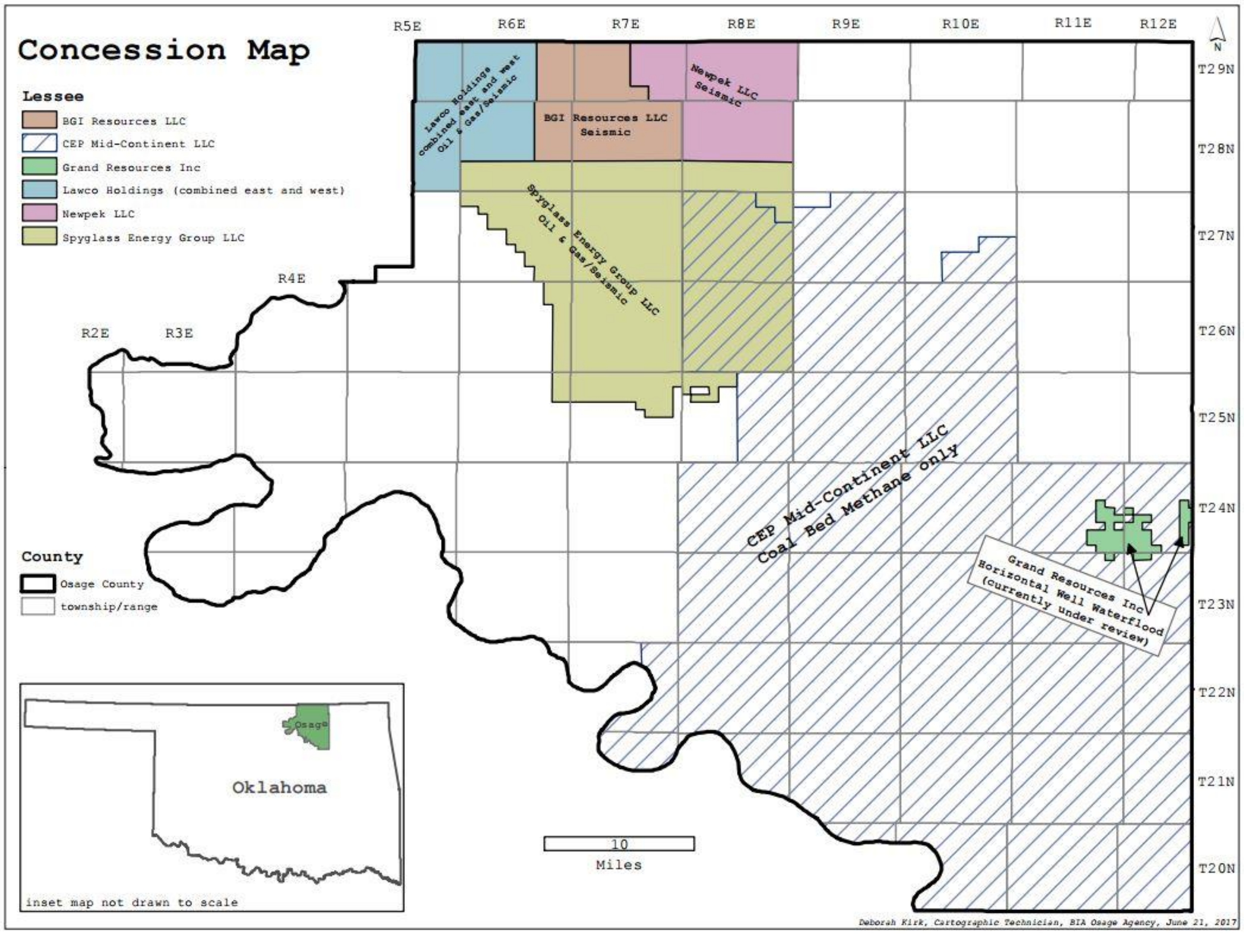


Figure 9. Map of Osage County Concession Agreements. Map courtesy of the BIA Osage Agency.

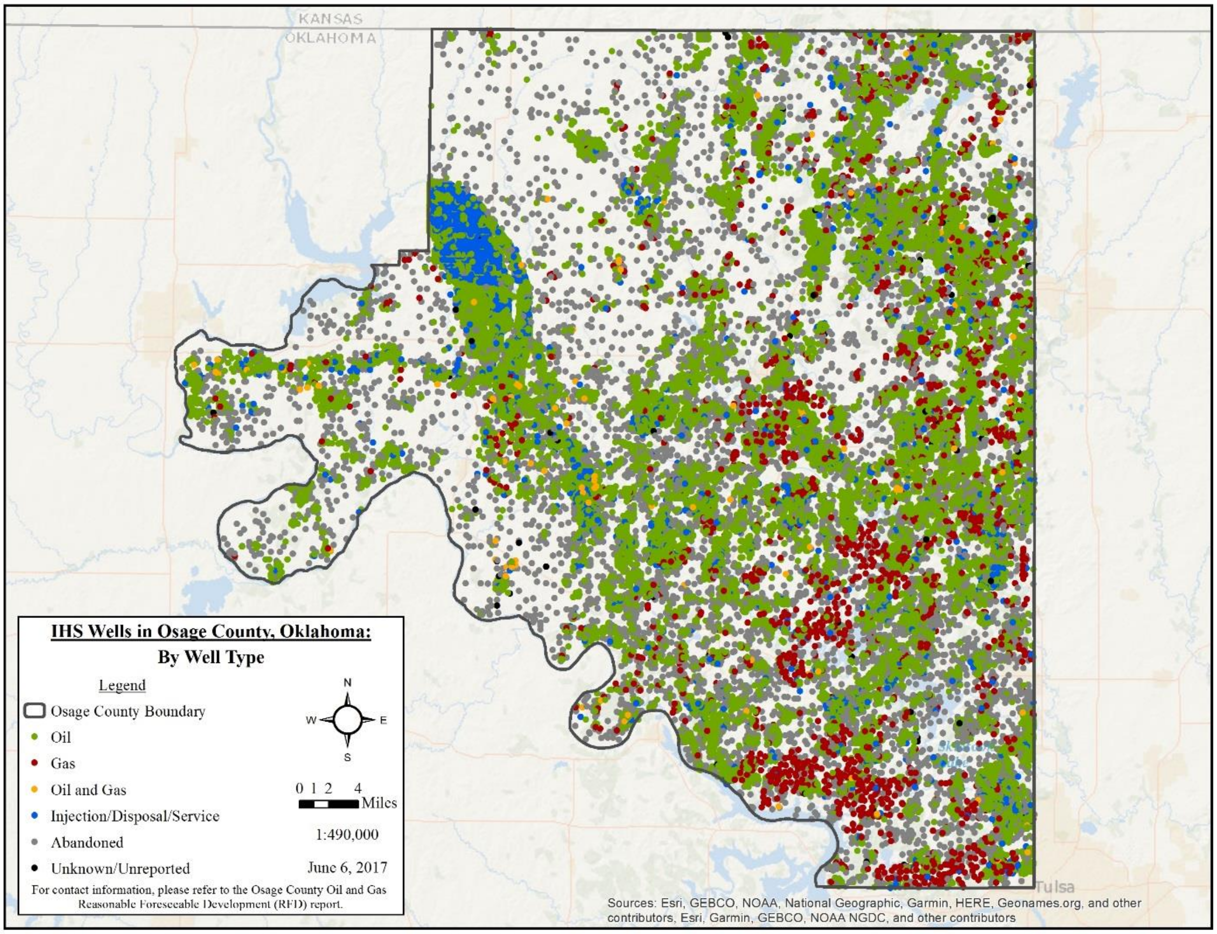


Figure 10. Map of Osage County Wells by Well Type (Oil, Gas, Oil and Gas, Injection/Disposal/Service, Abandoned, Unknown/Unreported). Map courtesy of the Bureau of Land Management (BLM) National Operations Center (NOC).

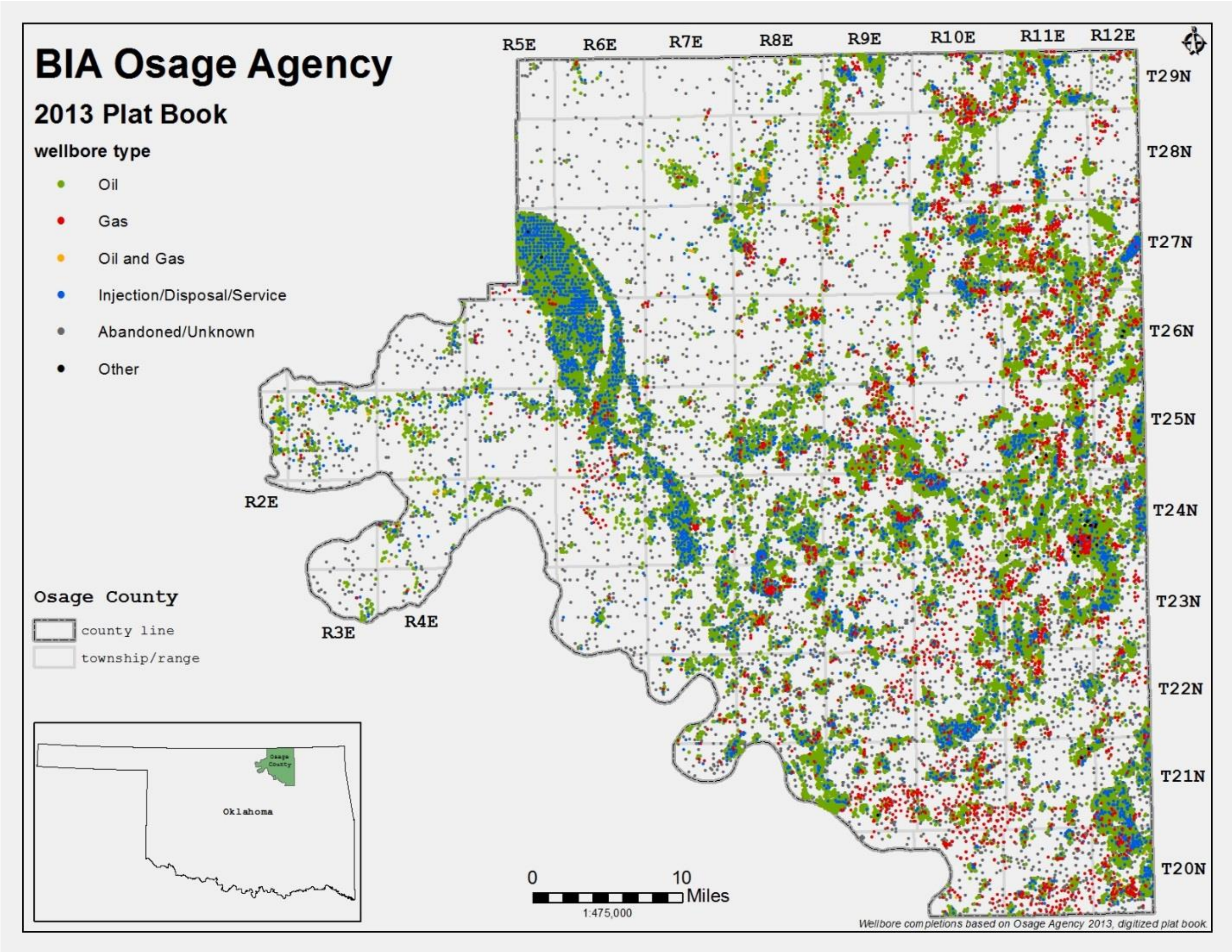


Figure 11. Map of Osage County Wells by Well Type According to BIA Osage Agency Data. Map courtesy of the BIA Osage Agency.

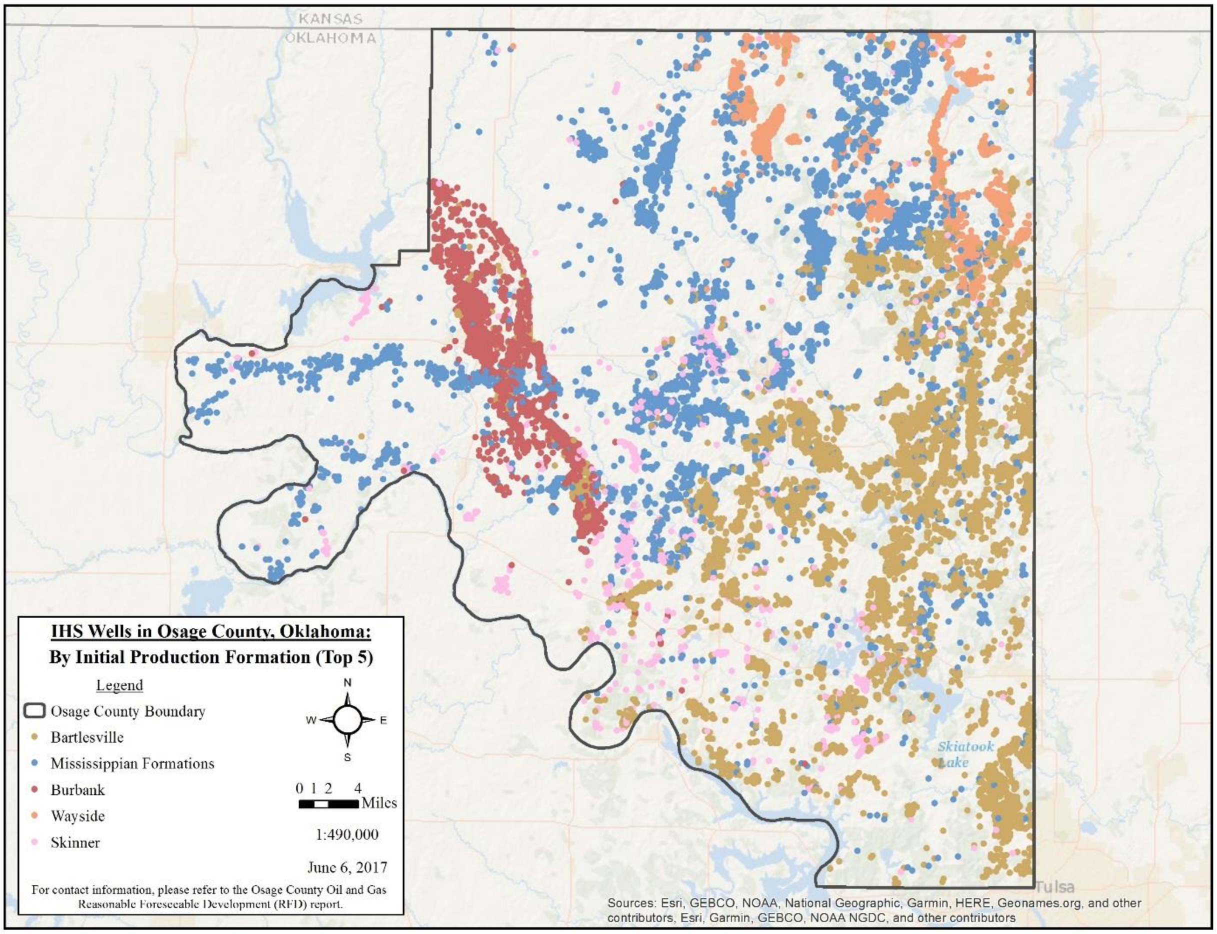


Figure 12. Map of Osage County Wells by Top 5 Initial Production Formation Activity (Bartlesville, Mississippian Formations, Burbank, Wayside, Skinner). Map courtesy of the BLM NOC.

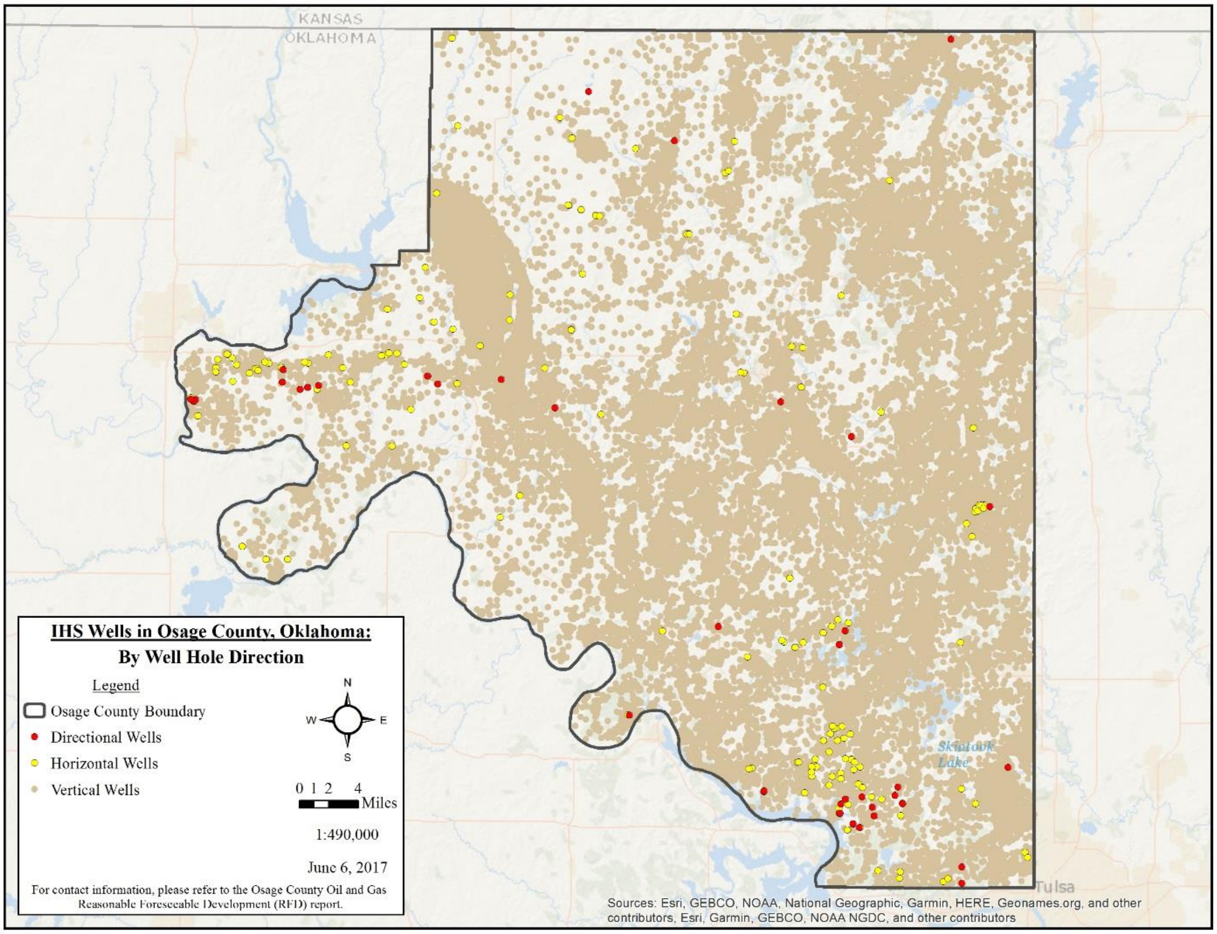


Figure 13. Map of Osage County Wells by Hole Direction (Vertical, Horizontal, Directional). Map courtesy of the BLM NOC.

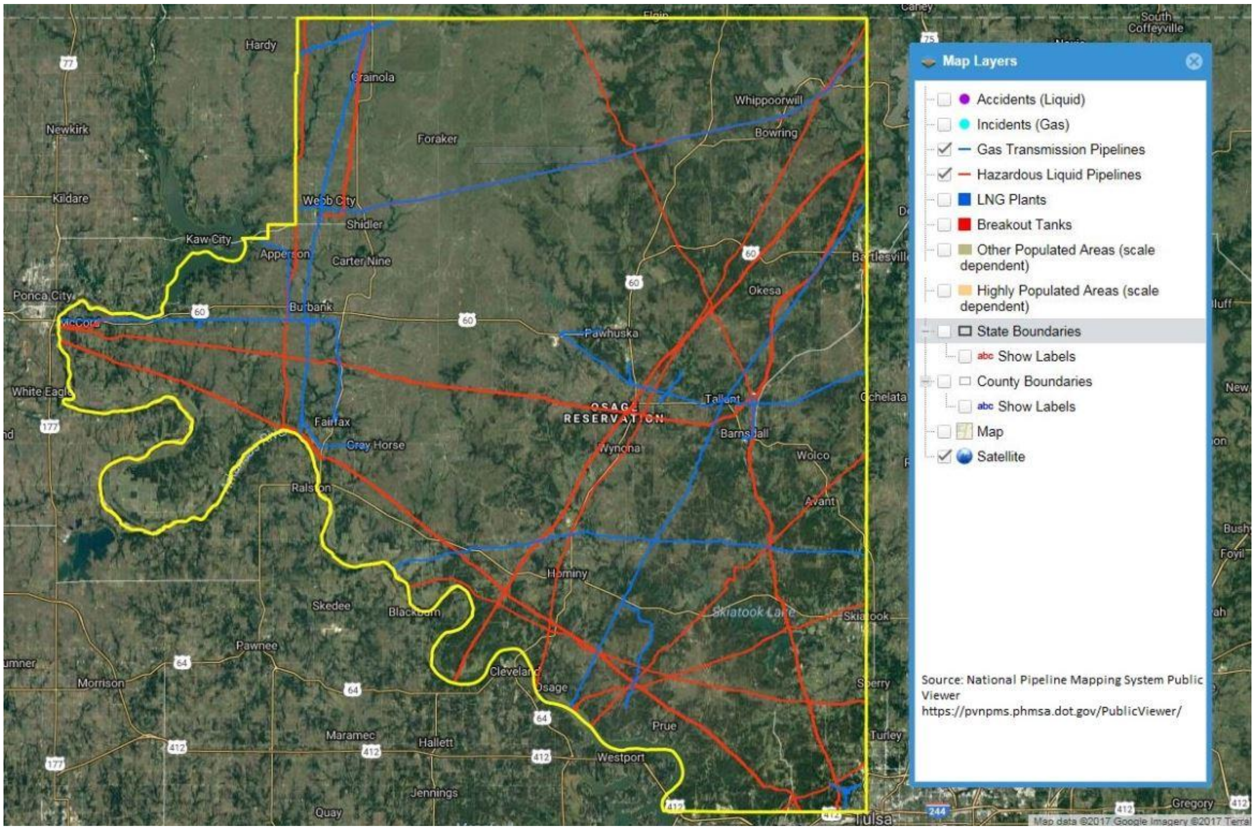


Figure 14. Map of Osage County Pipeline Infrastructure. Map courtesy of National Pipeline Mapping System Public Viewer.

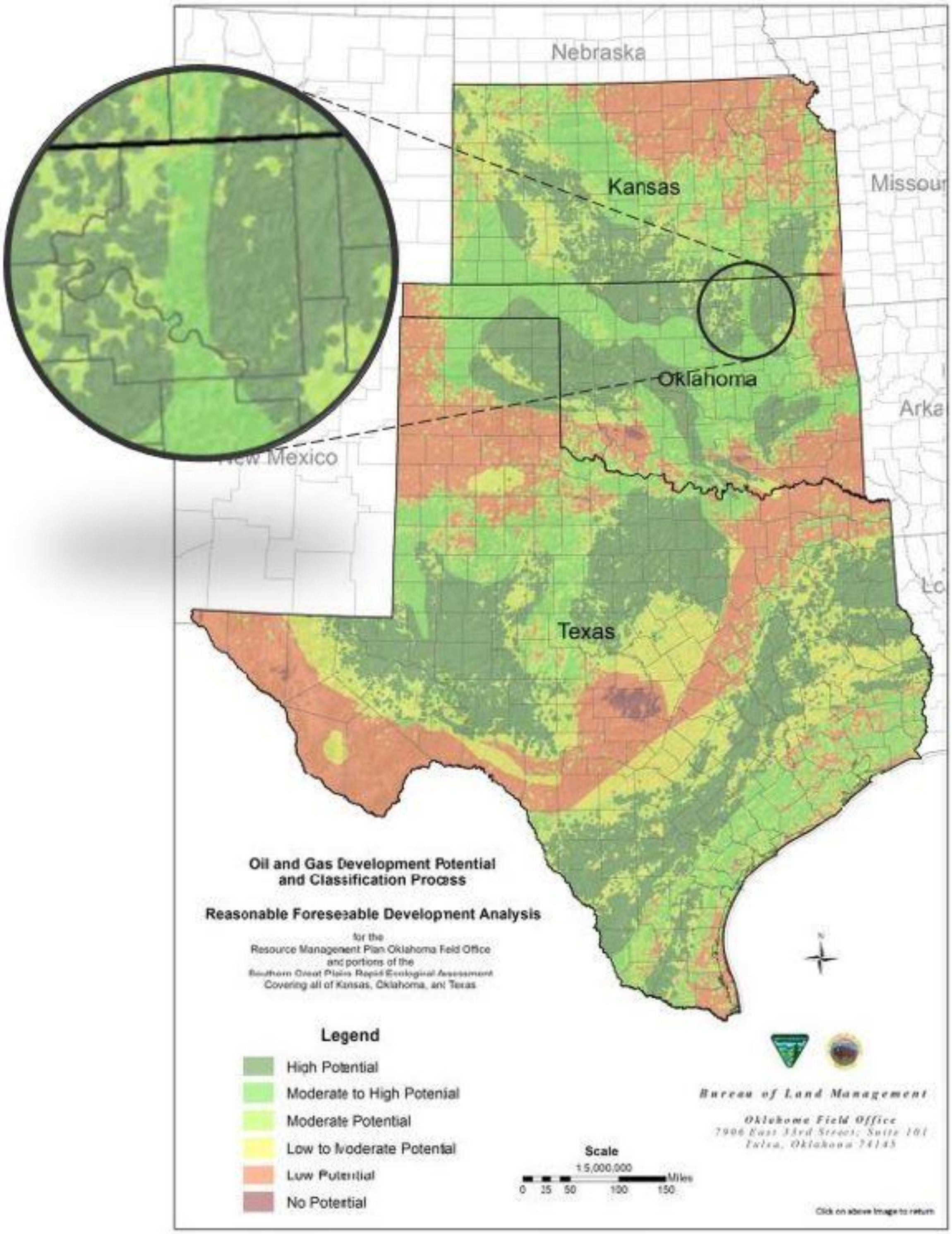


Figure 15. Map of Oil and Gas Development Potential for Kansas, Oklahoma and Texas. Map courtesy of the BLM Oklahoma Field Office. Enhancement shows Osage County's location on the map along with a zoomed-in view of the county.

Appendix B

Osage County Oil and Gas Biological Opinion and Biological Assessment

United States Department of the Interior
FISH AND WILDLIFE SERVICE
Division of Ecological Services
9014 East 21st Street
Tulsa, Oklahoma 74129
918/581-7458 / (FAX) 918/581-7467

In Reply Refer To:
FWS/R2/OKES/
2017-F-2338

July 12, 2018

Memorandum

To: Director, Division of Environmental and Cultural Resources Management, Bureau of Indian Affairs Eastern Oklahoma Region Office, Muskogee, Oklahoma

From: Field Supervisor, FWS, Tulsa, Oklahoma J. Polk

Subject: Programmatic Consultation Relating to the Osage Agency Oil and Gas Program Impacts to the American Burying Beetle (ABB) in Osage County, Oklahoma (Attached)

Attached is the U.S. Fish and Wildlife Service's (Service) amended biological opinion (Opinion) pursuant to section 7 of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq.*), on effects of the Bureau of Indian Affairs-Osage Agency (Osage Agency) Oil and Gas Program in Osage County, Oklahoma for years 2018-2026. The Osage Agency determined that the American burying beetle (*Nicrophorus americanus*-ABB) is likely to be adversely affected by the proposed action. The Service concurs with that determination and effects of the proposed action on the ABB are addressed in our Opinion. The Osage Agency also determined that the proposed action may affect, but not likely to adversely affect the whooping crane (*Grus Americana*), interior least tern (*Sterna antillarum athalassos*), piping plover (*Charadrius melodus*), red knot (*Calidris canutus rufa*), and Neosho mucket (*Lampsilis rafinesqueana*). The Service concurs with these determinations based upon the avoidance and minimization measures for these species set forth by the Osage Agency in the biological assessment.

Our Opinion is based on information provided in the July 13, 2017, Biological Assessment (Assessment), e-mail communications between the Service, Bureau of Indian Affairs, Osage Agency, scientific literature, and other sources of information. A complete record of this consultation is on file at the Service's Oklahoma Ecological Services Field Office, in Tulsa, Oklahoma. The attached Opinion addresses effects of the proposed action on the ABB and its habitat.

The Assessment and this Opinion include conservation measures for avoiding, minimizing and offsetting any unavoidable impacts from Osage Agency's Oil and Gas Program to the ABB for years 2018 through 2026. For each project within the ABB's range in Osage County, Oklahoma, the Osage Agency will determine the proposed project's potential impacts to ABB. Impacts will be minimized by using acceptable conservation and minimization measures, and unavoidable impacts will be mitigated through conservation funded by oil and gas proponents that will result in direct habitat uplift for the ABB. The Osage Agency will perform section 7 consultations for other federally listed species in Oklahoma that are impacted by these projects separate from this Opinion and these consultations must be completed with the Service before individual project implementation, as needed.

Questions or comments should be referred to Laurence Levesque at 918-382-4509.

Attachment

FINAL BIOLOGICAL OPINION

U.S. Fish and Wildlife Service
Endangered Species Act Section 7 Consultation

U.S Fish and Wildlife Service Reference: FWS/R2/OKES/21440-2017-F-2338

Biological Opinion for the Bureau of Indian Affairs, Osage Agency, Osage County Oil and Gas Program for Years 2018-2026

Consulting Agency:
Bureau of Indian Affairs

Biological Opinion Conducted By:
U.S. Fish and Wildlife Service
Oklahoma Ecological Services Field Office
Tulsa, Oklahoma

Approved:

Jonna E. Polk

Jonna Polk, Field Supervisor
Oklahoma Ecological Services Field Office

July 27, 2018
Date

INTRODUCTION

This document provides the U.S. Fish and Wildlife Service's (Service) programmatic Biological Opinion (Opinion) addressing the anticipated impacts of oil and gas development projects over the next eight years (2017-2025) for the Bureau of Indian Affairs Osage Agency (Osage Agency) in Osage County, Oklahoma. The projects and their effects on the Federally- listed American burying beetle (*Nicrophorus americanus* – ABB) are evaluated in accordance with section 7 of the Endangered Species Act of 1973 (Act), as amended (16 U.S.C. 1531 *et seq.*). The Osage Agency provides federal oversight on Osage Nation oil and gas development projects in Osage County, Oklahoma. This Opinion will provide a predictable and streamlined process, which the Osage Agency will utilize when permitting oil and gas activities within the ABB's range in Osage County. The Osage Agency proposes to minimize and mitigate, to the maximum extent practicable, adverse effects of incidental take from activities affecting ABB.

CONSULTATION HISTORY

The process of developing the Opinion was initiated when Osage Agency submitted their original draft biological assessment (assessment), on July 12, 2016, for review and comment. On October 7, 2016, comments were submitted to the Osage Agency for incorporation in the draft assessment. On January 11, 2017, a meeting was held between the Service, Bureau of Indian Affairs Eastern Oklahoma Regional Office, and the Osage Agency to further discuss the programmatic assessment. On April 18, 2017, a second draft of the assessment was submitted by the Osage Agency for comment by the Service. On May 23, 2017, the Service submitted comments to the Osage Agency on the second draft. On July 13, 2017, a final version of the assessment was submitted to the Service by the Osage Agency. The Service contacted Osage Agency via phone on September 1, 2017, requesting clarification on the proposed term the assessment covered. The Osage Agency responded via email on September 12, 2017. On September 15, 2017, a letter from the Service initiating formal consultation was sent to the Osage Agency.

DESCRIPTION OF THE PROPOSED ACTION

Overview and Scope

Section 7 of the Act requires that, through consultation with the Service, federal actions do not jeopardize the continued existence of threatened, endangered, or proposed species or result in the destruction or adverse modification of critical habitat. Oil and gas development projects in Osage County, Oklahoma have a federal nexus, because they are authorized by the Osage Agency. The oil and gas activities permitted by Osage Agency have the potential to adversely impact both the ABB and its habitat, therefore, the Osage Agency needs to address incidental take of listed species through consultation with the Service under section 7 of the Act. The Osage Agency currently consults with the Service on a project-by-project basis for oil and gas operations in Osage County, Oklahoma. This programmatic consultation will allow for projects to be covered under an overall consultation, thereby streamlining the review process for the Osage Agency and Service, resulting in better conservation of the ABB.

All anticipated oil and gas development activities authorized or permitted by the Osage Agency in Osage County, Oklahoma are addressed in this Opinion. The Osage Agency estimates that about 300 wells will be permitted annually over the next eight years, through 2025, within the ABB's historic and current range in Osage County, Oklahoma. Project types range from geophysical exploration; oil and gas drilling and workover operations, drilling pad and access road construction; pipeline construction, and other such oil and gas development activities. The type and amount of temporary habitat impacts, permanent cover change, and permanent habitat loss that could occur from any of the proposed activities varies considerably, but typically would not exceed any proposed limits of disturbance in the permit application submitted to the Osage Agency. Not all projects will affect ABBs or their habitat (*e.g.*, workover operations on existing pads). The Osage Agency will ensure that the conditions set forth in this Opinion are implemented for all oil and gas development projects where ABBs or their habitat will be affected in Osage County, Oklahoma.

Action Area

The action area encompasses the known and potential range of the ABB and its habitat in Osage County, Oklahoma (Figure 1). The Osage Agency's conservation program (minimization and mitigation measures) associated with this Opinion and outlined in the assessment only applies in occupied (or assumed to be occupied) ABB habitat within the ABB range. The total project area occupies approximately 1,419,669 acres (574,520 hectares) and includes portions of five ecoregions, as defined by Woods *et al.* (2005). The current range of the ABB in Osage County is dominated by the Osage Cuestas of the Central Irregular Plains, the Northern Cross Timbers of the Cross Timbers, the Flint Hills, and the Cross Timbers Transition and the Prairie Tablelands of the Central Great Plains ecoregions. The natural vegetation varies and consists of natural communities encompassing areas of tall grass prairie, oak woodland, and scrubby oak forest. Many of these plant communities provide suitable habitat for the ABB.

Project Details

The following types of oil and gas development activities authorized by the Osage Agency may affect the ABB.

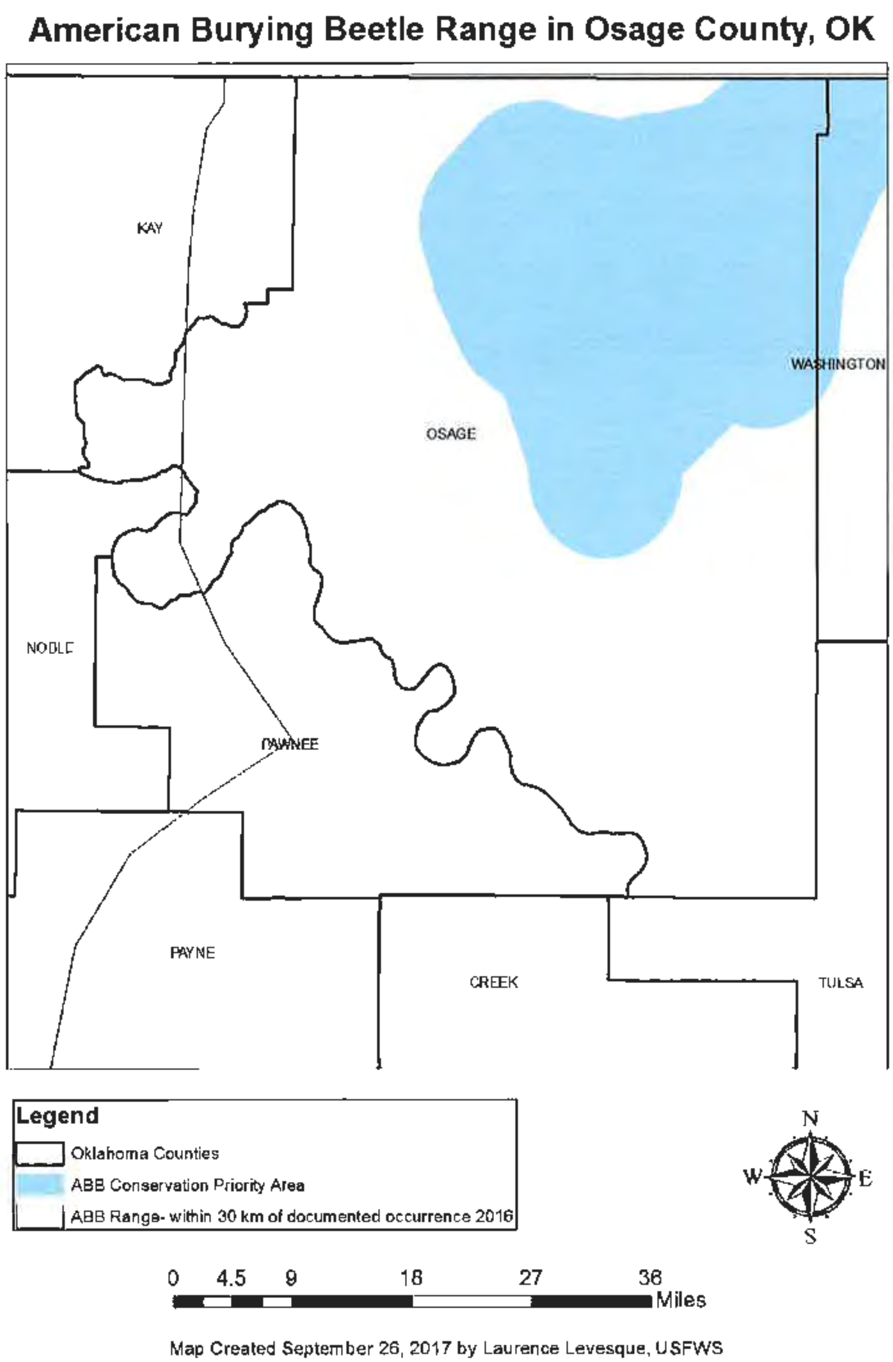
Workover Operations

Potential workover activities (Bureau of Indian Affairs 2015) associated with operation and maintenance of wells generally do not include new ground disturbance. These activities include acid fracturing, drilling or modification of bores on existing well pads, well conversions (gas to oil or oil to gas), plugging and abandonment, re-drilling a previously plugged well, and other activities. A full description of workover activities can be found in the Bureau of Indian Affairs' (2015) Programmatic Environmental Assessment for Approving Workover Operations.

Over the past three years, 512 permits for workover operations have been approved by the Osage Agency. Although most workover operations are confined to the existing well pad area, occasionally there is need to expand the work area beyond the existing pad. There have been approximately 20 permits issued by the Osage Agency over the last three years for projects involving work outside of the existing well pad area, impacting approximately 13 acres in total.

Over the next eight years, the Osage Agency anticipates an increase of about 50 acres per year (400 acres total) in workover and plugging operations that cause disturbance beyond the existing pad. These impacts are temporary in nature and are remediated once the work has been completed.

Figure 1. Current American burying beetle (ABB) range in Osage County, Oklahoma. For the most recent range information please refer to the Service's American burying beetle webpage <*https://www.fws.gov/southwest/es/oklahoma/ABB_Add_Info.htm*>.



Well Pads and Access Roads

Well pads include all structures and equipment necessary for recovering crude oil or natural gas, obtaining water for oil and gas recovery, or fluid disposal following production. Typical well pad construction requires vegetation clearing, grading to level the pad, constructing storm water and erosion control structures, laying shale, gravel, and/or rock over the well pad, and constructing pits, trenches, and sumps. Constructing an impoundment outside of the existing well pad is sometimes needed to maintain a water source for hydraulic fracturing operations.

Development of well sites may use existing roadways or may require constructing new lease roads. Newly constructed roads are first cleared of vegetation with a bulldozer and leveled with a road grader. Shale, rock, or gravel is applied to stabilize the length of the road.

Following construction of access roads and well pads, drilling rigs and associated equipment are transported to the well pad and installed. All drilling activities occur within the previously disturbed (cleared and graded) well pad. After drilling is completed, the rig is removed and hydraulic fracturing equipment may be brought onto the well pad to facilitate production. All activities associated with drilling and well completion occur on previously disturbed areas. After drilling and completion, typically 75 percent of the well pad and associated disturbances (*i.e.* rights-of-way, roads, utility lines, etc.) are re-vegetated. The remaining 25 percent is typically maintained in a developed state to facilitate oil and gas development activities.

Over the next eight years, approximately 300 new well pads and access roads are expected to be built related to new oil and gas development within the Action Area. Each well pad and access road impacts an average of 2.0 acres, with 0.5 acres being permanent and 1.5 acres being temporary impacts. These projects are anticipated to result in 3,600 acres (1,457 hectares) of temporary habitat loss, and 1,200 acres (486 hectares) of permanent habitat loss. No permanent land cover change is anticipated.

Summary

Over the next eight years (2017-2025), it is anticipated that proposed oil and gas development projects in Osage County, Oklahoma will impact a total of 5,200 acres (2,104 hectares) within the ABB's current range (Table 1).

Impacts will result from workover operations, well pad construction, well pad access road construction, and pipeline activities which will include the use of vehicles, trucks or heavy equipment.

Table 1. Total anticipated ABB habitat disturbance by Osage Agency activity type (acres).

	Temporary Habitat Loss	Permanent Land Cover Change	Permanent Habitat Loss	Total Habitat Disturbance
Workover Operations	400	0	0	400
Well Pads and Access Road Construction	3,600	0	1,200	4,800
TOTAL Acres				5,200

AMERICAN BURYING BEETLE PROCEDURES UNDER THE PROPOSED ACTION

Under the existing consultation process, lessees proposing oil and gas development activities having the potential to disturb suitable ABB habitat may conduct surveys for the presence of ABBs or assume presence and apply for an incidental take coverage through section(s) 7 and/or 10 of the Act. Currently, in the case of a positive ABB survey, the lessee has the following options: 1) obtain an incidental take permit through the Service's ABB Industry Conservation Plan (ICP) process under section 10 of the Act; 2) obtain an incidental take permit through an individual habitat conservation plan under section 10 of the Act; or 3) through a formal consultation between the Osage Agency and the Service (this would be a site-specific or batched section 7 consultation).

The ICP is a general conservation plan developed by the Service with oil and gas industry input. The ICP offers project proponents a streamlined permitting process that results in the same assurances and protections as a Habitat Conservation Plan. Within its 45-county planning area in Oklahoma, the ICP provides the oil and gas industry with a mechanism for incidental take authorization during construction, operation, maintenance, repair, and decommissioning of oil and gas projects. The ICP also describes measures to minimize and mitigate take of the ABB and impacts on its habitat.

The Osage Agency is proposing to adopt certain provisions of the Service's ICP, as outlined in the Osage Agency's assessment. These provisions will apply to lessees who have a positive ABB survey or wish to presume that the ABB is present. Currently, if there is a negative survey result, unless the Osage Agency makes a "no effect" determination, the Osage Agency must submit an individual consultation package and wait up to 45 days for a response from the Service. American burying beetle surveys conducted in the early season may need to be duplicated, due to processing time for the agencies and the requirement of a 30-day posting of the Notice of Availability for the site-specific Environmental Assessment before permits can be approved. Projects that would impact ABB habitat during the inactive season (usually late September to mid- May) must have ABB surveys conducted after July 28. Late season surveys may be necessary to extend the window for drilling permits to be issued, and allow the project to be initiated during the ABB inactive/dormant season.

The Osage Agency is proposing that the Service eliminate the requirements of individual consultation package submittal and the 45-day processing period in instances where there is a negative survey or determination (with supporting documentation) that no ABB habitat exists in the area of proposed activities. In such instances, the Osage Agency would still require appropriate best management practices as permit conditions, and would include any necessary site-specific permit conditions based upon review of project plans and National Environmental Policy Act documents. The Osage Agency would also report annually to the Service acreages of temporary or permanent impacts and any permanent cover change. All negative surveys must be valid for the appropriate timeframe for which ground disturbing activities are anticipated to occur (surveys conducted prior to July 28 are only valid until the end of the same year's active season and surveys conducted after July 28 are valid until the beginning of the following year's active season).

Additionally, the Osage Agency is consulting with the Service on the Osage Oil and Gas Program (the proposed action) on a programmatic level to have Service authorize incidental take through a programmatic biological opinion for oil and gas activities that may impact the ABB. The programmatic Opinion will allow for streamlining and make the consultation process more efficient. The Opinion would authorize incidental take for the Osage Agency based on the estimated acres of suitable ABB habitat ("occupied habitat") disturbed annually by oil and gas activities. This is a maximum of approximately 600 acres, comprised of 450 acres of temporary disturbance and 150 acres of permanent disturbance. The Osage Agency would report annually to the Service the number of acres disturbed under its programmatic incidental take statement and specify the number of projects with negative surveys with a may affect, not likely to adversely affect determination. If annual acres of disturbance exceed the limit defined in the incidental take statement, the Osage Agency would re-initiate consultation with the Service.

An ABB presence/absence survey would need to be conducted before ground-disturbing oil and gas activities begin within the ABB's range in the planning area, (see Figure 1, American Burying Beetle Range in Osage County, OK), unless the habitat is characterized as an area unfavorable for the ABB (Service 2016). Surveys would be necessary for well drilling and workover operations that result in ground disturbance beyond the extent of an existing well pad, road, or other disturbed area. Surveys would be based on the most recent Service survey guidance for Oklahoma. Lessees also may assume presence of ABBs and proceed with actions through section 7 or 10 of the Act. For workover operations tiered to the Programmatic Environmental Assessment for Approving Workover Operations, the Osage Agency requires that these activities not disturb the ground beyond the extent of the existing disturbance. Therefore, workover operations tiered to the Programmatic Environmental Assessment for Approving Workover Operations (or any superseding National Environmental Policy Act document that encompasses the Programmatic Environmental Assessment for Approving Workover Operations) would not require ABB surveys.

Applicants for workover permits must provide photographic documentation of vegetation height on the well pad where work is proposed. If well pad vegetation height is below eight inches (20.3 centimeters), the Osage Agency would assume that habitat for ABB is not present. In these cases, the Osage Agency will likely make a "no effect" determination, and therefore, site-specific consultation with the Service is not necessary.

If photographic documentation accompanying a workover application shows vegetation height is above eight inches, the Osage Agency would visit the site to determine extent and suitability of any ABB habitat present. If well pad soils are conducive to ABB burrowing or burying carrion then it would be considered suitable ABB habitat for reproduction. If well pad soils are compacted or contain a high percentage of rock or gravel, and there is excessive vegetation height, that would indicate potential foraging habitat for ABB exists. Vegetation may be removed from areas suitable as foraging habitat for the ABB only during the inactive season. The lessee must commit through conditions of approval of the permit, to maintain the vegetation height of the project area at a height of 8 inches or less until the proposed workover or plugging action has been implemented or until the permit expires (2 years). The proposed activity may commence immediately after vegetation removal has been completed within the inactive season without the need of a presence/absence survey.

Vegetation may also be removed during the inactive season in situations where the well pad has suitable reproduction habitat for the ABB; however, the lessee must commit to only removing the vegetation through the use of hand tools (*e.g.*, weed eaters, manual weed cutter, etc.) and will not be able to utilize heavy machinery such as riding mowers or tractors/brush hogs to remove vegetation.

Where suitable habitat for reproduction exists, the lessee must also commit to delaying the implementation of the proposed activity until after the beginning of the ABB active season (approximately May 15th of each year). The proposed activity may not commence during the inactive season after the vegetation removal because the ABB may still be dormant in the ground within the perimeter of the well pad. After the active season has begun then the proposed activity may commence without the need for an ABB presence/absence survey. In both situations the Osage Agency will require that the lessee maintain the vegetation below eight inches until the project is either implemented or the permit expires.

Under the circumstances described above, the Osage Agency would make a "no effect" determination due to the fact that no suitable habitat will exist within the project area at the time of project implementation. Workover permits are generally valid for a term of two years; however, an order of the Superintendent, Notice to Lessees (NTL), or special permit condition may be utilized, when justified, to reduce the period of potential disturbance to ABB habitat from maintaining vegetation height below eight inches (20.3 centimeters).

However, under circumstances where vegetation was proposed to be removed during the ABB active season, an ABB survey would be required prior to project implementation. If the survey results are negative, vegetation removal could begin provided the procedure outlined below for valid negative ABB survey results is followed. Alternatively, if the negative survey was conducted after July 28th, then the lessee could wait until the ABB's inactive season to begin vegetation removal as described above.

When surveys are completed, and survey results are negative, lessees would report the results to the Service and the Osage Agency. For lessees relying on negative early season survey results, the early season survey results would remain valid until the end of the ABB active season. Late season negative survey results would remain valid until the beginning of the next active season. Development activities with valid negative ABB surveys would receive a "may affect, not likely to adversely affect" determination or a "no effect" determination from the Osage Agency. Under the current process, this would require site-specific consultation with the Service for concurrence on the determination.

Under the proposed action, the Osage Agency requests that the Service issue a blanket concurrence for the Osage Agency's determination that development, with valid negative ABB surveys, "may affect, not likely to adversely affect" or would have "no effect" on ABB. In these circumstances, site-specific consultation with the Service would no longer be necessary, thus eliminating the need to submit individual project packages to the Service and eliminating the 45-day processing period for the proposed action. Lessees would have approval to proceed after the Osage Agency confirms that survey results have been submitted to the Service for review. This will enhance the efficiency of the Osage Agency's permitting process. As stated above, the Osage Agency would annually report to Service the acreages of disturbance for activities authorized in unoccupied ABB habitat, and Osage Agency would also include appropriate permit conditions to avoid significant environmental impacts identified through the review of project plans and the National Environmental Policy Act process.

When ABB surveys are positive, or when ABB presence is assumed, lessees would be required to minimize or mitigate the proposed disturbance, in accordance with the procedures detailed in the assessment and this Opinion. Osage Agency is adopting the minimization and mitigation measures listed below.

Conservation Measures Proposed by the Osage Agency

Several conservation measures have been proposed by the Osage Agency in their biological assessment to conserve the ABB, as described below. The following conservation measures have been proposed and will be implemented by the Osage Agency:

1. Avoid or minimize soil and vegetation disturbance. Avoid removal of or damage to trees, shrubs, and groundcover to the extent possible. Avoid or minimize alteration of the natural topography, and limit activities on steep slopes.

2. Erosion control measures are required for the duration of the construction, drilling, and completion phases of the project. Erosion control measures must minimize the impact of soil, debris, or contaminants moving from the well site to adjacent lands and waterways.

3. All vehicles and equipment must utilize and stay confined to existing and new roads described in the approved National Environmental Policy Act document. These roads must be maintained and upgraded as needed according to Osage Agency direction and agreements between the operator and surface owners.

4. Tank batteries must have a Spill Prevention and Control and Countermeasure Plan (SPCC) in compliance with EPA Regulations under 40 CFR, Part 112. A fluid impermeable secondary containment dike/berm must be constructed around any tank battery and facilities according to 40 CFR, Section 112.7. The dike/berm and entire containment area must be graveled. No water collected within the secondary containment shall be discharged. In accordance with the SPCC plan and the Osage Agency regulations, the lessee will immediately notify the Osage Agency of all spill incidents.

5. No venting or flaring of gas is allowed unless prior written approval of the Osage Agency Superintendent has been obtained.

6. Store and label chemicals properly (including secondary containment). Do not store equipment or chemicals onsite if they are not being used onsite. Do not leave open containers of chemicals or wastes onsite.

7. Keep sites clean and free of any litter, trash, old equipment, contaminated soil, or unused containers. Promptly dispose of any wastes at an appropriate recycling facility, approved landfill, or other approved location. Remove any unused equipment not necessary to the operation of the lease after drilling activities have been completed.

8. All pits (including tank batteries contained within a dike/berm) must be enclosed with a fence of at least four strands of barbed wire, or approved substitute. All earthen pits to be used for storage of salt water or other deleterious substances must be lined with an impermeable layer to prevent contamination of soils and groundwater. Temporary pits must be filled and leveled immediately upon completion of the activity.

9. To the extent possible, minimize disturbance to land owners, wildlife, and natural resources due to noise, excessive traffic, dust, or other impacts associated with operations.

10. Do not conduct activities within stream channels or wetlands without proper authorization. Avoid any discharge of soil or contaminants or removal of stream water that could result in a violation of applicable federally approved water-quality standards.

11. Return disturbed area to original contour or as directed by the surface owner. If needed, add clean soil to disturbed areas. Restore disturbed areas by reestablishing vegetation using seed, sod, or other approved method. Restore with native species unless otherwise directed by the surface owner in writing and approved by the BIA. No noxious or invasive species may be used in revegetation and reclamation activities.

12. If well drilling, completion, and development are successful, all areas of the surface disturbance (*i.e.,* well pad, access road, pipeline, etc.) that are not needed or used in the production or operation of the well shall be promptly reclaimed as described in the approved National Environmental Policy Act document. If well drilling, completion,

and development are not successful, reclamation of the entire area will begin promptly. After a producing well is no longer in production, reclamation of the site will begin promptly. Reclamation shall be completed not later than ninety (90) days from rig removal, well abandonment, or final plugging of a well, unless otherwise approved by the Osage Agency.

13. The lessee shall conduct activities in a manner that avoids any potential incidental take or harm to federally-listed threatened and endangered species, or in a manner that complies with any permit or authorization issued by the Service. Lessee must follow guidance in the Service "Oklahoma Ecological Services Field Office Migratory Bird and Eagle Impact Avoidance Measures for Actions Associated with Oil and Gas Projects" (April 2014), found at the following website: http://www.fws.gov/southwest/es/oklahoma/documents/abb/abb_icp/migbird%20and%20eagle%20avoidance%20measures%20april2014.pdf

14. Lessee must follow the Service's established protocol regarding areas where the American burying beetle (ABB) is known or suspected to exist. See http://www.fws.gov/southwest/es/oklahoma/ABBICP.htm. If proposed operations require the construction of a drilling pit or other excavation activity by heavy equipment, then the lessee must ensure that suitable habitat for the ABB does not exist. If proposed operations will impact suitable habitat for the ABB, it will be the responsibility of the lessee to obtain authorization from the Service to proceed with that portion of the project.

Minimization Measures

The following minimization measures will be implemented for all projects that are within the range of the ABB and may impact ABB habitat.

1. Reduce motor vehicle, machinery, or heavy equipment use. Motor vehicles, machinery, and heavy equipment can generate take of American burying beetles by crushing and collisions when individuals of the species are above-ground or by soil compaction when the species is underground. Reducing the number and use of motor vehicles and heavy equipment in occupied ABB habitat can minimize impacts from these activities. Lessees will minimize the number and use of motor vehicles and heavy equipment necessary in occupied ABB habitat to meet the objectives of the activity. If heavy equipment, machinery, or motor vehicle use is required in occupied ABB habitat for an activity, these vehicles will be allowed only in the areas that are necessary. All motor vehicles, machinery, and heavy equipment shall be parked within areas already impacted, areas where disturbance is planned to occur, or areas where occupied ABB habitat impacts and mitigation, as appropriate, have been assessed.

2. Reduce risk of motor vehicles sparking wildfire. Vehicle use or improper maintenance of vehicles and machinery could ignite fires during dry conditions or in areas with dry vegetation, which may cause take of ABBs. Motor vehicles, machinery, and heavy equipment should not be parked where dry grass or vegetation could be ignited. All

vehicles will be maintained per the respective service manuals. In dry conditions, grass and debris will be cleaned away from machinery exhaust systems and bearings on a weekly basis. All bearings will be lubricated and all spark arrestors will be serviced as necessary to reduce risk of sparking a fire. Fire mitigation equipment necessary at each project includes: a shovel, water, and working fire extinguisher in case of accidental ignition of a wildfire.

3. Increase safety during operation fluid use and storage. Operations fluids (fuel, oil, or other fluids for maintenance of equipment) may cause take of ABBs if spilled. Lessees must follow all applicable state and federal laws regarding fuel use and storage. Additionally, all operational fluids (fuel and motor vehicle oil) will be stored and all equipment must be fueled within areas already impacted, areas where disturbance is planned to occur, or areas where occupied ABB habitat impacts and mitigation, as appropriate, have been assessed.

4. Reduce erosion and increase soil stability. Land erosion can directly impact ABB habitat and cause take of ABBs. To prevent topsoil loss, gully formation, or other negative impacts to ABB habitat, lessees will implement erosion control techniques in accordance with prudent industry standards for sediment and erosion control. Examples of prudent industry standards are described in the Independent Petroleum Association of America's Reasonable and Prudent Practices for Stabilization of Oil and Natural Gas Exploration and Production Sites found at: http://www.ipaa.org/governmentrelations/reasonable-and-prudentpractices-for-stabilizationrapps-for-oil-and-natural-gas-explorationand-production-sites/. Lessees must comply with all state and federal laws regarding erosion control and soil stabilization.

5. Provide educational program for construction personnel. Human presence and movement within ABB habitat may cause take of ABBs. All workers operating in the project area will be trained about ABB habitat, biology, reasons for ABB decline, and the responsibility of all workers to protect the ABB. Standardized ABB educational information is provided on the Service website: www.fws.gov/southwest/es/oklahoma/ABBICP. Lessees will provide each worker with a full color Endangered Species Card with a picture of the ABB and a summary of information about the ABB before conducting soil disturbing activities. Lessees will post signs at all access points to the project area highlighting the areas as occupied ABB habitat and reminding workers to follow special restrictions in the area. All workers are required to report any ABB sightings to the project manager or environmental inspector, remove all food wastes from the work area each day, and prohibit dogs or cats on the work area (workers may not bring animals or pets to the job site). Additionally, all workers must park their vehicles within already impacted areas, areas where disturbance is planned to occur, or areas where impacts and mitigation, as appropriate, have been assessed.

6. Limit use of artificial lighting. Artificial lighting (*i.e.*, from construction or operations at night) can cause take of ABBs by interfering with normal behavior patterns. Therefore, activities occurring during the ABB active season within occupied ABB habitat will be

limited to daylight hours, other than situations described below. Necessary lighting associated with operations or in limited instances where it is necessary to extend construction activities beyond daylight hours (*e.g.*, to maintain the integrity of a bore hole during horizontal directional drill activities when installing a pipeline) must be down-shielded to minimize the effect on ABBs. Additionally, sodium vapor lights are required, rather than ultraviolet or mercury vapor lights near occupied ABB habitat, because they have been shown to be the least attractive to ABBs (Anschutz *et al.* 2007). Drilling rigs used during production, communication towers, or emergency response situations that require lighting are not required to use sodium vapor lighting or down shield lighting.

7. Limit use of gas flares. Light sources can cause take of ABBs by interfering with the species' normal behavior patterns and increasing energetic demands. Current technology allows for enclosure of the flame for some types of flares, thus minimizing or eliminating emitted light. Projects requiring small, constantly burning flares throughout the life of the project will cover the flame to eliminate the visibility of all natural gas flares to minimize artificial light sources that are attractive to ABBs.

8. Limit disturbance from mechanical vegetation maintenance. Vegetation maintenance following construction in areas already restored to ABB habitat (areas with temporary and permanent cover change impacts) may disturb individuals of the species and alter their normal behavior. Vegetation maintenance frequency and duration should be restricted to that necessary to allow for visual surveys and prevent hazards (e.g., fire). Vegetation must be maintained at a height of eight inches (20.3 centimeters) or more to maintain soil moisture. Vegetation maintenance activities will be completed during the ABB inactive season (approximately late September –early May) because these activities may cause take of ABBs during the active season. Given the implementation of this minimization measure, the Service believes that no additional mitigation is necessary for post-construction, intermittent non-soil disturbing operations and maintenance (e.g., mowing using tractor equipment or vehicle traffic along right-of-way) within ABB habitat.

9. Limit herbicide use. Removal of vegetation within ABB habitat may cause take of ABBs. Herbicides necessary for vegetation maintenance or removal in areas already restored to ABB habitat (areas with temporary and permanent cover change impacts) must be applied by licensed applicators in accordance with label directions. Herbicides must be applied using methods that minimize spray drift. If broadcast application of herbicides is necessary for effective right-of-way vegetation control (*e.g.*, in areas with dense stands of target woody plants and/or invasive forbs or grasses), application equipment must be equipped with spray nozzles designed to produce an herbicide spray pattern of uniform water droplet size and apply herbicides at a calibrated rate and at a set pattern on the right-of-way, thus ensuring precise application. Aerial broadcast application of herbicides cannot be used. Following complete restoration of ABB habitat, herbicides used for vegetation maintenance following construction may only be applied if vegetation can be maintained at a height of eight inches or more (to maintain soil moisture). Large equipment and vehicles necessary for application of herbicides may only be used once in a given area during the ABB active season. Any additional use of herbicide during the

ABB active season must be done by hand application instead of large equipment and vehicles.

10. Set aside topsoil for replacement following construction. Projects with temporary or permanent cover change impacts that require removal of top soil within occupied ABB habitat will set aside the top soil during construction activities for restoration following construction.

Post-construction Restoration

1. Replace topsoil. During restoration of project areas within occupied ABB habitat that required top soil removal during project activities (as described under Minimization Measures above), top soil will be replaced at the original location.

2. Relieve soil compaction. Immediately following Covered Activities that removed vegetation and compacted soil by heavy equipment or other means, and prior to vegetation re-establishment, the impacted area will be ripped to a depth of 24 inches(61 centimeters; or to rock, if present, whichever is less), to relieve soil compaction at depths used by ABBs. This effort will improve or enhance ABB habitat by making soils easier for ABBs to bury carrion or themselves. This measure is not required for small project areas (such as maintenance work on a pipeline) where the use of tractors and ripping equipment would result in increasing the impact area.

3. Re-establish vegetation. Following vegetation removal within a project area containing occupied ABB habitat prior to impacts, vegetation will be re-established with a native species composition similar to the surrounding area or, if requested by the landowner, the same vegetation type that existed prior to impacts. Preference should be given to the establishment of native vegetation if the landowner does not have specific requests and restoration of native vegetation is feasible. If construction/soil disturbance ends during the dormant vegetation season, bare soil will be temporarily stabilized if necessary to prevent erosion. At the beginning of the next growing season (preferably prior to the start of the ABB active season in mid-late May), these areas will be re-established with vegetation. Seeds used during vegetation reestablishment must be free of invasive species seeds. Invasive species to be avoided are listed at http://ok-invasive-plant-council.org/images/OKinvasivespp.pdf. For an impact to be considered temporary, vegetation must be re-established to the original density (based on visual comparison of before/after photographs of the project area and comparison to adjacent undisturbed areas) within five years of the initial impact. Vegetation reestablished for permanent cover change impacts should be restored to the density of the grasslands or pastures nearest to the project area, preferahly restored with native species.

4. Inspection for invasive plant species. Because vegetation composition may change the carrion base (small mammal and bird composition) of an area, lessees will monitor project sites with temporary or permanent cover change impacts following post-construction restoration and document any invasive species (as listed at http://okinvasive-

plant-council.org/images/OKinvasivespp.pdf) in their annual reports during the 5-year restoration period.

Mitigation

Verification of Mitigation and Reporting

Lessees in cooperation with the Osage Agency will estimate which type of habitat impact will occur on each portion of the project area and mitigate appropriately, with Osage Agency approval, prior to any ground-disturbing activities likely to result in take of ABBs in occupied ABB habitat. Proof of purchase of mitigation credits at an approved bank, or proof of other mitigation method acceptable to Service, must be provided to the Osage Agency prior to issuance of a permit or other approval of ground-disturbing activity. All offsite mitigation provided for the ABB must be within a location approved by the Service.

Lessees estimating temporary or permanent habitat loss impacts within all or part of their project area will mitigate with appropriate ratios prior to impacts and document the impact start date (the date impacts to occupied ABB habitat began). All areas mitigated as temporary or permanent cover change impacts must implement post-construction restoration measures described below and these areas must be restored to a condition suitable for ABB use within 5 years of the impact start date. Lessees will include information about restoration methods within their annual reports submitted to the Osage Agency. When a Lessee has restored these areas, they will submit their restoration report to the Osage Agency.

Unless there is a positive ABB survey result, applicants for Osage Agency drilling permits, workover approvals, and other approvals would not need to be assigned acres pursuant to the Osage Agency's incidental take statement and no acres will be deducted from the total acreage for ABB.

For all oil and gas operations that require soil disturbance, regardless of survey results, lessees must report to the Osage Agency the number of acres temporarily disturbed and the number of acres permanently disturbed. The Osage Agency will report to the Service annually the acres of suitable ABB habitat disturbed, under the programmatic Opinion and incidental take statement. The Osage Agency's reports will include total acres disturbed, compiled from lessee reports and other available information such as maps and site inspection data.

For oil and gas operations outside of ABB range delineated by the Service, the action would not affect ABB and consultation with the Service for the ABB would not be required.

Offsite Habitat Mitigation through Mitigation Lands

This section describes how impacts to occupied ABB habitat will be offset through conservation and management of ABB habitat in perpetuity. All mitigation proposals must, to the maximum extent practicable, meet the minimum standards and other requirements described in *American Burying Beetle Conservation Strategy for the Establishment, Management, and Operations of Mitigation Lands* found at http://www.fws.gov/southwest/es/oklahoma/ABBICP.

1. Individual- or Lessee-responsible mitigation lands. These consist of mitigation lands established by the lessee. Such mitigation tracts must be described in detail and included in the project description. Such lands must, to the maximum extent practicable, meet the minimum standards and other requirements described in Service guidelines, *American Burying Beetle Conservation Strategy for the Establishment, Management, and Operations of Mitigation Lands* found at http://www.fws.gov/southwest/es/oklahoma/ABBICP. Also described in Service guidelines, conservation easements and agreements must be approved by the Service prior to any habitat impacts that could result in take of ABBs. The lessee or their designee is responsible for ensuring the success of and managing the mitigation land in perpetuity, even if the project is finite in duration (refer to Service guidelines).

2. Conservation Banks. Conservation banks are mitigation lands that are established by a Bank Sponsor. These sites are usually established to mitigate for the effects of multiple projects. A Service-approved conservation bank meets the minimum standards and other requirements described in Service guidelines (*American Burying Beetle Conservation Strategy for the Establishment, Management, and Operations of Mitigation Lands and Guidance for the Establishment, Use, and Operation of Conservation Banks*, found at: http://www.fws.gov/southwest/es/oklahoma/ABBICP). Conservation banks are established through a conservation bank agreement with the Service and conservation easements for the bank must be approved by the Service. When a lessee chooses to mitigate through the purchase of credits in an approved conservation bank, the bank sponsor is responsible for ensuring the success of and managing the mitigation land in perpetuity upon sale of the credits. If a lessee chooses this option, lessee must purchase appropriate credits prior to any habitat impacts that could result in take of the ABB. Lessees can visit http://ribits.usace.army.mil/, the Regulatory In-lieu Fee and Bank Information and Tracking System (RIBITS) for information on Service approved conservation banks with available ABB credits.

3. Third party mitigation lands. These mitigation lands are usually established for a single project or project proponent rather than multiple projects or proponents as are conservation banks. Such lands and agreements must, to the maximum extent practicable, meet the minimum standards and other requirements described in Service guidelines, *American Burying Beetle Conservation Strategy for the Establishment, Management, and Operations of Mitigation Lands* found at http://www.fws.gov/southwest/es/oklahoma/ABBICP. Conservation easements and agreements must be approved by the Service prior to any habitat impacts that could result in take of ABB. The mitigation land sponsor (landowner or easement holder) is responsible for and assumes liability for the success of and management of the approved mitigation land in perpetuity.

The following ABB mitigation ratios will be implemented by Osage Agency in accordance with the Service's Mitigation Recommendations for the ABB in Oklahoma (Table 2).

Table 2. Mitigation Ratios for ABB Impacts. Ratio = acres of impact: acres of offset

	Areas Where Impacts Occur		
Impact Period	ABB Range (but not within CPA)	Conservation Priority Area (CPA)	Mitigation Land*
Temporary	1:0.25	1:0.5	1:1.5
Permanent Cover Change	1:0.5	1:1	1:2
Permanent	1:1	1:2	1:3
*Mitigation Land ratio is equal to the CPA ratio plus the mitigation acre(s) lost.			

STATUS OF THE SPECIES

The ABB is the largest silphid (carrion beetle) in North America, reaching 1.0 to 1.8 inches (2.5 to 4.75 cm) in length (Wilson 1971, Anderson 1982, Backlund and Marrone 1997). The most diagnostic feature of the ABB is the large orange-red marking on the raised portion of the pronotum, a feature shared with no other members of the genus in North America (Service 1991). The ABB is a nocturnal species that lives only for one year. The beetles are active in the summer months and bury themselves in the soil for the duration of the winter. Immature beetles (tenerals) emerge in late summer, over-winter as adults, and comprise the breeding population the following summer (Kozol 1990). Adults and larvae are dependent on carrion for food and reproduction. They must compete for carrion with other invertebrate species, as well as vertebrate species.

American burying beetles are strong fliers and have been reported moving distances ranging from 0.10 to 2.6 miles (0.16 to 4.18 km) in various parts of their range (Bedick *et al.* 1999, Creighton and Schnell 1998, Jurzenski *et al.* 2011, Schnell *et al.* 2011). When not involved with brood rearing, carrion selection by adult ABBs for food can include an array of available carrion species and size (Trumbo 1992). American burying beetles also capture and consume live insects. Immediately upon emergence from their winter hibernation, ABBs begin searching for a mate and a proper carcass for reproduction. Once a carcass has been found, inter-specific as well as intra-specific competition occurs until usually only a single dominant male and female burying beetle remain (Scott and Traniello 1987).

Suitable ABB habitat must have soil conditions that are conducive to excavation by ABBs (Anderson 1982; Lomolino and Creighton 1996). Level topography and a well formed detritus layer at the ground surface are common (Service 1991). American burying beetles are considered feeding habitat generalists and have been successfully live-trapped in several vegetation types including native grasslands, grazed pastures, riparian zones, and a variety of forest types including coniferous forests, deciduous forest with little undergrowth, and oak-hickory forest, as well as on a variety of soil types (Creighton *et al.* 1993; Lomolino and Creighton 1996; Lomolino *et al.* 1995; Service 1991 and 2008, Walker 1957). American burying beetles are widely believed to depend on landscape-level heterogeneity of habitat that supports the small mammals, birds and other sources of carrion necessary for their life cycle. A diverse landscape consisting of patches of woodland, shrubland, and herbaceous areas are believed to be a key component of good ABB habitat. Interspersion of the various vegetative cover types creates the discontinuity of habitat needed to support carrion species preferred by the ABB.

American burying beetles are relatively easy to capture, yet population estimates of ABB are problematic and precise estimates of absolute or even relative densities remain a challenge (Service 2008). The ABB experiences a relatively rapid turnover rate in the trappable ABB population due to factors such as natural mortality, dispersal, burrowing underground and while attending carrion/broods (Creighton and Schnell 1998). Because the ABB completes its lifecycle in one year, each year's population size is highly dependent on the reproductive success of the previous year. Therefore, populations may fluctuate (due to weather, disease, *etc.*), with high numbers and abundance in one year, followed by a decline in numbers the succeeding year. However, these short-term stochastic events are not expected have long-term effects on robust populations (Service 2008).

Habitat fragmentation causes increased vertebrate scavenger pressure, which decreases availability of carrion of the appropriate size, and increases competition between burying beetles (Creighton *et al.* 2007). There is little doubt that habitat loss and alteration affect this species at local or even regional levels, and could account for the extirpation of populations once they become isolated from others (Kozol 1995, Ratcliffe 1996, Amaral *et al.* 1997, Bedick *et al.* 1999). It is unclear if an extirpated ABB population can successfully be re-established. Protection of large areas of appropriate native habitat appears to be the best known method for enhancing the conservation of the ABB. Relatively large areas of native habitat tend to support the highest known ABB populations.

The American Burying Beetle Recovery Plan (Service 1991) and the 5-year status review of the species (Service 2008) identify the following factors as potential threats to the ABB: disease/pathogens, pesticides such as DDT, direct habitat loss and alteration, interspecific competition, increase in competition for prey, increase in edge habitat, decrease in abundance of prey, loss of genetic diversity in isolated populations, agricultural and grazing practices, and invasive species. None of these theories alone adequately explain why the ABB declined while congeneric species are still relatively common rangewide. There are eight sympatric congeners which are not in peril (Sikes and Raithel 2002).

The prevailing theory regarding the ABBs' decline is habitat fragmentation (Service 1991) which: (1) reduced the carrion prey base of the appropriate size for ABB reproduction, and (2) led to increased competition by vertebrate scavengers for this prey (Kozol 1995, Ratcliffe 1996, Amaral *et al.* 1997, Bedick *et al.* 1999) due to the ABBs relatively large size and specialized breeding behavior which require larger carcass sizes (Creighton *et al.* 2007). Although much of the evidence suggesting the reduction of carrion resources as a primary mechanism driving the decline of the ABB is circumstantial, this hypothesis fits the temporal and geographical pattern of the disappearance of ABBs; and, is sufficient to explain why ABBs declined while related species did not. In a fragmented ecosystem, larger species have been shown to be negatively affected before smaller species, a phenomenon that has been well-documented with carrion and dung beetles in South America (Klein 1989).

Since the middle of the 19th century, certain animal species in the favored weight range for ABBs have either been eliminated from North America or significantly reduced over their historic range (Service 1991), including the passenger pigeon (*Ectopistes migratorius),* greater prairie-chicken (*Tympanchus cupido)* and wild turkey *(Meleagris gallopavo)*. Fragmentation of large contiguous habitats into smaller pieces or patches of habitat may increase animal species richness, but the species composition usually changes. Correspondingly, historically large expanses of natural habitat that once supported high abundance of indigenous species are now artificially fragmented, supporting fewer numbers or lower densities of indigenous species that once supported ABB populations. Fragmentation also facilitated increased competition for limited carrion resources among the "new" predator/scavenger community.

Climate change is another factor that has the potential to impact the ABB. Although the impact of climate change on the ABB has not been thoroughly evaluated, the ABB appears to be sensitive to air and soil temperatures, particularly during the summer months. However, it is difficult to anticipate the exact impact that implementation of this proposed action will have on increasing factors that exacerbate climate change.

Kozol *et al.* (1994) examined ABB genetic variation within and between the Block Island, Rhode Island population and the eastern Oklahoma and western Arkansas population. Both populations have low levels of genetic variation, and most of the variation occurs within a single population. There were no unique diagnostic bands within either population, but they found the Oklahoma-Arkansas population to be somewhat more genetically diverse. Reduced genetic variation is often a result of founder effect, genetic drift, and inbreeding.

Numerous ABB surveys have been conducted throughout eastern Oklahoma. The majority of these surveys are associated with projects such as road construction, oil and gas projects, and similar development activities that may result in soil disturbance and impacts to ABB habitat. To determine whether ABBs may occur within these project areas, project proponents use permitted surveyors to conduct surveys for ABB. Because these surveys are associated with development projects that limit their temporal and spatial distribution, only limited conclusions can be drawn. The known ABB range in Oklahoma has expanded over time, but this could be explained by increased survey effort and area. American burying beetle captures typically fluctuate annually and between years, but in general ABB numbers appear stable to increasing within the action area. Critical habitat has not been designated for the ABB.

A more detailed life history account of the American burying beetle can be found on our website: *http://www.fws.gov/southwest/es/Oklahoma/ABB_Add_Info.htm.*

ENVIRONMENTAL BASELINE

The environmental baseline includes past and present impacts of all federal, state, or private actions in the action area; the anticipated impacts of all proposed federal actions in the action area that have undergone formal or early section 7 consultation; and the impact of state and private actions that are contemporaneous with the consultation process. The environmental baseline defines the current status of the species and its habitat in the action area to provide a platform to assess the effects of the action now under consultation.

Status of the Species in the Action Area

The most current information for ABBs in Oklahoma can be found at the Service website: *http://www.fws.gov/southwest/es/Oklahoma/ABB_Add_Info.htm.*

Oklahoma counties with confirmed ABB sightings since 1992 include Atoka, Bryan, Cherokee, Choctaw, Coal, Craig, Creek, Haskell, Hughes, Johnston, Latimer, Le Flore, Marshall, Mayes, McCurtain, McIntosh, Muskogee, Okfuskee, Okmulgee, Osage, Pittsburg, Pontotoc, Pushmataha, Rogers, Seminole, Sequoyah, Tulsa, Wagoner, and Washington (29 counties). Additional counties with ABB habitat and potential occurrence due the proximity to the above counties include: Adair, Carter, Delaware, Garvin, Kay, Lincoln, Love, McClain, Murray, Nowata, Ottawa, Pawnee, Payne, and Pottawatomie.

The Oklahoma ABB range in Osage County includes 1,419,669 acres (574,520 hectares) with 1,282,247 acres (518,907 hectares) of potential habitat. Within the Osage County is a Conservation Priority Area (CPA), where ABB capture rates are higher than in the overall range, which encompasses 498,037 acres (201,549 hectares) centered around The Nature Conservancy's Tallgrass Prairie. Osage County supports the largest area of known occupied ABB habitat in the northern portion (Flint Hills) of the ABB range in Oklahoma.

The Osage County ABB area includes diverse land cover types and habitats that includes the Flint Hills, Northern Cross Timbers, Cross Timbers Transition, Osage Cuestas, and Prairie Tableland. Most of these cover types have at least some positive ABB surveys, but they are not all equal in suitability for ABBs. The two main ecoregions are the Northern Cross Timbers and the Flint Hills, which account for 59 percent and 36 percent, respectively, of the ABB range in Osage County. The Northern Cross Timbers encompass 835,851 acres (338,257 hectares) in the ABB range in Osage County. The Northern Cross Timbers are forest habitats interspersed with prairie habitat comprised primarily of post oak *Quercus stellata* and blackjack oak *Q. marilandica*, interspersed with big bluestem *Andropogon gerardii*, little bluestem *Schizachyrium scoparium*, switchgrass *Panicum virgatum*, and Indiangrass *Sorghastrum nutans*. The Flint Hills encompass 507,680 acres (205,451 hectares) of the ABB range in Osage county. The Flint Hills are characterized as prairie habitat dominated by tall grasses such as big bluestem, little bluestem, switchgrass, and Indiangrass, as well as such as short grasses including blue grama *Bouteloua gracilis*, sideoats grama *B. curtipendula*, and hairy grama *B. hirsuta*.

Oil and gas activity is high throughout the analysis area, as well as agricultural land uses, primarily cattle ranching. In Oklahoma, an Industry Conservation Plan (ICP) was developed to streamline ESA compliance for the oil and gas Industry. Current risk factors in the action area include habitat loss/alteration due to agricultural land uses (mostly grazing with some areas of row crops), commercial forestry, energy related projects, and some areas of urban expansion. Urban expansion near Tulsa, Oklahoma has reduced habitat suitability and connectivity. Some portions of the analysis area are more affected by habitat loss and alteration than others, which may explain why many areas of potential habitat have few or no positive ABB surveys.

ABB Habitat within the Action Area

Some areas within the Action Area are unsuitable for ABB use (*i.e.*, areas that are developed, have unsuitable soils, or contain water). To determine how many acres within the Action Area may be impacted by the Covered Activities in areas that are habitat for the ABB, the Service estimated the ratio of ABB habitat to areas unsuitable for the ABB using GIS and the 2006 National Land Cover Database (NLCD) (Fry *et al.* 2011). The Osage Agency or its permittees will likely delineate potential habitat for the ABB within their project areas at a smaller scale than the NLCD data, using different methods (for example, ground-truthing or satellite aerial photography). However, for the purpose of roughly estimating the total habitat within the Action Area, the Service elected to use the NLCD data. Definitions for each of the land cover categories are in Table 3. Areas selected as ABB habitat included the land cover categories of Deciduous Forest, Evergreen Forest, Mixed Forest, Shrub/Scrub, Herbaceous, Woody Wetlands, Emergent Wetlands, and Hay/Pasture (Table 3). Although portions of the Woody Wetlands and Emergent Wetlands are likely unsuitable for the ABB, portions of those areas are likely suitable, especially during dry periods. Therefore, the entire category was included as habitat for this analysis. Areas unsuitable for the ABB (areas where take is not expected to occur) included the land cover categories of Open Water, Developed Open Space, Developed Low Intensity, Developed Medium Intensity, Developed High Intensity, Barren Land, and Cultivated Crops. Approximately 91.0 percent (1,141,753 acres; 462,051 hectares) of the Action Area was considered ABB habitat according to NLCD data, and approximately 9.0 percent (112,830 acres; 45,661 hectares) was not considered ABB habitat.

There may be some additional lands within the Action Area are not suitable for the ABB (based on vegetation type and land management practices). However, the Service does not currently have the data necessary to determine the potential suitability of the entire Action Area using these additional factors. Therefore, for the purpose of this analysis, the Service assumes that 91.0 percent of the Action Area may be habitat for the ABB.

Table 3. Total Acres of ABB habitat within ABB Range in Osage County, Oklahoma.

Land Cover	NLCD Land Cover Description	Habitat (Acres)	Non-Habitat (Acres)
Open Water	Areas of open water, generally with less than 25% cover of vegetation or soil.	0	35,611
Developed, Open Space	Areas with a mixture of some constructed materials, but mostly vegetation in the form of lawn grasses. Impervious surfaces account for less than 20% of total cover. These areas most commonly include large-lot single-family housing units, parks, golf courses, and vegetation planted in developed settings for recreation, erosion control, or aesthetic purposes.	0	65,706

Land Cover	NLCD Land Cover Description	Habitat (Acres)	Non-Habitat (Acres)
Developed, Low Intensity	Areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 20% to 49% percent of total cover. These areas most commonly include single-family housing units.	0	6,020
Developed, Medium Intensity	Areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 50% to 79% of the total cover. These areas most commonly include single-family housing units.	0	1,370
Developed, High Intensity	Highly developed areas where people reside or work in high numbers. Examples include apartment complexes, row houses and commercial/ industrial. Impervious surfaces account for 80% to 100% of the total cover.	0	508
Barren Land	Areas of bedrock, desert pavement, scarps, talus, slides, volcanic material, glacial debris, sand dunes, stripmines, gravel pits and other accumulations of earthen material. Generally, vegetation accounts for less than 15% of total cover.	0	1,176
Deciduous Forest	Areas dominated by trees generally greater than 16.5 feet (5 meters) tall, and greater than 20% of total vegetation cover. More than 75% of the tree species shed foliage simultaneously in response to seasonal change.	367,993	0
Evergreen Forest	Areas dominated by trees generally greater than 16.5 feet (5 meters) tall, and greater than 20% of total vegetation cover. More than 75% of the tree species maintain their leaves all year. Canopy is never without green foliage.	1,084	0
Mixed Forest	Areas dominated by trees generally greater than 16.5 feet (5 meters) tall, and greater than 20% of total vegetation cover. Neither deciduous nor evergreen species are greater than 75% of total tree cover.	4	0

Land Cover	NLCD Land Cover Description	Habitat (Acres)	Non-Habitat (Acres)
Scrub/Shrub	Areas dominated by shrubs; less than 16.5 feet (5 meters) tall with shrub canopy typically greater than 20% of total vegetation. This class includes true shrubs, young trees in an early successional stage or trees stunted from environmental conditions.	2,659	0
Grassland/Herbaceous	Areas dominated by gramanoid or herbaceous vegetation, generally greater than 80% of total vegetation. These areas are not subject to intensive management such as tilling, but can be utilized for grazing.	781,268	0
Hay/Pasture	Areas of grasses, legumes, or grass-legume mixtures planted for livestock grazing or the production of seed or hay crops, typically on a perennial cycle. Pasture/hay vegetation accounts for greater than 20% of total vegetation.	114,267	0
Cultivated Crops	Areas used for the production of annual crops, such as corn, soybeans, vegetables, tobacco, and cotton, and also perennial woody crops such as orchards and vineyards. Crop vegetation accounts for greater than 20% of total vegetation. This class also includes all land being actively tilled.	0	27,031
Woody Wetlands	Areas where forest or shrubland vegetation accounts for greater than 20% of vegetative cover and the soil or substrate is periodically saturated with or covered with water.	11,899	0
Emergent Wetlands	Areas where perennial herbaceous vegetation accounts for greater than 80% of vegetative cover and the soil or substrate is periodically saturated with or covered with water.	3,073	0
Total Acres		1,282,247	137,422

- Metric conversion: 1 acre = 0.4 hectares

Factors Affecting Species Environment within the Action Area

Adequately evaluating the effects of this Opinion's implementation on the ABB requires that the Service consider not only the impacts from the proposed Project, but the context in which they would likely occur. This context includes ongoing effects to ABB from current activities as well as anticipated effects from projects likely to occur in the foreseeable future.

Research and Recovery Permits

Currently, more than 100 entities or individuals in Oklahoma possess valid Section 10(a)(1)(A) scientific research permits under which some authorized take of ABBs may occur. Most of these permits authorize surveys, which contribute to our understanding of where ABBs occur. All research conducted under these permits must further conservation efforts for the species. The loss of some individual ABBs over the short-term from research is allowed as the research, when applied to conservation efforts, should provide long-term benefits. The Service requires that every available precaution be implemented to reduce and/or eliminate authorized take associated with research activities.

Habitat Conservation Plans

An Oil and Gas ICP was finalized in May of 2014 to provide a mechanism to meet statutory and regulatory requirements by proponents engaged in geophysical exploration (seismic), development, extraction, transport, and/or distribution of crude oil, natural gas, and/or other petroleum products and maintenance, operation, repair, and decommissioning of oil and gas pipelines and well field infrastructure within the current range of the ABB in Oklahoma. The ICP is intended cover construction actions over a two year period and maintenance for up to 20 years. Additional information on the ICP was provided in the previous section.

ESA Section 7 Consultations

History of consultations within the action area is largely dependent on the number and scale of potential projects within an area. The Service has consulted on many other proposed actions with the potential to impact the ABB in Oklahoma. Project types evaluated included pipelines, roads, quarries, communication towers, residential housing development, bridges, mining, petroleum exploration/extraction/production, commercial development, recreational development, transmission lines, and water and waste water treatment facilities. Impacts from these activities vary in size and duration, with projects such as quarries being hundreds of acres and having permanent impacts, to water treatment facilities of a few acres with both permanent and temporary impacts. Most of these consultations are informal, result in no take of the ABB, and thus do not provide for incidental take. However, there are several existing and at least eight pending formal consultations that include some level of incidental take of ABBs. Most take is related to temporary actions with soil disturbance.

There are several biological opinions with incidental take statements issued for the ABB in Oklahoma that are currently in effect:

- Natural Resources Conservation Service for the Oklahoma Healthy Forests Reserve Program; issued September 14, 2010; 5,000 acres (2,023 hectares) of habitat;
- Bureau of Land Management for Wild Horse and Burro Program; April 1, 2010; 200,000 acres (80,937 hectares) of habitat;
- Rural Utility Service (RUS) for a KAMO Power transmission project; June 9, 2011; 28 acres (11 hectares) of habitat;
- RUS for Broadband Initiative Program; July 7, 2011; 1,500 acres (607 hectares);
- U.S. Army Corps of Engineers regarding operation of multiple reservoir and navigation projects in Kansas, Oklahoma, and Texas; April 2013, 106,990 acres (43,297 hectares) of habitat, 1,100 acres (445 hectares) potentially permanent and 105, 890 acres (42,852 hectares) of temporary or periodic (flood pool acres) habitat loss;
- U.S. Army Corps of Engineers and Bureau of Indian Affairs for the construction stage on the Flanagan South Pipeline Project; July 24, 2013; a nearly 600-mile (966-kilometer), 36-inch (91 cm) diameter interstate crude oil pipeline that would originate in Pontiac, Illinois, and terminate in Cushing, Oklahoma; 205.5 acres (83.2 hectares) of ABB habitat:115.5 acres (46.7 hectares) during construction, and 90 acres (36.4 hectares) during operation and maintenance activities;
- Muddy Boggy Conservation Bank regarding establishment, management and operation of a Conservation Bank for ABB, September 25, 2013, up to 1,180 acres (478 hectares)of temporary impacts that will result in overall beneficial effects;
- ABB Conservation Bank (ABBCB) regarding establishment, management and operation of a Conservation Bank for ABB, March 17, 2014, up to 289.6 acres (117 hectares) annually during the management that will result in overall beneficial effects;
- Southwestern Power Administration programmatic consultation for powerline maintenance, 2008, 4,855 acres (1,965 hectares) in process of reinitiation;
- Department of Energy, Clean Line Transmission Project, approximately 700 mile (1126 km) transmission line from Texas County, Oklahoma to Shelby County, Tennessee, in planning phase, proposed to cross several counties within the known range of the ABB. Formal consultation issued on November 20, 2015. Anticipated take estimated to be approximately 14,545.5 acres (5,886.4 hectares) of habitat loss.
- Oil and Gas Industry Conservation Plan Biological Opinion; issued May 21, 2014; no more than 32,234 acres (13,044 hectares) of ABB habitat impacted over a two year period, for which mitigation will be implemented.
- U.S. Army Corps of Engineers and Southern Power Administration Programmatic Biological Opinion, issued July 12, 2016, no more than 297,151 acres (120,253 hectares) of ABB habitat impacted at multiple reservoirs and the impacts will be temporary.
- Federal Highway Administration for Oklahoma Department of Transportation and Oklahoma Turnpike Authority activities; June 15, 2017; 6,349.5 acres (2,569.6 hectares) of habitat;
- Natural Resources Conservation Service for conservation practices in Oklahoma, August 29, 2017; 190,050 acres (76,911 hectares).

Effects of the Action

The following section includes an evaluation of direct, indirect and cumulative effects for the ABB, from oil and gas projects included in the proposed action.

Direct Effects

Direct effects are those that are direct or immediate effects of the project on the species or its habitat (Service 1998). Construction activities related to oil and gas projects frequently disturb soils and have the potential to harm individual ABBs. Direct impacts to ABBs during their inactive or active periods may result from clearing vegetation, heavy equipment operation, fuel and chemical contamination of the soil, grading, soil excavation and filling, and re-vegetation of disturbed areas.

Vegetation Removal

Activities that include removal of vegetation may cause habitat degradation, a reduction of habitat connectivity, a loss of breeding and sheltering habitat by removing vegetation and altering soil moisture (loss of vegetation decreases soil moisture), and cause a species composition change within the small community that ABBs rely on for reproduction (Grant *et al.* 1982). The ABB is sensitive to soil moisture and die quickly when desiccated (Bedick *et al.* 2006). Additionally, these activities may increase the potential for introduction of non-native or invasive species due to the removal of existing vegetation. American burying beetles occurring within the leaf litter or uncovered during the removal of vegetation may be wounded or killed from exposure to adverse weather conditions or crushed by vegetation removal equipment.

Use of Vehicles and Heavy Equipment

Activities requiring off-road vehicles, trucks, or heavy equipment may cause a loss of breeding and sheltering habitat (suitable soil for excavation and burial) from soil compaction, vegetation crushing and trampling, and alteration of soil moisture. Equipment causing soil compaction may crush ABBs within the area, either above ground (during active season) or below ground (during active or inactive season). During the ABB active season, equipment may crush brood chambers containing ABB adults, larvae, and eggs. Direct physical injury or mortality may result when individuals collide with equipment. In dry conditions, equipment could increase the risk of ignition of wildfire. Wildfire may cause loss of breeding, feeding, and sheltering habitat, alter the small mammal community (for a period of time) to a less appropriate size class for optimal ABB reproduction, and injury or mortality for individuals exposed to fire. Operation fluids (e.g., fuel and oil) required for equipment maintenance may cause take of ABBs if individuals or habitat are exposed to them during the active or inactive season.

Disturbance and Movement of Soil

Movement and physical disturbance of soil during construction activities such as grading, soil excavation, and topsoil stripping may crush or expose ABBs (adults, larvae, and/or eggs during the active season; adults during the inactive season) causing injury or mortality through direct impact or exposure to desiccation.

Soil erosion occurring during construction or following installation of project facilities may bury ABB adults or broods (during active season) or overwintering adults (during inactive season) too deep for them to emerge. Additionally, it may expose ABBs to adverse environmental conditions if soils (or individuals/broods) are washed away.

Human Presence and Movement

Introducing or increasing human presence and movement within or adjacent to ABB habitat may increase the amount of crushing or trampling of vegetation, leading to habitat degradation and potential displacement of ABBs in the area.

Light

Artificial lighting used during the active season may attract ABBs, which could result in take through collision or crushing by equipment and/or increasing energetic demands. Light used during nighttime construction can disrupt ABB foraging behavior and increase predation on ABBs (Service 1991). Additionally, light associated with the flame of gas flares used in drilling and production of natural gas may attract ABBs if they are not shielded. Light sources are not expected to affect ABBs during the inactive season, as ABBs are not above ground during that time period.

Vegetation Maintenance

Regular vegetation maintenance within project areas may cause injury or mortality of ABBs. During the active season, ABBs exposed to mowing/vegetation maintenance equipment may be crushed or exposed to desiccation. If vegetation maintenance reduces vegetation height to less than eight inches, the soil may dry to the point that: 1) ABBs have difficulty burying carcasses, 2) soil may not structurally support reproductive chambers, or 3) adult or larval ABBs become desiccated (Bedick *et al.* 2006). Maintaining grass and vegetation at less than eight inches tall could affect ABB reproduction (during the active season) and survival when ABBs are underground (during active or inactive season). If widespread application of herbicides are used to maintain the right-of-way (killing all vegetation within the right-of-way), instead of mechanical vegetation removal (*i.e.*, mowing) or spot-treatment of herbicides, soil may also dry causing the same impacts described above. Large mowing equipment operated within ABB habitat may cause soil compaction, resulting in take of buried ABBs during the active or inactive season. Vegetation maintenance may result in temporary habitat loss, temporary habitat fragmentation, and/or alteration of ABB habitat.

Impacts Analysis and Estimated Incidental Take

The Service anticipates impacts to ABBs will result from proposed action. Such impacts to ABBs are is expected to occur in the form of injury or death of adults, larvae, and eggs from by crushing or collision, or from limiting available resources, resulting in the loss of breeding, feeding, and sheltering habitat. Impacts to ABBs are expected to result from ground disturbance associated with construction and installation of well pads, pipelines, access roads, electrical distribution lines and substations, and off-site reservoirs. Activities related to operation and maintenance, reclamation, and decommissioning are also expected to result in take of the ABB.

Because quantification of the number of ABBs impacted incidental to Covered Activities is not possible given available data, the Service believes that relying on impacts to occupied ABB habitat is a suitable surrogate to estimate the amount of take that is likely to occur. Within the Opinion, "occupied ABB habitat" is defined as areas:

1. suitable for ABB use (containing ABB habitat), AND
2. Within the effective survey radius of a valid ABB survey where ABBs were identified *or* ABBs are assumed present (no surveys have been conducted).

Temporary Habitat Impacts, Permanent Cover Change, and Permanent Impacts

Impacts to ABB habitat are categorized as follows:

Temporary Habitat Impacts

Temporary habitat impacts include areas of ground disturbance resulting from project activities restored to a condition suitable for ABB use within five years of the impact with similar vegetative cover. The restoration timeframe of five years is based on the amount of time in which the Service expects most grass and shrub dominated cover types could be re-established to their previously undisturbed state based on the climate and vegetation types within the Action Area. The ABB is a habitat generalist and specific vegetation types required for the ABB have not been identified, but they have been documented within grassland cover types and native grasses and shrubs are a component of most areas that support ABBs in Oklahoma. Native warm season grasses can take several years to become established, but previous research suggests that five years is a realistic timeframe for restoration of these areas within the Action Area (USDA 2009).

Permanent Cover Change Impacts

Permanent cover change impacts are defined here as changing a vegetation cover type to a different vegetation cover type (*e.g.*, forest or shrubland to grassland), resulting in increased fragmentation of habitat (Oxley *et al.* 1974, Kozol 1995, Ratcliffe 1996, Amaral *et al.* 1997, Bedick *et al.* 1999, Trumbo and Bloch 2000, Marvier *et al.* 2004). Similar to temporary impacts, these areas are to be restored to a condition suitable for ABB use within five years. If these areas will be purposefully maintained (through vegetation control) as a different land cover type than existed prior to project implementation, the Service considers the vegetation cover of the area to have a permanent cover change.

Man-made changes to land cover types can create intense, sudden contrast between land cover types (*i.e.*, a grassland right-of-way fragmenting a contiguous stand of forest habitat), compared to natural patchy landscapes. These cover type conversions often occur within the right-of-ways of linear infrastructure, including road widening or new alignments.

To determine whether a project's cover change type will be permanently altered based on the proposed vegetation maintenance activities, project proponents should determine current land cover type using standard techniques (*i.e.*, ground truthing; analysis of recent aerial or satellite imagery; as described in Table 2, or the latest version of the Multi-Resolution Land Characteristics Consortium's National Land Cover Database, available at *http://www.mrlc.gov/*). The land cover type prior to impacts should be compared to the expected land cover type following the action (including any proposed maintenance/vegetation management activities and requests by the landowner). If the land cover type within the action area will be different (for example, prior to impact, NLCD classified the area at forest; following the impact, the land cover type will fit in the NLCD land cover description for herbaceous) than the original cover type 5 years after the action, the area will have a "permanent cover change." By definition, a permanent cover change does not eliminate ABB habitat.

Evidence suggests that permanent change in cover types, even if the original and resulting cover types are both native to the area, can increase threats to ABBs (Trumbo and Bloch 2000) by increasing the number of invasive plant species present (Marvier *et al.* 2004), reducing the carrion prey base of the appropriate size for ABB reproduction (Oxley *et al.* 1974), or increasing the scavenger competition for carrion (Kozol 1995, Ratcliffe 1996, Amaral *et al.* 1997, Bedick *et al.* 1999) necessary for ABB reproduction. Additionally, changing the vegetation cover type from forest to grassland provides access, which may increase human use and presence (including use of vehicles) in the area.

Impacts within new right-of-ways that have a permanent change in cover and are immediately adjacent and parallel to existing right-of-ways, may be considered temporary impacts because they do not increase habitat fragmentation. Co-locating right-of-ways along existing right-of-ways, roads, or other interruptions in habitat does not contribute to further fragmentation or edge effect and is preferable to crossing previously undisturbed areas.

Permanent Impacts

Permanent impacts are those that eliminate ABB habitat (*i.e.*, buildings, roads, new right-of-way not adjacent to existing right-of-ways), as well as any impact to habitat that takes more than five years to restore to ABB habitat. Permanent impacts to ABB habitat are expected to result in the greatest amount of take of individuals of the species.

Total ABB Impact Estimates within Action Area

Although it is difficult to accurately predict the total impact of Osage Agency oil and gas projects in the Action Area over the next eight years on ABB, the Service developed an estimate of total impacts within the Action Area based on a review of the assessment submitted by Osage Agency and detailed in *Description of the Proposed Action* above. A summary is provided in Table 4.

Given our estimate that 91.0 percent of the Action Area could potentially be ABB habitat and the total estimated disturbance associated with proposed action is 5,200 acres (2,104 hectares), the Service's estimated total impact of proposed action to the ABB habitat is 4,732 acres (1,915 hectares) (91.0 percent of the proposed action estimate, Table 3). That is approximately 0.41 percent of the 1,141,753 acres (462,051 hectares) of suitable ABB habitat within the Planning Area that may be impacted over the duration of the Opinion. The Service believes that not all ABB habitat impacts will occur in areas occupied by the ABB (determined through surveys or assuming presence). However, without knowing the specific locations of the impacts, the Service cannot estimate the exact amount of occupied ABB habitat that will be impacted. Therefore, assuming that all ABB habitat that will be impacted may be occupied (for the purpose of estimating take), we have determined that a maximum of 4,732 acres of occupied ABB habitat would be impacted.

Table 4. Summary of BIA proposed Action Area, ABB habitat, and potential impacts (acres)

	Acres
BIA Action Area Size	1,474,560
ABB Habitat within Action Area	1,141,753
Total estimated habitat disturbance within Action Area (from Table 1)	5,200
Anticipated impacts to ABB habitat (total ground disturbance x 0.91)	4,732

Metric conversion: 1 acre = 0.4 hectares

Cumulative Effects

Cumulative effects are those effects of future, non-federal state, tribal, local government, and private actions that are reasonably certain to occur in the action area considered in this Opinion. Future federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act. In addition to those projects with a Federal nexus that undergo consultation, there are numerous actions that do not require Federal funding, permitting, or authorization and consequently do not require consultation with the Service. Any of several private development projects may occur in Oklahoma.

Portions of the Action Area have undergone urban or industrial development, while other portions are primarily agricultural and have experienced little development. Major developments have included conversion of native vegetation to agricultural crops or grazing land, urban or rural development, transportation projects, rights-of-way clearing for utilities, and development of industrial facilities. Examples include tree management and harvest on private holdings and private conversion of native prairie rangeland to cropland in Oklahoma. Construction of houses, industrial manufacturing sites, power lines and roads are also examples of private projects that could impact ABBs. When large areas of native woodland and native grasslands are affected, loss and fragmentation of these habitats incrementally reduce the recovery potential of ABBs by damaging the functionality of these supporting ecosystems.

The Action Area encompasses a portion of Indian Nation Council of Governments State Planning Region in Oklahoma. The Census Bureau information shows that between 2000 and

2010, Osage County grew in population by approximately 6.8 percent (U.S. Census Bureau 2010). Osage County is projected to grow in population between 2010 and 2075 at an annual average of 0.79 percent (Oklahoma Department of Commerce 2012).

Residential and commercial developments are associated with population growth and are being constructed outside city limits or in previously undeveloped or rural areas. The specific numbers of new or anticipated projects and associated acres of disturbance are difficult if not impossible to quantify. However, it is clear that there are numerous, continuing, and expanding impacts to ABBs and their habitat from projects without a federal nexus. All of the above activities cause loss and further fragmentation of ABB habitat in Oklahoma, reducing incrementally the ability of the species to recover in the state. Construction activities that disturb soils within the current range of ABBs may cause mortality of ABB adults, and (potentially) ABB larvae and eggs. Although direct mortality of ABBs from individual construction activities is local and constitutes a short-term adverse effect, the cumulative loss of ABBs from multiple development projects in a larger area may eventually reduce the ability of a given population to survive in a fragmented landscape. Lighting associated with construction of new roads (*i.e.*, not associated with the proposed Project) and new residential developments can result in harassment and disruption of normal feeding behavior when ABBs are attracted to lights. Future construction and developments of this type by state or private entities may impact ABBs and interfere with feeding or breeding by distracting the ABB.

The IPCC (2007) concluded that warming of the climate system is unequivocal and most of the observed increases in average temperatures globally is likely due to man-made greenhouse gas concentrations. The use/combustion of fossil fuels, such as oil and gas, produces greenhouse gas emissions that contribute to global climate change. Emissions from consumer vehicles in particular, may occur as a result of production and use of oil and gas but typically occur later in time and are difficult to predict. Consequently, the Service assumes there will be greenhouse gas emissions that result from field production at full development of the anticipated leases in Osage County. However, the incremental contribution of these emissions on climate change globally cannot be estimated with any certainty but the Service expects the net impacts to be small.

Conclusion

Less than 0.4 percent of Osage Agency's individual oil and gas projects proposed within the ABBs range in Osage County over the next eight years are expected to have an adverse effect on the species, and could result in take of ABBs. Over the next eight years, direct impacts to 4,732 acres (1,915 hectares) of potential ABB habitat are expected; 3,549 acres (1,436 hectares) of temporary habitat loss, and 1,183 acres (479 hectares) of permanent habitat loss.

After reviewing the current status of the ABB, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is the Service's Opinion that implementation of the proposed actions are not likely to jeopardize the continued existence of the ABB. No critical habitat has been designated for this species; therefore, none would be affected.

The Service's determination is based on the following primary factors:

- Since the Recovery Plan was developed in 1991, numerous other ABB populations have been discovered, and the recovery objective of reducing the immediate threat of extinction through discovery or establishment of new populations has been met (Service 2008).

- Although the small population in Texas, on the periphery of the range, may be declining, available evidence indicates that populations of ABB are relatively stable in Nebraska, South Dakota, Oklahoma, Arkansas, Kansas, and Rhode Island.

- The Osage Agency's activities covered under this Opinion likely would cause take of ABBs in the form of killing, harm, and harassment within Oklahoma. However, some of these losses constitute a one-time or short-duration pulse effect to the ABB populations in Osage County, Oklahoma, so they are unlikely to affect ABB populations long-term.

- Anticipated habitat loss is relatively minor (less than one percent) considering that approximately 1,141,753 acres (462,051 hectares) of ABB habitat exists within the ABB range in Osage County, Oklahoma. A maximum of 4,732 acres (1,915 hectares) (0.41 percent) is expected to be impacted. Because permanently lost acres of ABB habitat will be mitigated at a 1:1 ratio or higher, temporarily lost acres of ABB habitat will be restored and mitigated at a 1:0.25 ratio or higher, and newly fragmented acres of ABB habitat will be mitigated at a 1:0.5 ratio or higher, the protection and management in perpetuity of ABB conservation areas is expected to fully mitigate for the effects of the habitat loss during oil and gas operations.

- Methods used to determine the amount of ABB habitat within the action area in Oklahoma has not been applied to other states within the ABB range. However, given that the ABB range expands well beyond Oklahoma, the Service anticipates that the overall percentage of range wide ABB habitat that may be impacted by proposed actions in this Opinion is likely much smaller than 0.41 percent (the percentage of Osage County, Oklahoma ABB habitat in that may be impacted by the proposed oil and gas projects).

- American burying beetle mortality that occurs as a result of project implementation would constitute a short-term effect to populations, which would have minimal impact on the species as a whole and the mitigation is anticipated to provide secure areas for ABB and mitigate for these short-term effects.

The proposed action would not appreciably reduce the likelihood of survival and recovery of the ABB because conservation measures in the Opinion will minimize impacts to the species, reduce the level of take, and result in long-term mitigation for impacts by preserving ABB habitat in perpetuity.

INCIDENTAL TAKE STATEMENT

Section 9 of the Act and federal regulations pursuant to section 4(d) of the Act prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to engage in any such conduct. Harm is further defined by FWS to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Harass is defined by FWS as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

The measures described below are non-discretionary, and must be undertaken by the Osage Agency so that they become binding conditions of any grant or permit issued to an applicant, as appropriate, for the exemption in section 7(o)(2) to apply. The Osage Agency has a continuing duty to regulate the activity covered by this incidental take statement. If the Osage Agency (1) fails to assume and implement the terms and conditions or (2) fails to require the applicant to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the Osage Agency must report the progress of the action and its impact on the species to the Service as specified in the incidental take statement. [50 CFR §402.14(i)(3)]

The Opinion and associated supporting documentation clearly identify anticipated effects to the ABB likely to result from the proposed Osage Agency oil and gas activities and the measures that are necessary and appropriate to minimize those effects. All avoidance, minimization and mitigation measures described in this Opinion are hereby incorporated by reference as reasonable and prudent measures and terms and conditions within this Incidental Take Statement pursuant to 50 CFR sec. 402.14(i). Such terms and conditions are non-discretionary and must be undertaken for the exemptions under section 10(a)(1)(B) and section 7(o)(2) of the Act to apply. If the Osage Agency or their permittees fail to adhere to these terms and conditions, the take authorization provided under the section 7(o)(2) may lapse. The amount or extent of incidental take anticipated under the Opinion, associated reporting requirements, and provisions for disposition of dead or injured animals are described in the Opinion.

Amount or Extent of Take Anticipated

The Service anticipates incidental take of ABBs will occur as a result of the proposed action in the form of harm, harass, and/or killing. Estimating the number of ABBs that will be taken is difficult because there is no estimate of population density for the action area. Take of the ABB is also difficult to quantify because: 1) individuals of the species are small in size, making them difficult to locate, which makes encountering dead or injured individuals unlikely; 2) ABB losses may be masked by temporal fluctuations in numbers; 3) ABBs spend a substantial portion of their lifespan underground; and 4) the species is primarily active at night. These factors make it difficult to detect the amount of take that will occur. Although we cannot estimate the number of individual ABBs that will be incidentally taken, the Service is providing a mechanism to quantify take levels and define when take would be considered to be exceeded. For purposes of this Opinion, the Service defines incidental take in terms of the number of occupied acres disturbed.

Use of Impacts to Habitat as a Proxy for Take

The use of habitat as a proxy for take of individuals of a species is consistent with existing case law. Courts have recognized that as a general matter "Congress wanted incidental take to be stated in numbers of animals, where practical, not in terms of habitat markers" (*Miccosukee Tribe of Indians or Florida v. US*, 566 F.3d 1257 [11th Cir. 2009]). However, courts have also explained that "While Congress indicated its preference for a numerical value; it anticipated situations in which impact could not be contemplated in terms of a precise number. In the absence of a specific numerical value, however, the Fish and Wildlife Service must establish that no such numerical value could be practically obtained" (see *Arizona Cattle Growers' Association v. U.S. Fish and Wildlife Service*, 273 F.3d 1229, 1249-50 [9th Cir. 2001]). See also *Oregon Natural Resources Council v. Allen*, 476 F.3.d 1031, 1037 [9th Cir. 2007] in which the Service was directed to explain why it was unable to numerically quantify the level of take.

Based upon estimates detailed in Osage Agency's assessment and reiterated in this Opinion, information exchange between Bureau of Indian Affairs representatives and Service staff, and a review of publicly available information and scientific literature, it is anticipated that incidental take may occur within a maximum of 4,732 acres (1,915 hectares) of occupied ABB habitat within the action area, in the form of harm, harassment, and/or mortality. Therefore, the following amount of incidental take will be authorized by this Opinion:

- Individuals will be taken on no more than 4,732 acres (1,915 hectares) of ABB habitat that occurs within the action area.

Effect of the Take

In the accompanying Opinion, the Service has determined that this level of anticipated take is not likely to result in jeopardy of the ABB due to the small extent of expected habitat losses (less than one percent) in comparison to the total occupied range of the ABB and the long-term beneficial effects associated with the action, most importantly the permanent minimization of take and the effects of conservation of large blocks of habitat in the form of mitigation banks. No critical habitat has been designated for the ABB; therefore, none will be affected.

Reasonable and Prudent Measures

The Service believes the following reasonable and prudent measure is necessary and appropriate to minimize incidental take of ABBs. The Osage Agency shall:

1. Ensure oil and gas project proponents fully implement the proposed action as described in this Opinion, including their proposed Conservation Measures, Minimization Measures, and Mitigation.

2. Ensure that oil and gas project proponents fully adhere to the time frames for which a negative ABB survey is valid and a May Affect-Not Likely to Adversely Affect determination has been reached. For example, a negative ABB survey that is conducted prior to July 28th of a given year is only valid until the end of the same year's active season. Conversely, a negative ABB survey is conducted after July 28th until the end of the active season are only valid until the beginning of the following years' active season. If ground disturbing activities must be completed prior to the end of the time frame the survey is valid, otherwise, consultation may have to be re-initiated or the project proponent may assume presence and utilize either the ICP or this programmatic Opinion.

The reasonable and prudent measure, with its implementing terms and conditions, is designed to minimize the impacts of incidental take that might otherwise result from Opinion implementation. If, during the course of the action, this level of incidental take is exceeded, such incidental take represents new information requiring re-initiation of consultation and review of the reasonable and prudent measures.

Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the Act, the Service must ensure the following terms and conditions that implement the reasonable and prudent measure described above. The terms and conditions are non-discretionary.

1.1 The Osage Agency will ensure that project proponents calculate and purchase Credits from Service approved ABB Conservation Banks to offset acres of ABB impact <u>prior to the start of the project</u> (or impact occurrence).

1.2 The Osage Agency will ensure that all Minimization Measures, as described in the *Conservation Measures Proposed by Osage Agency* section above, will be implemented for all projects within the ABB's range that will impact ABB habitat.

1.3 The Osage Agency will track each project's mitigation offset on a spread sheet and will submit this to the Service's Oklahoma Ecological Service Field Office on a yearly basis.

1.4 The Osage Agency will ensure that time frames of negative surveys are adhered to properly as outline in Reasonable and Prudent Measure Number 2 and are accurately tracked and reported to the Service.

1.5 The Osage Agency will ensure that if vegetation is managed to make it unsuitable as ABB habitat, either after a valid negative survey for the appropriate timeframe has been conducted or by use of hand tools (weed eaters, manual vegetation cutters), that vegetation is maintained below 8" in height until ground disturbing activities have concluded.

The Service believes that no more than 4,732 acres of ABB habitat will be incidentally taken as a result of the proposed action. The reasonable and prudent measures, with their implementing terms and conditions, are designed to minimize the impact of incidental take that might otherwise result from the proposed action. If, during the course of the action, this level of incidental take is exceeded, such incidental take represents new information requiring reinitiation of consultation and review of the reasonable and prudent measures provided. The Federal agency must immediately provide an explanation of the causes of the taking and review with the Service the need for possible modification of the reasonable and prudent measures.

Procedures of Handling and Disposing of Dead or Injured Listed Species

Upon locating a dead, injured, or sick listed species initial notification must be made to the nearest Service Law Enforcement Officer [Oklahoma: (405) 715-0617]. Secondarily, the Oklahoma Ecological Services Field Office should be contacted within three working days of its findings at (918) 581-7458. Written notification must be made within seven calendar days and include the date, time, and location of the animal, a photograph if possible, and any other pertinent information. The notification shall be sent to the Law Enforcement Office with a copy to this office. Care must be taken in handling sick or injured animals to ensure effective treatment and care and in handling dead specimens to preserve biological material in the best possible condition.

All dead or moribund individuals will be frozen and the date and location of collection recorded. These specimens should then be furnished to the Sam Noble Museum of Natural History located at the University of Oklahoma.

Reinitiation Notice

This concludes formal consultation on the action outlined in the Opinion. As provided in 50 CFR §402.16, reinitiation of formal consultation is required where discretionary federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information shows that the action may affect listed species in a manner or to an extent not considered in this Opinion; (3) the action is subsequently modified in a manner that causes an effect to the listed species not considered in this Opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation.

We appreciate the opportunity to work with you on this project. If you have any questions please contact Laurence Levesque at 918-382-4509 or laurence_levesque@fws.gov.

LITERATURE CITED

Amaral, M., A. J. Kozol, and T. French. 1997. Conservation strategy and reintroduction of the endangered American burying beetle. Northeastern Naturalist 4(3): 121–132.

Anderson, R.L. 1982. On the decreasing abundance of *Nicrophorus americanus* Olivier (Coleoptera: Silphidae) in eastern North America. *Coleopterists Bulletin* 36:362–65.

Anschutz, R. M., W. J. Allgeier, D.G. Snethen, W.W. Hoback. 2007. The impacts of light and light types on nocturnal carrion beetles, including the American Burying Beetle. Poster Presentation as North Central Branch Entomology Meeting, Winnipeg, Manitoba, Canada.

Backlund, D.C., and G.M. Marrone. 1997. New Records of the endangered American burying beetle, *Nicrophorus americanus* Olivier, (Coleoptera:Silphidae) in South Dakota. The Coleopterists Bulletin, 51(1):53–58.

Bedick, J.C., B.C. Ratcliffe, W.W. Hoback, and L.G. Higley. 1999. Distribution, ecology and population dynamics of the American burying beetle *Nicrophorus americanus* Olivier (Coleoptera, Silphidae)] in South-central Nebraska, USA. Journal of Insect Conservation 3(3): 171–181.

Bedick, J.C., W.W. Hoback, and M.C. Albrecht. 2006. High water-loss rates and rapid dehydration in the burying beetle, *Nicrophorus marginatus*. Physiologcal Entomology 31:23–29.

Bureau of Indian Affairs (BIA). 2015. Programmatic Environmental Assessment for Approving Workover Operations. BIA Osage Agency. Pawhuska, Oklahoma.

Creighton, J.C., R. Bastarache, M.V. Lomolino, M.C. Belk. 2007. Effect of forest removal on the abundance of the endangered American burying beetle, Nicrophorus americanus. Journal of Insect Conservation, Published online: 16 October 2007.

Creighton, J.C. and G. Schnell. 1998. Short-term movement patterns of the endangeredAmerican burying beetle *Nicrophorus americanus*. Biological Conservation 86: 281-–287.

Creighton, J.C., C.C. Vaughn, and B.R. Chapman. 1993. Habitat preference of the endangered American burying beetle (*Nicrophorus americanus*) in Oklahoma. The Southwestern Naturalist 38:275–277.

Fry, J., Xian, G., Jin, S., Dewitz, J., Homer, C., Yang, L., Barnes, C., Herold, N., and Wickham, J., 2011. Completion of the 2006 National Land Cover Database for the Conterminous United

States, PEandRS, Vol. 77(9):858-864.

Grant, W.E., E.C. Birney, N.R. French, and D.M. Swift. 1982. Structure and productivity of grassland small mammal communities related to grazing-induced changes in vegetative cover. Journal of Mammalogy 63(2):248–260.

IPCC 2007. Climate Change 2007: Synthesis Report. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Core Writing Team, Pachauri, R.K. and Reisinger, A. (Eds.) IPCC, Geneva, Switzerland. pp 104.

Jurzenski, J., D.G. Snethen, M.L. Brust, and W.W. Hoback. 2011. New records of carrion beetles in Nebraska reveal increased presence of the American burying beetle, *Nicophorus americanus* Olivier (Coleoptera: Silphidae). Great Plains Research 21:131–143.

Klein, B.C. 1989. Effects of forest fragmentation on dung and carrion beetle communities in Central Amazonia. Ecology 70: 1715-1725.

Kozol, A.J. 1990. The natural history and reproductive strategies of the American burying beetle, *Nicrophorus americanus*. Unpublished report prepared for the U.S. Fish and Wildlife Service 15pp.

Kozol, A.J. 1995. Ecology and Population genetics of the endangered American burying beetle, *Nicrophorus americanus*. Ph.D. Dissertation, Boston University, USA.

Kozol, A.J., J.F.A. Traniello, and S.M. Wouldiams. 1994. Genetic variation in the endangered burying beetle *Nicrophorus americanus* (Coleoptera: Silphidae). Annals of the Entomological Society of America 6:928-935.

Lomolino, M. V. and J. C. Creighton. 1996. Habitat selection, breeding success and conservation of the endangered American burying beetle, *Nicrophorus americanus*. Biological Conservation 77:235–241.

Lomolino, M. V., J. C. Creighton, G.D. Schnell, and D. L. Certain. 1995. Ecology and conservation of the endangered American burying beetle, *Nicrophorus americanus*. Conservation Biology 9:605–614.

Marvier, M., P. Kareiva, M.G. Neubert. 2004. Habitat Destruction, Fragmentation, and Disturbance Promote Invasion by Habitat Generalists in a Multispecies Metapopulation. Risk Analysis 24, 869–878.

Oklahoma Department of Commerce. 2012 Demographic State of the State Report. Oklahoma State and County Population Projections through 2075. Found at: http://okcommerce.gov/wp-content/uploads/2015/06/Population_Projections_Report-2012.pdf

Oxley, D.J., M.B. Fenton, and G.R. Carmody. 1974. The effects of roads on populations of small mammals. J. Appl. Ecol. 11: 51-59.

Ratcliffe, B.C. 1996. The carrion beetles (Coleoptera: Silphidae) of Nebraska. Bulletin of the Nebraska State Museum Vol. 13. 100pp.

Schnell, G. D., A.H. Hiott and V. Smyth. 2011. Evaluation of American burying beetles on the Weyerhaeuser Habitat Conservation Plan Area 10 year Assessment Report 1997-2006.

Scott, M.P. and J.F.A. Traniello. 1987. Behavioral cues trigger ovarian development in the burying beetle *Nicrophorus tomentosus*. Journal of Insect Physiology 33: 693–696.

Sikes, D.S., and Christopher J. Raithel. 2002. A review of hypotheses of decline of the endangered American burying beetle (Silphidae: *Nicrophorus americanus* Olivier). Journal of Insect Conservation 6: 103–113.

Trumbo, S.T. 1992. Monogamy to communal breeding: exploitation of a broad resource base by burying beetles (*Nicrophorus*). Ecological Entomology 17:289-298.

Trumbo, S.T. and P.L. Bloch. 2000. Habitat fragmentation and burying beetle abundance and success. Jour. of Insect Conservation 4(4): 245-252.

United States Census Bureau. 2010. Osage County, Oklahoma Quick Facts. Found at: https://www.census.gov/quickfacts/fact/table/osagecountyoklahoma/PST045216

United States Department of Agriculture (USDA) – NRCS. 2009. Natural Resources Conservation Service. Establishing Native Warm Season Grass Mixtures. April 2009 Fact Sheet.

United States Fish and Wildlife Service (Service). 1991. American Burying Beetle (*Nicrophorus americanus*) Recovery Plan. Newton Corner, Massachusetts. 80 pp.

United States Fish and Wildlife Service (Service). 2008. Five-year review of the status of the American Burying Beetle. June 16, 2008. Southwest Regional Office, Albuquerque, New Mexico.

United States Fish and Wildlife Service (Service). 2016. American Burying Beetle Impact Assessment for Project Reviews. Oklahoma Ecological Services Field Office, Tulsa, Oklahoma. 19 pages.

Walker, T. J. 1957. Ecological studies of the arthropods associated with certain decaying materials in four habitats. Ecology 38(2) 262-276.

Wilson, E.O. 1971. The Insect Societies. Harvard University Press, Cambridge, MA.

Woods, A. J., J. M. Omernik, D. R. Butler, J. G. Ford, J. E. Henley, B. W. Hoagland, D. S. Arndt, and B.C. Moran. 2005. Ecoregions of Oklahoma (color poster with map, descriptive text, summary tables, and photographs): Reston, VA, US Geological Survey (map scale 1:1,250,000).

United States Department of the Interior
Bureau of Indian Affairs
Eastern Oklahoma Region
Osage Agency

OSAGE COUNTY OIL AND GAS BIOLOGICAL ASSESSMENT JULY 2017

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ATTACHMENTS

ACRONYMS AND ABBREVIATIONS

ACRONYMS AND ABBREVIATIONS	Full Phrase
ABB	American burying beetle
APD	application for permit to drill
APLIC	Avian Power Line Interaction Committee
BA	biological assessment
BIA	United States Department of the Interior, Bureau of Indian Affairs
BMP	best management practice
BO	biological opinion
˚C	degrees Celsius
CFR	Code of Federal Regulations
COAs	conditions of approval
CPA	USFWS American burying beetle Conservation Priority Area
CWA	Clean Water Act
CWS	Canadian Wildlife Service
DOI	United States Department of the Interior
EIS	environmental impact statement
ESA	Endangered Species Act of 1973
˚F	degrees Fahrenheit
FR	*Federal Register*
HCP	habitat conservation plan
ICP	American Burying Beetle Industry Conservation Plan
IPaC	USFWS Information Planning and Conservation system
MBTA	Migratory Bird Treaty Act of 1918
NEPA	National Environmental Policy Act of 1969
NTL	notice to lessee
NWR	USFWS National Wildlife Refuge
ODWC	Oklahoma Department of Wildlife Conservation
PEA	Programmatic Environmental Assessment
ROW	right of way
SPCC	spill prevention and control and countermeasure plan
T&E	threatened and endangered
US	United States
USACE	United States Army Corps of Engineers

USC	United States Code
USFWS	United States Department of the Interior, Fish and Wildlife Service

SECTION 1 INTRODUCTION

1.1 BACKGROUND

Under provisions of the United States (US) Endangered Species Act (ESA) of 1973, as amended (16 USC, Section 1531 et seq.), federal agencies are directed to conserve threatened and endangered (T&E) species and their habitats. Section 7(a) (1) states that all federal agencies shall "utilize their authorities in furtherance of the purposes of this Act by carrying out programs for the conservation of endangered species and threatened species…." Thus, the conservation and recovery of T&E species is not simply the responsibility of the US Fish and Wildlife Service (USFWS) but of all federal agencies.

The US Department of Interior (DOI) Bureau of Indian Affairs (BIA) Osage Agency is responsible for managing the Osage Mineral Estate in Osage County, Oklahoma, for the benefit of the Osage. The Osage Oil and Gas Program is governed by the 1906 Osage Allotment Act and regulations set forth in 25 CFR, Part 226. In addition, the Osage Agency Superintendent has issued various directives and policies, and the agency has developed best management practices (BMPs), which are incorporated into permits to drill and approvals for workover operations.

The purpose of this biological assessment (BA) is to evaluate the extent to which the existing Osage Oil and Gas Program (The Proposed Action; see **Section 2**) may affect T&E species.

Section 7(a) (2) of the ESA requires agencies such as the BIA to consult or confer with the USFWS when there is discretionary federal involvement or control over the proposed action. The ESA requires agencies to determine the impacts of the proposed action on listed species, and to ensure that listed species are afforded adequate consideration and protection. Informal consultation occurs when the federal agency, after discussion with the USFWS, determines that the proposed action is not likely to affect any listed species in the action area, and the USFWS concurs. Formal consultation occurs after the agency determines that the proposed action is likely to adversely affect listed species or critical habitat, or when the USFWS does not concur with the agency's finding (USFWS 1998).

This BA provides documentation and analysis for the proposed action. It addresses federally listed T&E species and has been prepared under the 1973 ESA Section 7 regulations, in accordance with the 1998 procedures set forth by the USFWS.

The BIA requests formal consultation leading to a programmatic biological opinion (BO) and incidental take statement for the American burying beetle (ABB). The BIA is proposing to, in coordination with the USFWS, assume certain responsibilities in order to effectively address covered oil and gas activities in Osage County, in occupied habitat within the USFWS ABB Planning Area. In addition, the BIA proposes to streamline processing time for oil and gas activities where there is a negative ABB survey or absence of suitable ABB habitat, as described in **Section 2.3**, American Burying Beetle Activities Under the Proposed Action.

The BIA also requests informal consultation and concurrence for the impacts of the proposed action on five additional T&E species and their critical habitat (see **Table 1-1**).

Table 1-1
List of Threatened and Endangered Species

Common Name	Species Name	Federal Status[1]	Critical Habitat[2]
Listed Species for Potential Consultation			
Invertebrates			
American burying beetle	*Nicrophorus americanus*	E	
Neosho mucket mussel	*Lampsilis rafinesqueana*	E	Designated
Birds			
Whooping crane	*Grus americana*	E	Designated
Red knot	*Calidris canutus rufa*	T	
Interior least tern	*Sternula antillarum athalassos*	E	
Piping plover	*Charadrius melodus*	T	Designated

Sources: USFWS 2015a; BIA 2015b
[1]Status: E = Endangered; T = Threatened
[2]Critical habitat: The planning area does not contain designated or proposed critical habitat.

1.2 SPECIES ADDRESSED

The species addressed in this BA are all listed T&E species or candidate species that are known to occur in the planning area (**Table 1-1**); the planning area does not contain designated or proposed critical habitat for any listed T&E species. In addition to the listed species in **Table 1-1**, the BA addresses one candidate species; rattlesnake-master borer moth (*Papaipema eryngii*). The planning area is described in detail in **Section 1.4**, Description of the Planning Area.

1.3 CONSULTATION HISTORY

The BIA has developed several BMPs during the preparation of NEPA documents, including but not limited to the Programmatic Environmental Assessment for Workover Operations (BIA 2015a) and the Draft Osage County Oil and Gas Environmental Impact Statement (EIS) (Draft Osage EIS; BIA 2015b). Although the USFWS is not a cooperating agency for the Draft Osage EIS, the BIA has met with the USFWS and described the resulting BMPs, several of which should help avoid, minimize, or mitigate wildlife-related impacts. The BMPs are summarized in **Section 2.4**, Best Management Practices.

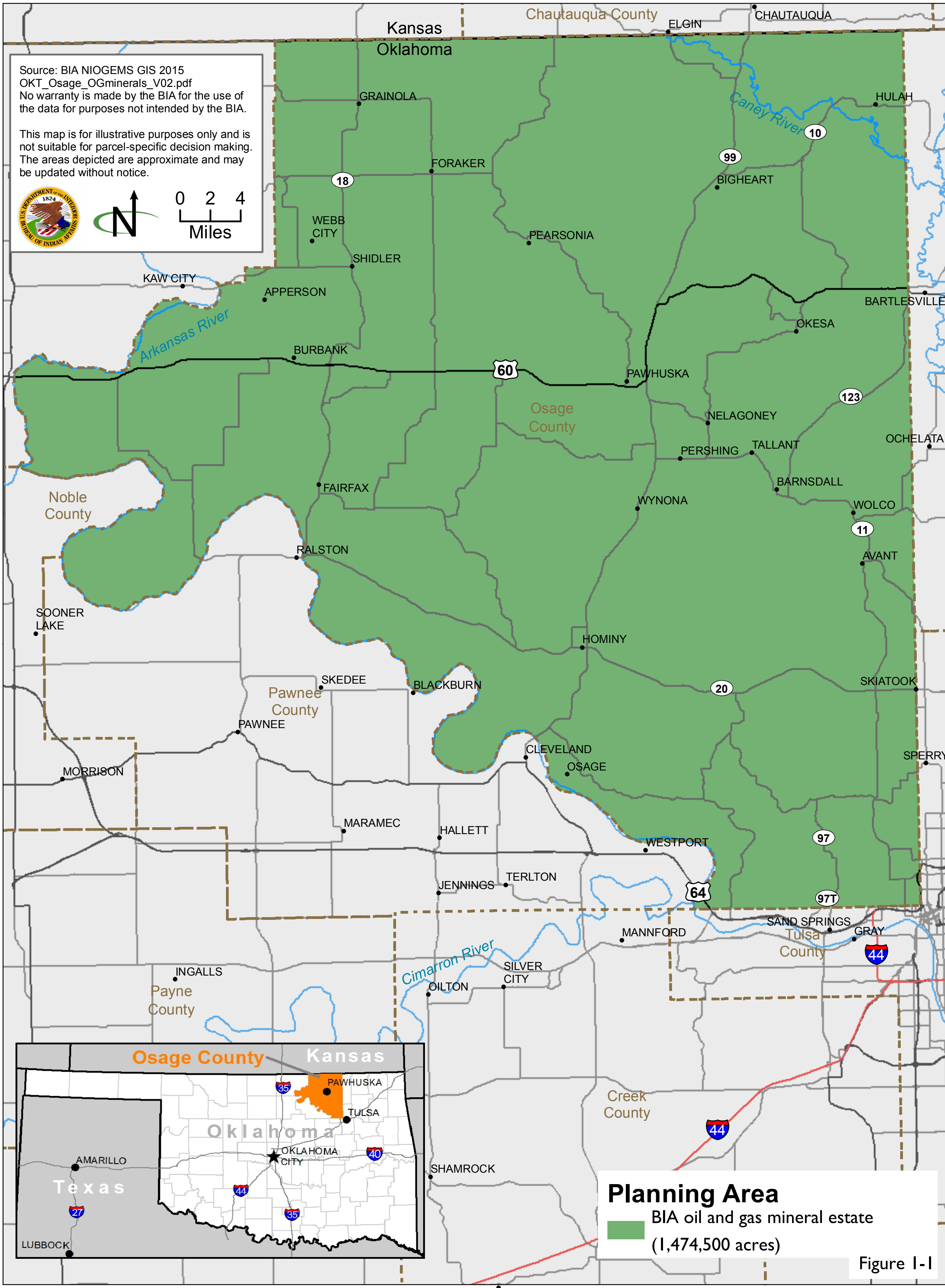
1.4 DESCRIPTION OF THE PLANNING AREA

Figure 1-1, Planning Area, represents the area subject to analysis in this BA (action area). The planning area covers all of the subsurface mineral estate in Osage County, approximately 1,474,500 acres. Osage County is in northeast Oklahoma, bordering Kansas. The BIA's Eastern Oklahoma Regional Office, Osage Agency manages all of the subsurface mineral estate in the county. **Table 1-2**, Planning Area Surface Ownership, and **Figure 1-2**, Surface Administration, show the acreage in each type of surface ownership in the planning area.

Table 1-2
Planning Area Surface Ownership

Landowner/Surface Management Agency[1]	Acres	Percentage of Total
Allotted	121,500	8
Private or other (not including The Nature Conservancy)	1,231,000	83
State	14,500	1
The Nature Conservancy	35,200	2
Tribal[2]	1,600	<1
US Army Corps of Engineers (includes open water)	70,700	5
Total	**1,474,500**	**100**

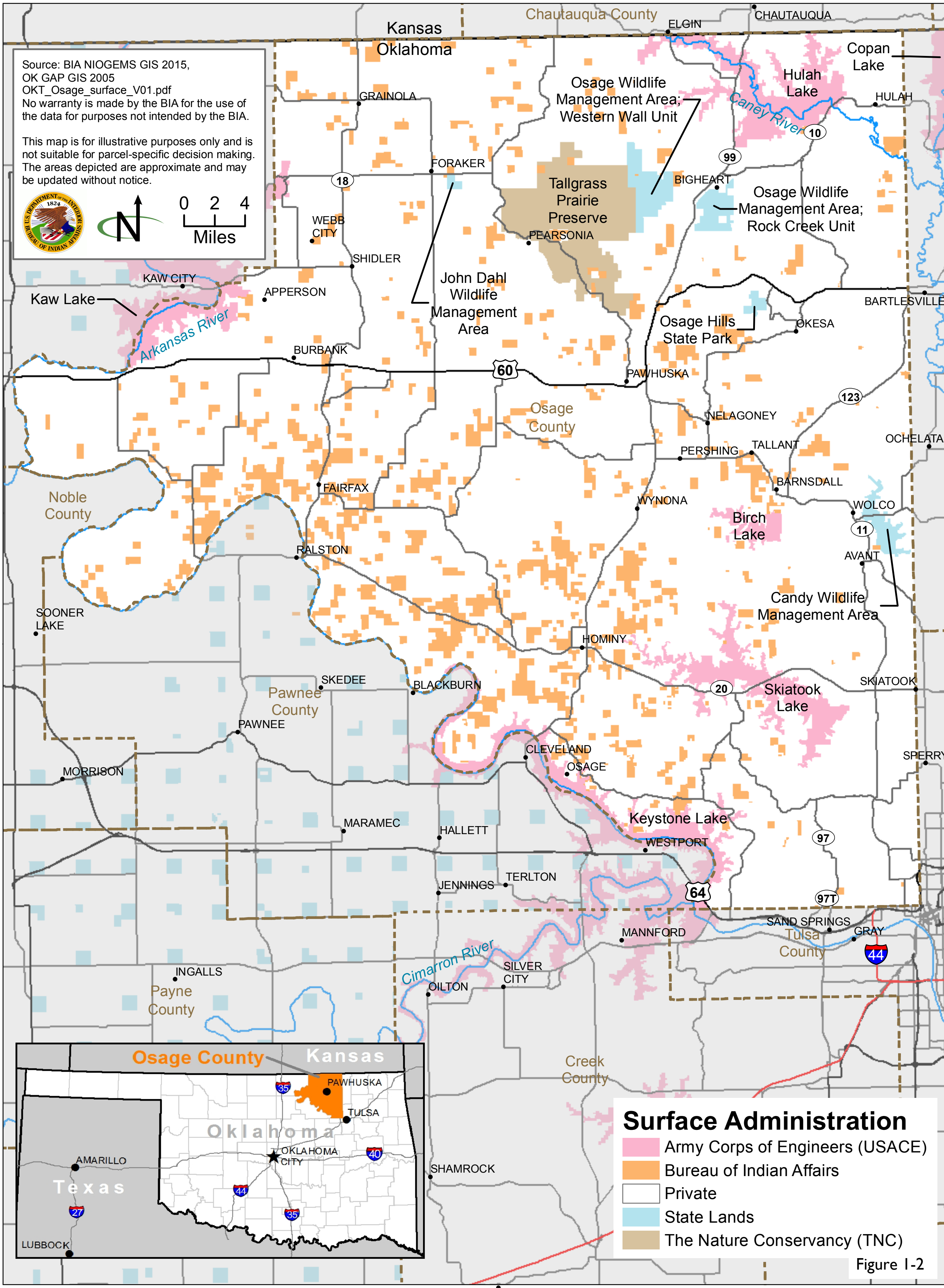
Sources: BIA NIOGEMS GIS 2015; OK GAP GIS 2008
[1]Land not identified as state, allotted, or tribal land was assumed to be privately owned.
[2]Tribal trust and allotted acreage is likely larger than that shown. The Osage Nation is working to determine the correct acreage of tribal lands in the planning area based on the historic reservation boundaries. The Tribe also owns lands in fee simple, and fee lands are not included in Table 1-2; for example, Osage Nation holds the "Bluestem Ranch" tract (approximately 43,000 acres) in fee.



Planning Area

BIA oil and gas mineral estate (1,474,500 acres)

Figure 1-1



Source: BIA NIOGEMS GIS 2015, OK GAP GIS 2005 OKT_Osage_surface_V01.pdf No warranty is made by the BIA for the use of the data for purposes not intended by the BIA.
This map is for illustrative purposes only and is not suitable for parcel-specific decision making. The areas depicted are approximate and may be updated without notice.
0 2 4
Miles
N
Kansas
Oklahoma
Chautauqua County
ELGIN
CHAUTAUQUA
Copan Lake
Hulah Lake
HULAH
Caney River
Osage Wildlife Management Area; Western Wall Unit
GRAINOLA
FORAKER
BIGHEART
Tallgrass Prairie Preserve
PEARSONIA
Osage Wildlife Management Area; Rock Creek Unit
WEBB CITY
SHIDLER
John Dahl Wildlife Management Area
KAW CITY
Kaw Lake
APPERSON
Arkansas River
Osage Hills State Park
BARTLESVILLE
OKESA
BURBANK
PAWHUSKA
Osage County
NELAGONEY
PERSHING
TALLANT
OCHELATA
BARNSDALL
FAIRFAX
WYNONA
WOLCO
Noble County
Birch Lake
RALSTON
AVANT
Candy Wildlife Management Area
SOONER LAKE
HOMINY
SKEDEE
BLACKBURN
Pawnee County
Skiatook Lake
SKIATOOK
PAWNEE
CLEVELAND
OSAGE
SPERRY
MORRISON
MARAMEC
HALLETT
Keystone Lake
WESTPORT
JENNINGS
TERLTON
SAND SPRINGS
GRAY
Tulsa County
MANNFORD
INGALLS
Payne County
Cimarron River
SILVER CITY
OILTON
Creek County
SHAMROCK
Osage County
Kansas
PAWHUSKA
TULSA
Oklahoma
OKLAHOMA CITY
AMARILLO
Texas
LUBBOCK
18
99
10
60
123
11
20
97
64
97T
44
35
40
27
Surface Administration
Army Corps of Engineers (USACE)
Bureau of Indian Affairs
Private
State Lands
The Nature Conservancy (TNC)

Figure 1-2

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SECTION 2
PROPOSED ACTION

2.1 PROPOSED ACTION

The proposed action is summarized in this section. The objective of the proposed action is to promote oil and gas production and, to the extent possible, to minimize potential adverse environmental impacts on landowners, wildlife, and natural and cultural resources from noise, traffic, excavations, dust, and other disturbance associated with construction and operations under oil and gas leases. To achieve this objective, the BIA would continue to apply BMPs (see **Section 2.4**, Best Management Practices) to the following types of activities under oil and gas leases, which are described in more detail in **Section 2.2**, Oil and Gas Activities under the Proposed Action:

- Activities within the scope of the BIA's (2015a) Workover Programmatic Environmental Assessment (PEA; workover activities)
- Applications for permit to drill (APDs) and other permitted and non-permitted lease activities

Under the proposed action, lessees must comply with and obtain any necessary permits or authorizations required under 25 CFR, Part 226, and other federal laws, including the ESA (1973), Clean Water Act (1972), Clean Air Act (1963), Safe Drinking Water Act (1974), and National Historic Preservation Act (1966).

All lessees must comply with the requirements of 25 CFR, Part 226, an approved lease, and the terms and conditions of any BIA-issued permit or approval. The BIA is authorized to apply requirements in the form of notices to lessees (NTLs) or Orders of the Superintendent to ensure that all operations are conducted in a manner that protects natural resources, environmental quality, and life and property. Through a combination of permit terms and conditions of approval (COAs), as well as NTLs and orders, the BIA may specify applicable requirements and practices that are interpreted as necessary or considered to be appropriate measures to protect natural resources in compliance with the regulations. The BIA would generally not apply measures that would prohibit development of an approved lease, but would first seek to impose reasonable measures for avoidance, minimization and mitigation of impacts from oil and gas activities.

2.2 Oil and Gas Activities Under the Proposed Action

Typical oil and gas activities included in the proposed action are summarized in this section. The term "Covered Activities" under the BIA's proposed action and this BA includes all of the described facilities and activities for which BIA has jurisdiction and regulatory authority.

Geophysical exploration is the process of locating oil and gas deposits beneath the earth's surface. This involves generating seismic waves and measuring their reflectance through differing geologic structures. Ground disturbance associated with geophysical exploration may include clearing vegetation or road construction.

Non-permitted lease activities include those activities on a lease that are not associated with issuance of a drilling permit or performance of a workover review. These can include some ground-disturbing activities such as changes to established access roads or burial or rerouting of existing flow lines. Appropriate conservation measures may be imposed in this instance by standard lease or permit conditions, or a site-specific NTL or order issued by the Superintendent. The BIA may initiate consultation with USFWS under Section 7(c) of the ESA for species other than the ABB at any time it becomes necessary, for activities which require BIA approval or that are within the scope of standard permit conditions.

Potential workover activities (BIA 2015a) associated with operation and maintenance of wells generally do not include new ground disturbance. These activities include acid fracturing, new drilling or modification of bores on existing well pads, well conversions (gas to oil or oil to gas), plugging and abandonment, re-drilling a previously plugged well and other activities. A full description of workover activities can be found in the BIA's (2015a) Workover PEA.

Permits to drill and other BIA-authorized activities may include construction, operation, and maintenance of new and existing well field infrastructure and decommissioning of obsolete facilities. Activities may include geophysical exploration, well pad, road, and other infrastructure construction, as well as operation and maintenance of infrastructure.

Well pads include all structures and equipment necessary for recovering crude oil or natural gas, obtaining water for oil and gas recovery, or fluid disposal following production. Typical well pad construction requires vegetation clearing, grading to level the pad, constructing storm water and erosion control structures, laying shale, gravel, and/or rock over the well pad, and constructing pits, trenches, and sumps. Constructing an impoundment outside of the existing well pad is sometimes needed to maintain a water source for hydraulic fracturing operations.

Development of well fields relies on existing roadways or may require constructing new roads. Newly constructed roads are first cleared of vegetation with a bulldozer and leveled with a road grader. Shale, rock, or gravel is used to stabilize the length of the road.

Following construction of access roads and well pads, drilling rigs and associated equipment are transported to the well pad and installed. All drilling activities occur within the previously disturbed (cleared and graded) well pad. After drilling is completed, the rig is removed and hydraulic fracturing equipment may be brought onto the well pad to facilitate production. All activities associated with drilling and well completion occurs on previously disturbed areas. After drilling and completion, typically 75 percent of the well pad and associated activities (i.e. rights-of-way, roads, utility lines, etc.) is re-vegetated. The remaining 25 percent is typically maintained for oil/gas development activities.

Oil and gas pipeline construction involves land clearing activity where pipeline rights-of-way (ROWs) are cleared and graded. Pipeline construction ROWs are typically divided into four areas of activity: trenching, spoil piles (excavated materials consisting of topsoil or sub-soils that have been removed and temporarily stored during the construction activity), pipeline assembly, and vehicle traffic areas. Pipeline ROW widths are determined by the pipeline diameter and material, as well as terrain and site-specific conditions. After pipeline installation and backfilling the trench, work areas are graded and restored as closely as possible to preconstruction contours, and previously segregated topsoil is spread across the construction ROW. Pipe installation by conventional or directional boring, also known as horizontal direction drilling, may be utilized at roads, railroad crossings, water crossings, or in other sensitive areas to minimize disturbance.

Surface facilities associated with crude oil, natural gas, and petroleum product pipelines may include access roads, booster stations, pump stations, compressor stations, valve sites, meter stations, pig (a device used to clean and/or inspect pipelines) launchers and receivers (locations where pigs are inserted into or removed from a pipeline), processing/treatment plants, communication towers, electric distribution lines and other utilities, electric substations, and others.

2.3 American Burying Beetle Activities Under the Proposed Action

Under the current process, lessees proposing oil and gas activities with potential to disturb suitable ABB habitat may conduct surveys for the presence of ABBs or assume presence and apply for an incidental take permit through Section 7 and/or 10 of the ESA. Currently, in the case of a positive ABB survey, the lessee has the following options: 1) obtain an incidental take permit through the USFWS' ICP process under Section 10 of the ESA, 2) obtain an incidental take permit through an individual habitat conservation plan (HCP) under Section 10 of the ESA, or 3) obtain an incidental take permit through a formal consultation between the BIA and the USFWS (this would be a site-specific or batched Section 7 consultation, not a programmatic one).

The ABB ICP is a general conservation plan developed by the USFWS with oil and gas industry input. It offers project proponents a streamlined permitting process that results in the same assurances and protections as an HCP. Within its 45-county planning area in Oklahoma, it provides the oil and gas industry with a mechanism for incidental take authorization during construction, operation, maintenance, repair, and decommissioning of oil and gas projects and it also describes measures to minimize and mitigate take of the ABB and impacts on its habitat.

The BIA is proposing to adopt certain provisions of the USFWS' ABB ICP, as outlined in this BA. These provisions will apply to lessees who have a positive ABB survey or wish to presume that the ABB is present.

Currently, if there is a negative survey result, unless the BIA makes a "no effect" determination, then the BIA must submit an individual consultation package and wait up to 45 days for a response from the USFWS. ABB surveys conducted in the early season may have to be duplicated, due to processing time for the agencies and the requirement of a 30-day posting of the Notice of Availability for the site-specific EA before permits can be approved. Projects that would impact ABB habitat during the inactive season (usually late September to mid-May) must have ABB surveys conducted after July 28. Late season surveys may be necessary to extend the window for drilling permits to be issued, and allow the project to be initiated during the ABB inactive/dormant season.

BIA is proposing that USFWS eliminate the requirement for individual package submittal and the 45-day processing period, in cases where there is a negative survey or determination (with supporting documentation) that no ABB habitat exists in the area of proposed activities. In this situation, the BIA would still require appropriate BMPs as permit conditions, and would include any necessary site-specific permit conditions based upon review of project plans and NEPA documents. BIA would also report annually to the USFWS acreages of temporary, permanent cover change, and permanent impacts.

The BIA is also consulting with the USFWS on the Osage Oil and Gas Program (the proposed action) on a programmatic level to have USFWS authorize incidental take through a programmatic BO for oil and gas activities that may impact the ABB. The programmatic BO will allow for streamlining and efficiencies in the process.

The programmatic BO would authorize incidental take for the BIA based on the estimated acres of suitable ABB habitat ("occupied habitat") disturbed by oil and gas activities annually. This is approximately a maximum of 600 acres, comprised of 450 acres of temporary disturbance and 150 acres of permanent disturbance (see *Assumptions and Methods* of analysis for ABB in **Section 4.2.1**, American Burying Beetle). The BIA would report annually to the USFWS the number of acres disturbed under its programmatic incidental take statement. If annual acres of disturbance exceed the limit defined in the incidental take statement, the BIA would re-initiate consultation with the USFWS.

Before ground-disturbing oil and gas activities begin within the ABB's range in the planning area, (see **Figure 3-1**, American Burying Beetle) and not within the list of Areas Unfavorable for the ABB (USFWS 2015b), a presence/absence survey would be conducted. Surveys would be necessary for well drilling and workover operations that result in ground disturbance beyond the extent of an existing well pad, road, or other disturbed area. Surveys would be based on the most recent USFWS Oklahoma survey guidance. Lessees also may assume presence of ABBs and proceed with actions through section 7 or 10 of the ESA.

For workover operations tiered to the Workover PEA, the BIA requires that these activities not disturb the ground beyond the extent of the existing disturbance. Therefore, workover operations tiered to the Workover PEA (or any superseding NEPA document that encompasses the Workover PEA) may not require ABB surveys.

Applicants for workover permits must provide photographic documentation of vegetation height on the well pad where work is proposed. If well pad vegetation height is below 8 inches, the BIA would assume that habitat for ABB is not present. In these cases, the BIA makes a "no effect" determination, and site-specific consultation with the USFWS is not necessary.

If photographic documentation accompanying a workover application shows vegetation height is above 8 inches, the BIA would visit the site to determine what type of ABB habitat is present. If well pad soils are compacted or contain a high percentage of rock or gravel, and there is excessive vegetation height, that would indicate potential foraging habitat for ABB. If well pad soils are conducive to ABB burrowing or burying carrion that would be considered suitable ABB habitat for reproduction

Vegetation may be removed from areas suitable as foraging habitat for the ABB only during the inactive season. The lessee must commit through conditions of approval of the permit, to maintain the vegetation height of the project area at a height of 8 inches or less until the proposed workover or plugging action has been implemented or until the permit expires in 2 years. The proposed activity may commence immediately after vegetation removal has been completed within the inactive season without the need of a presence/absence survey.

Vegetation may also be removed during the inactive season in situations where the well pad has suitable reproduction habitat for the ABB; however, the lessee must commit to only removing the vegetation through the use of hand tools (e.g., weed eaters, manual weed cutter, etc.) and will not be able to utilize heavy machinery such as riding mowers or tractors/brush hogs to remove vegetation. The lessee must also commit to delaying the implementation of the proposed activity until after the beginning of the ABB active season (approximately May 15th of each year). The proposed activity may not commence during the inactive season after the vegetation removal due to the fact that the ABB may still be dormant in the ground within the perimeter of the well pad. Delaying project implementation will allow for the temperatures to become high enough for the ABB to become active, emerge from the ground and leave the project area. After the active season has begun then the proposed activity may commence without the need for an ABB presence/absence survey.

In both situations the BIA will require that the lessee maintain the vegetation below 8 inches until the project is either implemented or the permit expires. The BIA would make a "no effect" determination due to the fact that no suitable habitat will exist within the project area at the time of project implementation.

Well workover and plugging permits on leases are generally valid for a term of 2 years; however, an order of the Superintendent, NTL or special permit condition may be utilized, when justified, to reduce the period of potential disturbance to ABB habitat from maintaining vegetation height below 8 inches.

If vegetation were to be removed during the ABB active season, an ABB survey would be required. If the survey results are negative, vegetation removal could begin according to the procedure outlined below for valid negative ABB survey results. Alternatively, the lessee could wait until the ABB's inactive season to begin vegetation removal as described above.

When surveys are required, and survey results are negative, lessees would report them to the USFWS and the BIA. For lessees relying on negative early season survey results, the early season survey results would remain valid until the end of the ABB active season. Late season negative survey results would remain valid until the beginning of the next active season. Development activities with valid negative ABB surveys would receive a "may affect, not likely to adversely affect" determination or a "no effect" determination from the BIA. Under the current system, this would require site-specific consultation with the USFWS for concurrence on the determination.

Under the proposed action, the BIA requests that the USFWS issue a blanket concurrence for the BIA's determination that development, with valid negative ABB surveys, "may affect, not likely to adversely affect" or would have "no effect" on ABB. In these circumstances, site-specific consultation with the USFWS would no longer be necessary, thus eliminating the need to submit individual project packages to USFWS and eliminating the 45-day processing period. Lessees would have approval to proceed after the BIA confirms that survey results have been submitted to USFWS for review. This will enhance the efficiency of the BIA permitting process. As stated above, the BIA would annually report to USFWS the acreages of disturbance for activities authorized in unoccupied ABB habitat, and BIA would also include appropriate permit conditions to avoid significant environmental impacts identified through the review of project plans and the NEPA process.

When ABB surveys are positive, or when presence is assumed, lessees would be required to minimize or mitigate the proposed disturbance, in accordance with the procedures detailed in this BA and the programmatic biological opinion. BIA is adopting the minimization and mitigation measures listed in **Attachment A.**

Lessees with positive ABB surveys would be required to follow the minimization and mitigation measures listed in Attachment A. BIA will calculate the acreages and require appropriate documentation and reporting for the following types of impacts:

Temporary Impacts
Temporary impacts include areas of ground disturbance resulting from covered activities restored to a condition suitable for ABB use within 5 years of the impact with similar vegetative cover.

Permanent Cover Change Impacts
Permanent cover change impacts are defined here as changing a vegetation cover type to a different vegetation cover type (e.g., forest or scrubland to grassland), resulting in increased fragmentation of habitat. Similar to temporary impacts, these areas will need to be restored to a condition suitable for ABB use within 5 years. If these areas will be purposefully maintained (through vegetation control) as a different land cover type than prior to project implementation, it will be considered a permanent cover change. Impacts within ROWs (for projects such as pipeline and electric distribution lines) that have a permanent change in cover and are immediately adjacent and parallel to existing ROWs, may be considered temporary because they do not increase habitat fragmentation. Co-locating ROWs along existing ROWs, roads, or other interruptions in habitat does not contribute to further fragmentation or edge effect and is preferable to crossing previously undisturbed areas.

Permanent Impacts
Permanent impacts are those that eliminate ABB habitat (i.e., buildings, roads, quarries, strip mines), as well as any impact to habitat that takes more than 5 years to restore to ABB habitat. Permanent impacts to ABB habitat are expected to result in the greatest amount of take of individuals of the species.

2.3.1 Mitigation Ratios

BIA will utilize mitigation ratios established by the USFWS. These mitigation ratios are set forth in **Table 2-1**.

Table 2-1
Mitigation Ratios[1]

Impact Period	ABB Range Outside Conservation Priority Area	Conservation Priority Area	Mitigation Land[2]
Temporary	1:0.25	1:0.5	1:1.5
Permanent Cover	1:0.5	1:1	1:2
Permanent	1:1	1:2	1:3

[1] Mitigation Ratios are acres of impact: acres of mitigation
[2] Mitigation land ratio is equal to the CPA ratio plus the mitigation acres impacted

Each acre of *temporary impact* (≤5 years)[1] occurring within the ABB range (but not within a CPA), would require 0.25 acres of mitigation (1:0.25 ratio). The ABB Conservation Priority Areas (CPAs) contribute more towards ABB conservation compared to other areas within the species range, and therefore the ratio for each acre of temporary impact within a CPA is one-half acre of mitigation (1:0.5). To mitigate for each acre of temporary impact within a conservation bank or on mitigation lands the mitigation ratio is 1:1.5.

For *permanent cover change* impacts occurring within the ABB range, 0.5 acres of mitigation will be required (1:0.5 ratio) for each acre of impact. The ratio for each acre of these impacts within a CPA is 1 acre of mitigation (1:1). To mitigate for each acre of permanent cover change impact on mitigation lands, the mitigation ratio is 1:2, which is the same as the ratio for impacts in a CPA, plus replacement for the acre of mitigation from prior projects that would be impacted by the action.

Permanent impacts to occupied ABB habitat have higher mitigation ratios because they are expected to result in the highest level of effects over the longest period of time. For permanent impacts (>5 years) occurring within the ABB range, 1 acre of mitigation will be required for each acre of impact (1:1 ratio). The ratio for each acre of permanent impact within a CPA is 2 acres of mitigation (1:2), and on mitigation lands, the mitigation ratio is 1:3, which is the same as the ratio for impacts in a CPA, plus replacement for the acre of mitigation from prior projects that would be impacted by the action.

2.3.2 Verification of Mitigation and Reporting

Lessees in cooperation with BIA will estimate which type of habitat impact will occur on each portion of the project area and mitigate appropriately, with BIA approval, prior to any ground-disturbing activities likely to result in take of ABBs

[1] If the area has not become suitable for ABB use within 5 years following the temporary or permanent cover change impact start date, Lessees must provide additional mitigation prior to the end of the 5 year period, since the impact was actually permanent instead of temporary or permanent cover change. The amount of additional mitigation required is the difference between the amount of mitigation required for a permanent impact and the amount of mitigation previously secured as a temporary or a permanent cover change impact.

in occupied ABB habitat. Proof of purchase of mitigation credits at an approved bank, or proof of other mitigation method acceptable to USFWS, must be provided to the BIA Osage Agency prior to issuance of a permit or other approval of ground-disturbing activity. All offsite mitigation provided for the ABB must be within a location approved by the USFWS.

Lessees estimating temporary or permanent cover change impacts within all or part of their project area will mitigate with appropriate ratios prior to impacts and document the impact start date (the date impacts to occupied ABB habitat began). All areas mitigated as temporary or permanent cover change impacts must implement post-construction restoration measures described in Attachment A and these areas must be restored to a condition suitable for ABB use within 5 years of the impact start date. Lessees will include information about restoration methods within their annual reports submitted to BIA. When a Lessee has restored these areas, they will submit their restoration report to the BIA.

Unless there is a positive ABB survey result, applicants for BIA drilling permits, workover approvals, and other approvals would not need to be assigned acres pursuant to the BIA's incidental take statement and no acres will be deducted from the total acreage for ABB.

For all oil and gas operations that require soil disturbance, regardless of survey results, lessees must report to the BIA the number of acres temporarily disturbed and the number of acres permanently disturbed. The BIA will report to the USFWS annually the acres of suitable ABB habitat disturbed, under the programmatic BO and incidental take statement. The BIA's reports will include total acres disturbed, compiled from lessee reports and other available information such as maps and site inspection data.

For oil and gas operations outside of ABB range delineated by the USFWS, the action would not affect ABB and consultation with the USFWS for the ABB would not be required.

2.4 BEST MANAGEMENT PRACTICES

The BIA is consulting with the USFWS to confirm that the proposed action and mitigation ratios described in **Section 2.3** and Attachment A, Minimization and Mitigation Measures, along with the BMPs listed in **Table 2-2**, implemented as described through the Osage Oil and Gas Program, are appropriate and adequate to comply with requirements of the ESA for the ABB. In addition, BIA requests USFWS concur that the implementation of the BMPs (**Table 2-2**) and specific measures described in **Section 5** for other T&E species included in this BA, are appropriate. If there is a significant change in the BMPs or the Osage Oil and Gas Program due to ongoing NEPA activities and/or rulemaking, BIA will notify USFWS and reinitiate discussions if appropriate.

Table 2-2
Best Management Practices

	Best Management Practice	Is the BMP Included in Standard Drilling BMPs[1]	Included in Workover PEA BMPs[2]	Wildlife Related
1	Avoid impacts on National Register-eligible or unevaluated cultural resources on well sites and access roads. If cultural resources are discovered during construction or operation, stop work immediately, secure the affected site, and notify the BIA and Tribal Historic Preservation Officer. In the event of a discovery, work in that area shall halt and not resume until written authorization to proceed has been received from the BIA. All surface disturbances must be kept within the proposed ground disturbance area described in the NEPA document. Expansion or relocation of the well pads, access roads, or other implementation of additional activities not included in the approved NEPA document is prohibited unless an appropriate cultural resources survey has been submitted and determined adequate——approved by the BIA Osage Agency—and all appropriate permits have been obtained.	X	X	
2	Avoid or minimize soil and vegetation disturbance. Avoid removal of or damage to trees, shrubs, and groundcover to the extent possible. Avoid or minimize alteration of the natural topography, and limit activities on steep slopes.	X	X	X
3	Erosion control measures are required for the duration of the construction, drilling, and completion phases of the project. Erosion control measures must minimize the impact of soil, debris, or contaminants moving from the well site to adjacent lands and waterways.	X	X	X
4	All vehicles and equipment must utilize and stay confined to existing and new roads described in the approved NEPA document. These roads must be maintained and upgraded as needed according to BIA direction and agreements between the operator and surface owners.	X	X	X
5	Tank batteries must have a Spill Prevention and Control and Countermeasure Plan (SPCC) in compliance with EPA Regulations under 40 CFR, Part 112. A fluid impermeable secondary containment dike/berm must be constructed around any tank battery and facilities according to 40 CFR, Subpart 112.7. The dike/berm and entire containment area must be graveled. No water collected within the secondary containment shall be discharged. In accordance with the SPCC plan and the BIA regulations, the lessee will immediately notify the BIA of all spill incidents.	X	X	X

Table 2-2
Best Management Practices

	Best Management Practice	Is the BMP Included in Standard Drilling BMPs[1]	Is the BMP Included in Workover PEA BMPs[2]	Is the BMP Wildlife Related
6	No venting or flaring of gas is allowed unless prior written approval of the BIA Osage Agency Superintendent has been obtained.	X	X	X (where applicable)
7	Store and label chemicals properly (including secondary containment). Do not store equipment or chemicals on-site if they are not being used on-site. Do not leave open containers of chemicals or wastes on-site.	X	X	X
8	Keep sites clean and free of any litter, trash, old equipment, contaminated soil, or unused containers. Promptly dispose of any wastes at an appropriate recycling facility, approved landfill, or other approved location. Remove any unused equipment not necessary to the operation of the lease after drilling activities have been completed.	X	X	X
9	If the well is successful, all production equipment, facilities, and tanks, including well-head and aboveground piping/equipment, shall be properly enclosed to exclude livestock if present.	X	X	—
10	All pits (including tank batteries contained within a dike/berm) must be enclosed with a fence of at least four strands of barbed wire, or approved substitute. All earthen pits to be used for storage of salt water or other deleterious substances must be lined with an impermeable layer to prevent contamination of soils and groundwater. Temporary pits must be filled and leveled immediately upon completion of the activity.	X	X	X[2]
11	To the extent possible, minimize disturbance to land owners, wildlife, and natural resources due to noise, excessive traffic, dust, or other impacts associated with operations.	X	X	X
12	Do not conduct activities within stream channels or wetlands without proper authorization. Avoid any discharge of soil or contaminants or removal of stream water that could result in a violation of applicable federally approved water-quality standards.	X	X	X[3]

[2] BIA agrees to modify this BMP/permit condition to include the requirement of netting for open pits and tanks, as required by USFWS, to protect migratory birds.
[3] Authorization must be obtained from BIA and the USACE.

Table 2-2
Best Management Practices

	Best Management Practice	Is the BMP Included in Standard Drilling BMPs[1]	Included in Workover PEA BMPs[2]	Wildlife Related
13	Return disturbed area to original contour or as directed by the surface owner. If needed, add clean soil to disturbed areas. Restore disturbed areas by reestablishing vegetation using seed, sod, or other approved method. Restore with native species unless otherwise directed by the surface owner in writing and approved by the BIA. No noxious or invasive species may be used in revegetation and reclamation activities.	X	X	X
14	If well drilling, completion, and development <u>are</u> successful, all areas of the surface disturbance (i.e. well pad, access road, pipeline, etc.) that are not needed or used in the production or operation of the well shall be promptly reclaimed as described in the approved NEPA document. If well drilling, completion, and development <u>are not</u> successful, reclamation of the entire area will begin promptly. After a producing well is no longer in production, reclamation of the site will begin promptly. Reclamation shall be completed not later than ninety (90) days from rig removal, well abandonment, or final plugging of a well, unless otherwise approved by the BIA.	X	X	X
15	The lessee shall conduct activities in a manner that avoids any potential take or harm to federally listed T&E species, or in a manner that complies with any permit or authorization issued by the USFWS. Lessee must follow guidance in the USFWS "Oklahoma Ecological Services Field Office Migratory Bird and Eagle Impact Avoidance Measures for Actions Associated with Oil and Gas Projects" (April 2014), found at the following website: http://www.fws.gov/southwest/es/oklahoma/documents/abb/abb_icp/migbird%20and%20eagle%20avoidance%20measures%20april2014.pdf	X	X	X
16	Lessee must follow the USFWS's established protocol regarding areas where the American burying beetle (ABB) is known or suspected to exist. See http://www.fws.gov/southwest/es/oklahoma/ABBICP.htm. If proposed operations require the construction of a drilling pit or other excavation activity by heavy equipment, then the lessee must ensure that	X	X	X[4]

[4] Once the Programmatic BO is issued, this BMP will be superseded by the process and requirements outlined in the BA and Programmatic BO.

Table 2-2
Best Management Practices

	Best Management Practice	Is the BMP Included in Standard Drilling BMPs[1]	Is the BMP Included in Workover PEA BMPs[2]	Is the BMP Wildlife Related
	suitable habitat for the ABB does not exist. If proposed operations will impact suitable habitat for the ABB, it will be the responsibility of the lessee to obtain authorization from the USFWS to proceed with that portion of the project.			
17	Approval must be obtained from the Environmental Protection Agency prior to the commencement of workover operations related to underground injection, construction, or conversion of saltwater injection/disposal wells.	—	X	—

Notes:
[1] BMPs as detailed in the BIA's Workover Programmatic Environmental Assessment (BIA 2015a)
[2] BMPs as detailed in the BIA's standardized list of drilling BMPs to be applied to permitted activities

Because applicants would be required to comply with appropriate permit conditions and BMPs described for that species, individual Section 7 consultations would no longer be required for valid negative ABB results or for other T&E species where the BIA makes and documents a "no effect" or "may affect, not likely to adversely affect" determination. This determination would be based on the absence of habitat, valid negative ABB surveys, or minimization/mitigation measures and applied BMPs.

The BMPs in **Table 2-2** are tailored to planning area-specific conditions and issues; therefore, as a general rule, these measures could be applied through COAs to all new permitted activities and workovers in the action area. The BIA would have flexibility to tailor COAs or to allow exceptions based on site-specific circumstances. Exceptions could be granted where a BMP was not applicable, where the goal is achieved through regulation or another mechanism, or where another measure proposed by the lessee would achieve the goals of the BMP, given site-specific conditions.

The BIA would ensure compliance with the Migratory Bird Treaty Act of 1918 (MBTA; 16 USC, Sections 703-712) through use of BMP 15 and/or COAs, NTLs or orders of the Superintendent, as appropriate. Compliance would continue to be ensured through site-specific NEPA analysis, permit conditions, and inspections by federal agencies. The BIA would continue to require lessees to implement measures to protect migratory birds, including by installing netting over pits and tank batteries, as part of conducting activities in a workmanlike manner under 25 CFR, Part 226.19.

Table 2-2 describes the BMPs included as part of the proposed action. Also see **Attachment A**, USFWS American Burying Beetle Minimization and Mitigation Measures, and **Attachment B**, Standardized BMPs for Workovers and Drilling Permits.

SECTION 3
EVALUATED SPECIES

3.1 INTRODUCTION

Six listed T&E species and their critical habitat are addressed in this BA (see **Table 1-1**). This section describes the following for each species:

- Species description
- Life history
- Status and distribution
- Environmental baseline
- Critical habitat
- Threats

The environmental baseline is defined by the regulations implementing the ESA (50 CFR, Part 402.02) as the following:

- Past and present impacts of all federal, state, and private actions and other human activities in the action area
- The anticipated impacts of all proposed state or federal projects in the action area that have already undergone formal or early Section 7 consultation
- The impact of state or private actions that are contemporaneous with the consultation process

The action area is defined at 50 CFR, Part 402, to mean "all areas to be affected directly or indirectly by the federal action and not merely the immediate area involved in the action." For the purposes of this consultation, the action area includes lands and subsurface mineral estate in Osage County, and those areas nearby that could be affected by the proposed action.

3.2 LISTED SPECIES

3.2.1 American Burying Beetle (*Nicrophorus americanus*)

Species Description

The ABB is the largest carrion beetle in North America, reaching 1.0 to 1.8 inches (2.5 to 4.6 centimeters) in length (Wilson 1971; Anderson 1982; Backlund and Marrone 1997, in USFWS 2014c). ABBs are black, with the most diagnostic feature being a large orange-red marking on the raised portion of the pronotum;[5] this is a feature shared with no other members of the genus in North America (USFWS 1991). The ABB also has orange-red frons[6] and a single orange-red marking on the clypeus.[7] Antennae are large, with notable orange club-shaped tips (USFWS 2014c).

Life History

The ABB is a nocturnal species active in the summer, when ambient nighttime air temperatures consistently exceed 60 degrees Fahrenheit (°F; 15.5 degrees Celsius [°C]; USFWS 1991). During the daytime, ABBs likely bury themselves in vegetation litter (USFWS 2014c). Adult ABBs bury into the soil during the inactive season when ambient nighttime air temperatures consistently fall below 60 °F (15.5 °C; USFWS 1991). In Oklahoma, this typically occurs for approximately 8 to 9 months, from late September until mid-May (USFWS 2014b), depending on temperatures (USFWS 2014c). Reported inactive season burying depths vary from 0 to 27 inches (0 to 68.6 centimeters; Schnell et al. 2007; Hoback 2011, in USFWS 2014c).

ABBs are scavengers, and feed upon carrion prey. Adults locate carcasses using chemoreceptors on their antennae. Beetles are capable of finding carrion at a distance of up to 18.6 miles (30 kilometers; Jurzenski et al. 2011, in USFWS 2014c).

The ABB is considered a habitat generalist when searching for food items. It has been successfully live-trapped in native grasslands, grazed pasture, riparian zones, coniferous forests, mature forest, and oak-hickory forest, as well as on a variety of soil types (Creighton et al. 1993; Lomolino and Creighton 1996; Lomolino et al. 1995, in USFWS 2014c; USFWS 1991). In Oklahoma, ABB habitat consists of fragmented grassland/woodland matrices (USFWS 2014c).

Adult ABBs seek a mate soon after emerging from the inactive season. Typically, both male and female ABBs bury an entire carcass. Once underground, both adults remove the fur or feathers, roll the carcass into a ball, and treat it with secretions that retard the growth of mold and bacteria. The female ABB lays

[5] The upper surface of the first segment of the body that lies between the head and the abdomen
[6] The upper anterior part of the head
[7] The lower face located just above the mandibles

eggs in the soil near the carcass, which the larvae use as a food source. Individuals usually live for only one year (USFWS 2014c).

While studies indicate that the ABB is a habitat generalist in terms of feeding, it is likely more restricted when selecting burial sites for reproduction. Soil conditions must be conducive to excavation (Anderson 1982; Lomolino and Creighton 1996, in USFWS 2014c). Soil moisture is also a factor because ABBs die quickly when desiccated (Bedick et al. 2006, in USFWS 2014c). Burial soils are well drained and include sandy loam and silt loam, with a clay component noted at most sites. Level topography and a well-formed detritus layer at the ground surface are common (USFWS 1991).

Status and Distribution

The ABB was proposed for federal listing in October 1988 (53 *Federal Register* [FR] 39617). It was designated as an endangered species on July 13, 1989 (54 FR 29652), and retains this status. On March 16, 2016, the USFWS announced it will publish a substantial 90-day finding in response to an August 18, 2015, petition to delist the ABB (USFWS 2016a).

Critical habitat has not been designated. The American Burying Beetle Final Recovery Plan was signed on September 27, 1991 (USFWS 1991). At that time only two disjunct natural populations were known: one population found in four counties in Oklahoma and one population from an island off the coast of Rhode Island, at the extremities of the species' historic range (USFWS 2008).

Additional populations of ABB have been discovered since the recovery plan was completed in 1991. The USFWS's most recent five-year review found that the ABB remains endangered throughout its current range due to ongoing threats to known populations and the failure to discover or establish viable populations in the remaining recovery areas (USFWS 2008).

The historic range of the ABB included over 150 counties in 35 states, including most of temperate eastern North America and the southern portions of three eastern Canadian provinces (USFWS 1991). Documentation confirming the species' presence is not uniform throughout this broad historical range; more records exist from the Midwest into Canada and in the northeast of the United States than from the southeast and Gulf of Mexico region.

The ABB is known to occur in nine states: Rhode Island, Massachusetts, Oklahoma, Arkansas, Nebraska, Kansas, South Dakota, Texas, and Missouri (USFWS 2014c). Those in Missouri are part of a nonessential experimental population (under Section 10[j] of the ESA) that was reintroduced in 2012. In Oklahoma, 29 counties, including Osage County, currently have had confirmed ABB sightings (USFWS 2014c).

The USFWS updated the known range of the ABB in Oklahoma in 2016. The update is a result of positive survey findings in 2015 along the eastern and western edges of the species' range. The update represents a 2.3 percent expansion of the ABB's range in Oklahoma (approximately 410,900 acres). Since 2014, the known range in Oklahoma has increased by 5.3 percent (approximately 999,500 acres; USFWS 2016b).

Environmental Baseline

Occurrence in the Action Area

Most of the 1,474,500-acre planning area is within the potential range of ABB, and suitable habitat is widespread in the planning area. Most of northeastern Osage County is considered an ABB conservation priority area (CPA; USFWS GIS 2016). ABB range and CPAs are depicted in **Figure 3-1**, American Burying Beetle. The USFWS believes these CPAs are likely to contain important elements for beetle conservation, such as documented presence over multiple years, relatively high density populations, suitable breeding, feeding, and sheltering habitat, and carrion resources (USFWS 2015b). **Table 3-1**, Acres of ABB Habitat Classifications in the Planning Area, summarizes acreages of CPAs and potential range in the planning area.

Table 3-1
Acres of ABB Habitat Classifications in the Planning Area

Habitat Classification	Acres
CPA	495,700
Potential range	1,415,900

Source: USFWS GIS 2016

Past and Present Impacts

The following factors may have contributed to the ABB's decline (USFWS 2014c):

- Decline or extinction of preferred carrion species, including greater prairie-chicken (*Tympanchus cupido*), wild turkey (*Meleagris gallopavo*), and passenger pigeon (*Ectopistes migratorius*)
- Habitat loss and land use changes that result in fragmented habitat and increased edge habitat
- Reduction in the carrion prey base of the appropriate size for ABB reproduction and increases in vertebrate scavengers (e.g., raccoon [*Procyon lotor*] and striped skunk [*Mephitis mephitis*]) that are competition for this carrion prey

Critical Habitat

No critical habitat has been proposed or designated for the ABB.

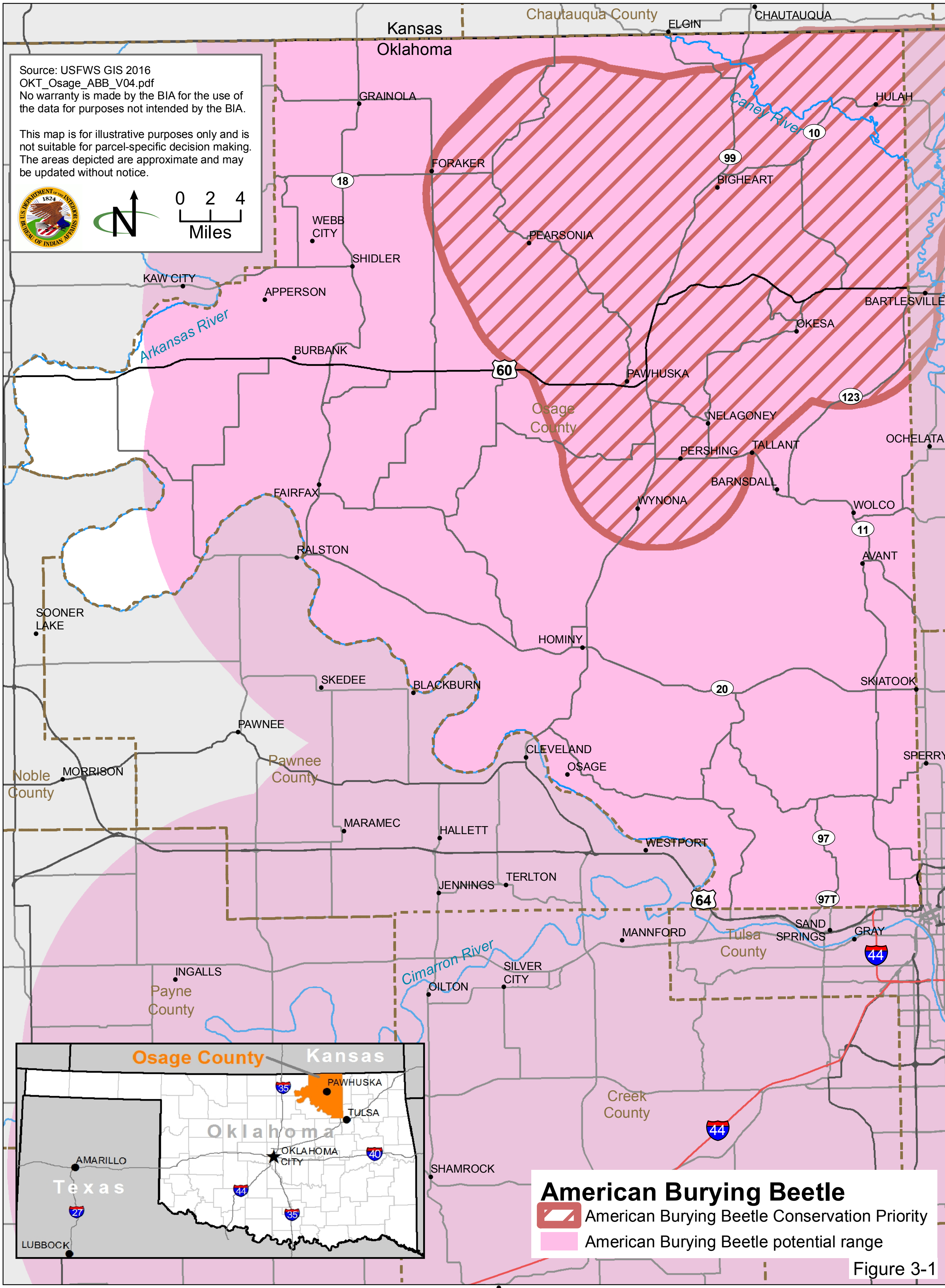
Source: USFWS GIS 2016
OKT_Osage_ABB_V04.pdf
No warranty is made by the BIA for the use of the data for purposes not intended by the BIA.
This map is for illustrative purposes only and is not suitable for parcel-specific decision making. The areas depicted are approximate and may be updated without notice.
0 2 4
Miles
N
Kansas
Oklahoma
Chautauqua County
ELGIN
CHAUTAUQUA
GRAINOLA
HULAH
Caney River
FORAKER
BIGHEART
WEBB CITY
PEARSONIA
SHIDLER
KAW CITY
APPERSON
BARTLESVILLE
OKESA
Arkansas River
BURBANK
PAWHUSKA
NELAGONEY
Osage County
PERSHING
TALLANT
OCHELATA
FAIRFAX
BARNSDALL
WYNONA
WOLCO
RALSTON
AVANT
SOONER LAKE
HOMINY
SKEDEE
BLACKBURN
SKIATOOK
PAWNEE
CLEVELAND
SPERRY
Noble County
MORRISON
Pawnee County
OSAGE
MARAMEC
HALLETT
WESTPORT
JENNINGS
TERLTON
SAND SPRINGS
MANNFORD
Tulsa County
GRAY
INGALLS
Payne County
Cimarron River
SILVER CITY
OILTON
Creek County
SHAMROCK
Osage County
Kansas
PAWHUSKA
TULSA
Oklahoma
OKLAHOMA CITY
AMARILLO
Texas
LUBBOCK
American Burying Beetle
American Burying Beetle Conservation Priority
American Burying Beetle potential range

Figure 3-1

Threats

The ABB recovery plan (USFWS 1991) and five-year review (USFWS 2008) identify potential threats, as follows:

- Disease and pathogens
- Pesticides
- Direct habitat loss or alteration
- Increase in edge habitat[8]
- Genetic diversity loss in isolated populations
- Increase in competition for carrion prey, including competition with other species, such as the imported red fire ant (*Solenopsis invicta*)
- Decrease in preferred carrion prey abundance
- Agricultural and grazing practices
- Noxious weeds and invasive plant species

3.2.2 Whooping Crane (*Grus americana*)

Species Description

Adult whooping cranes are white with a red crown and a long, dark, pointed bill. Immature whooping cranes are cinnamon brown. While in flight, their long necks are kept straight and their long dark legs trail behind. Adult whooping cranes' black wing tips are visible during flight. As the tallest North American bird, males approach 5 feet (1.5 meters) when standing erect. Males are generally larger than females (CWS and USFWS 2007).

Life History

Whooping cranes are monogamous but will re-pair following the death of a mate. Whooping cranes may start breeding as early as three years of age, but the average is five years. Most whooping cranes breed at Wood Buffalo National Park, Alberta, Canada, where they begin to arrive in April to begin nest construction. Generally, two olive-buff eggs are laid in late April or May, and they hatch approximately one month later. However, most breeding pairs, when successful, arrive at the winter range with one chick (CWS and USFWS 2007).

Whooping cranes winter at Aransas National Wildlife Refuge (NWR) in Texas, generally arriving between late October and mid-November. Migration occurs during the day, and cranes make regular stops to rest and feed at stopover locations during the two-week migration (CWS and USFWS 2007). Spring migration generally begins in late March to mid-April, when whooping cranes depart Aransas NWR for breeding grounds at Wood Buffalo National Park.

[8] The boundary of two intact habitats, e.g., the boundary between a forest and an agricultural field

Parents separate from young of the previous season when they depart for spring migration. The Salt Plains NWR in Oklahoma is a major migratory stopover for the crane population.

Whooping cranes are omnivorous and feed by probing the soil subsurface with their bills and taking foods from the soil surface or vegetation. Young chicks are fed by their parents. Summer foods include nymphal or larval forms of insects; frogs, rodents, and small birds; minnows; and berries. Migration foods are agricultural grains, frogs, fish, and insects. Winter foods are foraged from brackish bays, marshes, and salt flats and include crabs and clams and wolfberry (*Lycium carolinianum*; CWS and USFWS 2007).

Whooping crane is a long-lived species. Current estimates suggest a lifespan of up to 30 years in the wild (Mirande et al. 1993, in CWS and USFWS 2007); captive individuals have been recorded to live 35 to 40 years (Moody 1931; McNulty 1966, in CWS and USFWS 2007).

Status and Distribution

The whooping crane was originally listed as an endangered species on March 11, 1967, following establishment of the Endangered Species Preservation Act on October 15, 1966. It is currently listed as endangered under the Endangered Species Act of 1973, as amended. The current International Recovery Plan for the Whooping Crane, Third Revision (CWS and USFWS 2007) was approved on May 29, 2007 (72 FR 29544).

Critical habitat in the United States was designated in 1978 (43 FR 20938-942) and is in five sites in four states. No critical habitat is in the planning area; the nearest critical habitat unit is the Salt Plains National Wildlife Preserve, approximately 60 miles west of Osage County.

The whooping crane's historic range extended from the Arctic coast south to central Mexico, and from Utah east to New Jersey, South Carolina, Georgia, and Florida (Allen 1952; Nesbitt 1982, in CWS and USFWS 2007). The major nesting area during the nineteenth and twentieth centuries extended from central Illinois, northwestern Iowa, northwestern Minnesota, and northeastern North Dakota, northwesterly through southwestern Manitoba, southern Saskatchewan, and into east-central Alberta (Allen 1952, in CWS and USFWS 2007). The historic principal wintering range was the tall grass prairies, in southwestern Louisiana, along the Gulf Coast of Texas, and in northeastern Mexico near the Rio Grande Delta.

Currently, whooping cranes occur only in Canada and the United States. Approximately 83 percent of wild nesting sites are in Canada and 17 percent are in Florida and Wisconsin. The 2005-2006 population was estimated at 343 (CWS and USFWS 2007).

Environmental Baseline

Occurrence in the Action Area
Whooping crane migrating between winter and summer ranges likely pass through the planning area, though there are no nesting areas there. The nearest critical habitat unit is the Salt Plains NWR, approximately 60 miles west of Osage County. Salt Plains NWR is a major migration stopover area (CWS and USFWS 2007). The 200-mile-wide migration path for whooping crane is depicted in **Figure 3-2**, Whooping Crane Migration Path, which is adapted from the 2007 recovery plan (CWS and USFWS 2007). This migration path is approximately equivalent to the 95 percent sighting corridor used by the USFWS (2015d).

Important stopover or roosting habitat for whooping crane, as defined by the USFWS (2015d), occurs in the planning area and is used by whooping cranes during migration. Important stopover or roosting habitat is defined as the Cimarron, Red, Washita, South Canadian, and Arkansas Rivers and all reservoirs or emergent (not forested) wetlands larger than 10 acres.

Past and Current Impacts
The following factors have contributed to the whooping crane's decline (CWS and USFWS 2007):

- Habitat alteration or destruction from human population growth in North America, including conversion of much of historic nesting habitat to agricultural production, and alterations in freshwater inflows to wintering grounds
- Hunting was a primary reason for historical decline; though now illegal, birds are occasionally mistakenly shot by hunters or purposefully shot by vandals
- Adult whooping cranes are generally not susceptible to predation, but eggs and chicks are predated on breeding grounds by black bear (*Ursus americanus*), wolverine (*Gulo luscus*), gray wolf (*Canis lupus*), and other predators. In wintering grounds, predation by bobcat (*Lynx rufus*) and alligator (*Alligator mississippiensis*) are significant in introduced populations in Florida. Eagles also prey on juvenile whooping cranes during their migration.

Critical Habitat
Critical habitat in the United States was designated in 1978 (43 FR 20938-942) in four states and five sites, including Aransas NWR and several migratory stopover sites (see **Table 3-2**, Primary Constituent Elements of Whooping Crane Critical Habitat).

Figure 3-2
Whooping Crane Migration Path

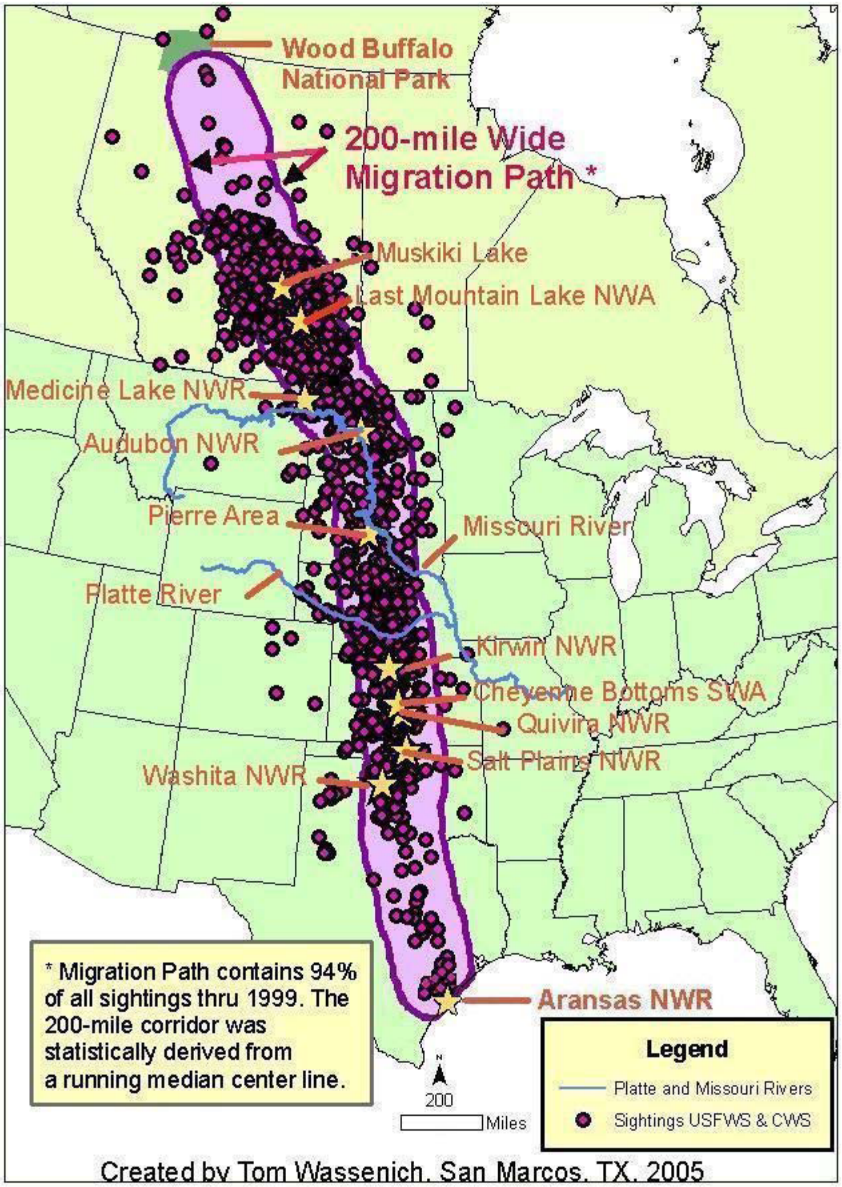

Table 3-2
Primary Constituent Elements of Whooping Crane Critical Habitat

Element	Description
Space for individuals and population growth and for normal behavior	• Whooping cranes are territorial. Each pair requires several hundred acres of undisturbed wetlands in and around Aransas NWR. Unmated subadults must also have some suitable habitat that is not regularly defended by the paired cranes. • The population wintering in the vicinity of Aransas NWR has been expanding. Although maximum density of the habitat has not yet been reached, some cranes are now moving up and down the coastal marshes from the refuge to establish wintering territories. • The four refuges in Idaho, Colorado, and New Mexico will offer further space for individual and population growth, as this separate flock becomes established in the wild.
Food, water, air, light, minerals, or other nutritional or physiological requirements	• All areas that are designated under this rule provide food, water, and other nutritional or physiological needs of the whooping crane.
Cover or shelter	• As do most other cranes in the world, whooping cranes generally require an open expanse for nightly roosting. This habit of using sand or gravel bars in rivers and lakes for nightly roosting appears to be one of the major factors in crane habitat selection. • Feeding cranes in migration are frequently found within short flight distances of reservoirs, lakes, and large rivers that offer bare islands for nightly roosting.
Sites for breeding, reproduction, or rearing	• Under this rule, only the Grays Lake area offers potential nesting habitat for the whooping crane. • The rearing of young cranes extends for approximately ten months; that is, until the young cranes are driven out of the family unit by their parents on the spring migration. All the areas under this rule constitute habitats essential to the rearing of these young whooping cranes by providing the cranes with sites for training, protection, feeding, and other normal behaviors.
Habitats that are protected from disturbances or are representative of the geographical distribution of the species	• Whooping cranes do not readily tolerate disturbances to themselves or their habitat. A human on foot can quickly put a whooping crane to flight at distances of over one quarter of a mile. • The one common feature uniting the vast majority of confirmed sightings of this crane in migration is the proximity to wetlands that provide undisturbed roosting sites.

Source: USFWS 1978

The designated critical habitat nearest to the planning area is the Salt Plains NWR in Oklahoma, approximately 60 miles to the west.

Threats

The whooping crane recovery plan (CWS and USFWS 2007) and five-year review (USFWS 2012a) identify potential threats to whooping crane, as follows:

- Wetland loss from agricultural and other development and river flow alterations from water diversion projects
- Development, including roads, buildings, power lines, and wind turbines, and collision with infrastructure and vertical structures
- Increasing human disturbance to whooping crane wintering grounds
- Disease or pathogens, including West Nile virus and red tide phytoplankton blooms, can be made worse by loss of wetlands and resulting concentrations of birds in smaller areas and by climate change
- Drought, altered hydrology, and increasing sea levels and coastal flooding due to climate change
- Chemical spills in the wintering grounds

3.2.3 Red Knot (*Calidris canutus rufa*)

Species Description

The red knot is a sandpiper, distinguishable among other shorebirds by its colorful breeding plumage, which is where its name derives from. Other distinguishing characteristics are the bill, which is black year-round, and the legs, which are dark gray to black (Harrington 1996, 2001, in American Bird Conservancy et al. 2005). Males in breeding plumage have a dark red or salmon breast, throat, and flanks, with a white belly. The crown and back are flecked with gray and salmon (Harrington 1996, 2001; Paulson 1993, in American Bird Conservancy et al. 2005). Female coloration is similar to that of males but is typically less intense. Nonbreeding plumage is a plain gray on the head and back, with light fringes of gray and white along the wings, giving an appearance of a white line running the length of the wing when in flight. The breast is white mottled with gray; the belly is dull white.

Life History

The average clutch size is four eggs, which have an incubation period of 21 to 22 days; pairs have only one clutch per season. Fledging is estimated at 18 days (American Bird Conservancy et al. 2005). Fledged chicks move with the male to wetland habitats, while the female abandons the brood.

Populations of red knots, including the subspecies *rufa*, migrate to the high Arctic in large flocks, through the contiguous United States, mainly in March to early June (Harrington 2001, in NatureServe 2015). Flocks generally arrive at breeding grounds in early June.

Most flocks depart breeding areas by mid-August (NatureServe 2015) and undertake an annual 18,600-mile (30,000-kilometer) hemispheric migration to wintering grounds in Patagonia and Tierra del Fuego in southern South America (American Bird Conservancy et al. 2005).

The red knot principally uses marine habitats in both North and South America for rest stopovers during migration. It prefers coastal habitats along the mouths of bays and estuaries, providing sandy beaches to forage for benthic invertebrates or horseshoe crab (*Limulus* spp.) eggs (Harrington et al. 1986; Harrington 1996, 2001; Tsipoura and Burger 1999, in American Bird Conservancy et al. 2005).

Status and Distribution

Red knot was listed as threatened under the ESA under a final rule published on December 11, 2014 (79 FR 73705). No recovery plan has been drafted.

Red knot nesting range centers in Canada, north of the Arctic Circle. Wintering range primarily is in southern South America; the species appears to be most abundant in northeastern Tierra del Fuego and Bahía Lomas in Chile, near the eastern end of the Strait of Magellan (NatureServe 2015). Population estimates for the subspecies *rufa* up to the early 1990s were 100,000 to 150,000. During the 1990s this fell to around 80,000, and by the early 2000s the population may have dropped to 35,000 to 40,000. Current estimates place the population at between 18,000 and 33,000 (NatureServe 2015).

Environmental Baseline

Occurrence in the Action Area

Red knots do not nest or winter in the planning area but have been observed there during migration (NatureServe 2015). Red knot may occasionally use wetland habitats in the planning area for resting or foraging during migration.

Past and Current Impacts

Past impacts are increased commercial harvest and overutilization of horseshoe crabs (for use as bait in eel and conch fisheries; especially in the Delaware Bay region in the 1990s [NatureServe 2015]). The subsequent reduction in horseshoe crab populations and their eggs have impacted red knot body condition and fitness during spring migration and annual survival (NatureServe 2015). Most of the *rufa* population migrates through Delaware Bay during northward migration (NatureServe 2015).

Past impacts have also included hunting. Red knot was historically heavily hunted for market and sport (American Bird Conservancy 2005)

Critical Habitat

No critical habitat has been designated for red knot.

Threats

The primary threats to red knot are as follows (American Bird Conservancy 2005, NatureServe 2015):

- Reduced availability of horseshoe crab eggs during spring migration

- Increased disease and pathogen susceptibility from reduced fitness during migration
- Oil pollution at wintering grounds and migration stopover habitats
- Human disturbance
- Habitat loss via reclamation of wetlands and waters for development
- Climate change may impact breeding, wintering, and migration habitats, including through sea level rise and loss of wetland habitat

3.2.4 Interior Least Tern (*Sternula antillarum athalassos*)

Species Description

Least terns (all currently recognized subspecies and populations) are the smallest members of the gull and tern family (Laridae). They measure about 8.3 to 9.5 inches (21 to 24 centimeters) long with a 20-inch (51-centimeter) wingspread. Sexes are alike, characterized by a black-capped crown, white forehead, grayish back and dorsal wing surfaces, snowy white undersurfaces, legs of various orange and yellow colors depending on the sex, and a black-tipped bill whose color also varies depending on sex (Watson 1966; Davis 1968; Boyd and Thompson 1985, in USFWS 1990). Immature birds have darker plumage than adults, a dark bill, and dark eye stripes on their white foreheads (USFWS 1990).

Life History

Interior least terns spend about four to five months at their breeding sites. They arrive at breeding areas from late April to early June from wintering habitat along the Central American coast and the northern coast of South America, from Venezuela to northeastern Brazil. Least terns nest in colonies, or terneries, on exposed gravel bars in rivers or in sand and gravel pits and other similar artificial nesting habitats. Nests can be as close as just a few yards apart or widely scattered up to hundreds of yards.

By late May, interior least terns lay two to three eggs, which are pale to olive buff and speckled or streaked with dark purplish-brown, chocolate, or blue-gray markings. Incubation is 20 to 25 days. Chicks hatch within one day of each other, are brooded for about one week, and usually remain within the nesting territory as they mature. Chicks fledge after three weeks, although parental attention continues until fall migration. Departure from colonies by both adults and fledglings varies but is usually complete by early September (USFWS 1990).

The riverine nesting areas of interior least terns are sparsely vegetated sand and gravel bars within a wide unobstructed river channel or salt flats along lake shorelines. Nesting locations usually are at the higher elevations and away from the water's edge because nesting starts when the river flows are high and small amounts of sand are exposed. Breeding site fidelity of coastal and California least terns (*S. a. browni*) is very high, and this may also be true for the interior least tern in its riverine environment. Least terns also nest on artificial habitats, such as sand and gravel pits and dredge islands, and even gravel rooftops (USFWS 1990).

The fish-eating interior least tern feeds in shallow waters of rivers, streams, and lakes, usually near nesting sites. Terns nesting at sand and gravel pits and other artificial habitats may fly up to one mile (3.2 kilometers) to fish. Fishing behavior involves hovering and diving over standing or flowing water (USFWS 1990).

Status and Distribution

The interior least tern was listed as endangered under the ESA in a final rule published on May 28, 1985 (50 FR 21784). The interior least tern recovery plan was approved in September 1990 (USFWS 1990). Critical habitat for interior least tern has not been designated.

The interior least tern is migratory and historically bred along the Mississippi, Red, and Rio Grande River systems and the rivers of central Texas. The breeding range extended from Texas to Montana and from eastern Colorado and New Mexico to southern Indiana. It included the Red, Missouri, Arkansas, Mississippi, Ohio, and Rio Grande River systems.

Currently, interior least terns continue to breed in most of the aforementioned river systems, although the species' distribution generally is restricted to less altered river segments (USFWS 1990). Interior least terns currently breed from the lower Ohio River in Indiana and Kentucky in the east, as far west as the Upper Missouri River in Montana; they breed as far north as Montana and as far south as southern Texas (USFWS 2013).

Reported numbers of nesting interior least tern have expanded by almost an order of magnitude (from less than 2,000 to about 18,000) since the species was listed, and the range has increased significantly. Currently, multiple colonies are known to occur in all major drainages where the species historically nested, and available monitoring data indicate most of these drainage populations are stable or increasing (USFWS 2013).

Environmental Baseline

Occurrence in the Unit

Interior least terns breed along portions of the Arkansas River in Osage County (USFWS 1990, 2013).

Past and Current Impacts

The following factors have contributed to the interior least tern's decline (USFWS 1990, 2013):

- Habitat alteration and destruction; regulated river flows, channelization, irrigation, and the construction of reservoirs and pools have contributed to the elimination of much of the tern's sandbar nesting habitat.
- Human disturbance reduces reproductive success; recreation is often concentrated in river systems where interior least terns breed.

Critical Habitat

No critical habitat has been designated for the interior least tern.

Threats

The primary threats to interior least terns are random floods and droughts, which can affect river flow and quantity and quality of nesting habitat (USFWS 2013).

3.2.5 Piping Plover (*Charadrius melodus*)

Species Description

Adult piping plovers have yellow-orange legs, a black band across the forehead from eye to eye, and a black ring around the neck. This chest band is usually thicker in males during the breeding season, and it is the only reliable way to tell the sexes apart. Piping plovers have a body length of 6.5 inches (17 centimeters), and wing span of 4.3 to 5 inches (11 to 12.7 centimeters; USFWS 1988).

Life History

Piping plovers are migratory shorebirds that spend approximately three to four months at their breeding grounds. Arrival time at breeding grounds varies by location but is generally in mid-April. Nest cups are shallow depressions lined with small pebbles or shell fragments. Eggs are laid in May; clutch size is four eggs. Incubation lasts 25 to 31 days, and fledging time varies from 21 to 35 days, depending on location. Adults depart breeding grounds by early August, with the juveniles departing a few weeks later (USFWS 1988).

Piping plovers breed in open, sparsely vegetated habitats, including barren sand and gravel, lake and river shorelines, and sandbars. The beach width, amount and distribution of vegetation, and substrate composition may affect nest site selection. Piping plovers have been observed nesting in interior least tern colonies at a number of Great Plains river sandbars, sand pits, and Atlantic coast beaches (USFWS 1988).

Wintering habitat consists of beaches, sandflats, and sand dunes along the Gulf of Mexico coastal beaches and adjacent off-shore islands. Spoil islands in the Intercoastal Waterway are also used (USFWS 1988).

Piping plovers eat marine worms, insects (fly larvae and beetles), crustaceans, mollusks, and other small marine animals. They forage on exposed beach substrates near the water's edge (USFWS 1988).

Status and Distribution

In 1986, the Great Lakes population of piping plovers was listed as endangered and all other populations were listed as threatened (50 FR 50726). The USFWS published a recovery plan for the northern Great Plains and Great Lake populations 1988, and later recovery plans updated information for the Atlantic Coast and Great Lakes breeding populations. Critical habitat for wintering piping plovers was designated on July 10, 2001 (66 FR 36038) and for the Northern Great Plains population on September 11, 2002 (67 FR 57637).

In the final listing rule (50 FR 50726), effective January 10, 1986, the USFWS did not use subspecies to distinguish breeding populations of piping plovers. Subsequent ESA actions have consistently recognized three separate breeding populations: on the Atlantic Coast (threatened), the Great Lakes (endangered), and the Northern Great Plains (threatened).

Historically, piping plovers bred across three geographic regions: The United States and Canadian Northern Great Plains, from Alberta to Manitoba and south to Nebraska, on Great Lakes beaches, and on Atlantic coastal beaches, from Newfoundland to North Carolina. Historic wintering sites are not well described, but the species was generally observed along the Gulf of Mexico, on the southern US Atlantic coastal beaches, from North Carolina to Florida, in eastern Mexico, and on scattered Caribbean islands (USFWS 1988). The species' current range is similar to its historic range (USFWS 1988).

Environmental Baseline

Occurrence in the Action Area

Although piping plovers have been observed migrating in Osage County, they do not nest or winter in the vicinity of the planning area (USFWS 1988, 2009).

Past and Present Impacts

The following factors may have contributed to the piping plover's decline (USFWS 1988):

- Habitat alteration and destruction, including loss of sandy beaches and other breeding and wintering habitat, due to recreational and commercial development and dune stabilization
- Human disturbance, including vehicular and foot traffic within breeding areas; disturbance inhibits incubation and other breeding behavior, reducing reproductive success

- Elimination of nesting habitat due to construction of reservoirs, river channelization, and flow modification
- Historical hunting

Critical Habitat

Critical habitat for the Northern Great Plains population of piping plover was designated in 2002 (67 FR 57638). It affects 18 population units in Minnesota, Montana, North Dakota, South Dakota, and Nebraska.

Primary constituent elements of piping plover critical habitat are described in **Table 3-3**, Primary Constituent Elements of Piping Plover Critical Habitat.

The designated critical habitat nearest to the planning area is the Platte River in central Nebraska, several hundred miles north of the planning area.

Table 3-3
Primary Constituent Elements of Piping Plover Critical Habitat

Location	Elements
On prairie alkali lakes and wetlands	• Shallow, seasonally to permanently flooded, saline to hypersaline wetlands, with sandy to gravelly, sparsely vegetated beaches, salt-encrusted mud flats, or gravelly salt flats • Springs and fens along edges of alkali lakes and wetlands • Adjacent uplands 200 feet (61 meters) above the high water mark of the alkali lake or wetland
On rivers	• Sparsely vegetated channel sandbars, sand and gravel beaches on islands, temporary pools on sandbars and islands, and the interface with the river
On reservoirs	• Sparsely vegetated shoreline beaches, peninsulas, islands composed of sand, gravel, or shale, and their interface with the water bodies
On inland lakes	• Sparsely vegetated and windswept sandy to gravelly islands, beaches, and peninsulas, and their interface with the water body

Source: USFWS 2002

Threats

The most recent five-year review (USFWS 2009) identified potential threats to piping plovers, as follows:

- Habitat loss and degradation on winter and migration grounds from shoreline and inlet stabilization
- Recreational disturbance from pedestrians, dogs, motorized vehicles, and boats
- Predation on wintering and migration grounds
- Contamination, including oil spills

- Impacts of climate change, including habitat loss from sea level rise and storms
- Minor threat from West Nile virus and avian influenza on wintering and migration grounds

3.2.6 Neosho Mucket Mussel (*Lampsilis rafinesqueana*)

Species Description

The Neosho mucket is a medium to large freshwater mussel. Its shell is relatively oblong, and the umbones[9] are low and project only slightly or not at all above the curvature of the shell (Shiver 2002).

Life History

The Neosho mucket is associated with shallow riffles and runs, with gravel substrate and moderate to swift currents. Channel stability is an important factor determining the location of Neosho muckets. They need substrate loose enough to allow burrowing, and typically they are embedded in the substrate in a variety of habitats in large streams and small rivers.

Like other freshwater mussels, Neosho muckets live embedded in the bottom of rivers and streams. They siphon water into their shells and across gills that are specialized for respiration and food collection. Food items include algae, bacteria, detritus, and microscopic animals (USFWS 2012b). Adults are filter feeders and generally orient themselves partially on or near the substrate surface to take in food and oxygen from the water column. Juveniles typically burrow completely beneath the substrate surface and are pedal feeders[10] until the structures for filter feeding are more fully developed.

The Neosho mucket spawns in late April and May and broods larvae from May through August (Shiver 2002). Males release sperm into the water column, and females draw it in through their siphons during feeding and respiration. Fertilization takes place inside the shell, and success is apparently influenced by mussel density and water flow conditions. The eggs are retained in the gills of the female until they develop into mature larvae called glochidia. The glochidia have a parasitic stage during which they must attach to the gills, fins, or skin of a fish to transform into a juvenile mussel. When the transformation is complete, the juvenile mussels drop from their fish host and sink to the stream bottom where, given suitable conditions, they grow and mature into adults (USFWS 2012b).

[9] The oldest, highest part of each shell valve
[10] Taking in food particles that adhere to the foot while it is extended outside the shell

Status and Distribution

In 2012, the USFWS proposed the Neosho mucket mussel for federal listing (77 FR 63440) and designated it as endangered with critical habitat in 2015 (80 FR 24692). No recovery plan has been developed.

Historically, populations existed in the Neosho, Illinois, and Verdigris River Basins. Over half of these populations are now extirpated, and the remainder are in decline, with one exception (USFWS 2012b). The Neosho mucket mussel is estimated to have been extirpated from 62 percent of its historic range.

Environmental Baseline

Occurrence in the Action Area

According to the Oklahoma Department of Wildlife Conservation (ODWC), the Neosho mucket mussel has been observed in the Caney River, both upstream and downstream of Hulah Lake in northeast Osage County (ODWC 2015). According to the proposed listing rule (USFWS 2012b), the Caney River population is considered extirpated, but suitable habitat is present. It is possible that suitable habitat may also be found in other Osage County streams.

Past and Present Impacts

The following factors may have contributed to the Neosho mucket mussel's decline (USFWS 2012b, 2015c):

- Water quality degradation from human settlement and modern industrial activities, such as mining and oil and gas extraction
- Habitat modification by stream channel alteration and land use changes, resulting in increased erosion and siltation into waterways
- Introduction of invasive fish species and loss of native host fish species

Critical Habitat

The USFWS designated critical habitat for the Neosho mucket mussel on April 30, 2015 (80 FR 24691). No critical habitat is in the planning area; it is generally located to the east and northeast of the planning area, in eastern Oklahoma, southeastern Kansas, southwestern Missouri, and northwestern Arkansas. No critical habitat unit is downstream of any stream or river in the planning area. The critical habitat nearest to the planning area is Unit NM6 (Fall and Verdigris Rivers, Kansas). It is in Montgomery and other counties in southeast Kansas, approximately 25 miles northeast of the planning area (USFWS 2015c). **Table 3-4**, Primary Constituent Elements of Neosho Mucket Mussel Critical Habitat, lists the primary constituent elements for Neosho mucket mussel critical habitat.

Table 3-4
Primary Constituent Elements of Neosho Mucket Mussel Critical Habitat

Element	Details
Stable river channels and banks with habitats that support a diversity of freshwater mussels and native fish	• Channels that maintain lateral dimensions, longitudinal profiles, and sinuosity patterns over time without changing bed elevation • Stable riffles, sometimes with runs, and mid-channel island habitats that provide flow refuges consisting of gravel and sand substrates, with low to moderate amounts of fine sediment and attached filamentous algae
Hydrologic flow regime necessary to maintain benthic habitats where the species are found and to maintain connectivity of rivers with the floodplain	• Allowing for the exchange of nutrients and sediment for maintaining the mussel host's habitat, food availability, spawning habitat for native fishes, and the ability for newly transformed juveniles to settle and become established in their habitats
Water and sediment quality necessary to sustain natural physiological processes for normal behavior, growth, and viability of all life stages	• Water quality features, such as conductivity, hardness, turbidity, temperature, pH, ammonia, heavy metals, and chemical constituents
Occurrence of natural fish assemblages for each inhabited river or creek that will serve as an indication of appropriate presence and abundance of fish hosts necessary for recruitment	• Suitable fish hosts include smallmouth bass (*Micropterus dolomieu*), largemouth bass (*M. salmoides*), and spotted bass (*M. punctulatus*).
Competitive or predaceous invasive species in quantities low enough to have minimal impact on survival of freshwater mussels	• No details given in USFWS (2015c)

Source: USFWS 2015c

Threats

The *Federal Register* listing (USFWS 2015c) for Neosho mucket mussel lists the following threats:

- Impoundments
- Channelization
- Sedimentation
- Chemical contaminants
- Mining
- Oil and natural gas development
- Invasive, nonnative species
- Temperature

3.3 CANDIDATE SPECIES

3.3.1 Rattlesnake-Master Borer Moth (*Papaipema eryngii*)

Species Description

Rattlesnake-master borer moth is a large chocolate-colored moth with bold white disk markings on the wings. Nearly all the larvae in the genus are purplish brown and have a pattern of longitudinal white stripes (Forbes 1954, in USFWS 2013b).

Life History

Moth larvae rely on the plant, rattlesnake master (*Eryngium yuccifolium*), which is the sole host plant for this species; a population of 100 to 1,000 rattlesnake master plants are needed for the moth to persist. The host plant is generally sparsely distributed and has been found to have relative frequencies in restored and relict prairies of less than 1 percent (Danderson and Molano-Flores 2010; Molano-Flores 2001, in USFWS 2013b).

Rattlesnake-master borer moths emerge as adults from mid-September to mid-October, flying through mid- to late October. Their nocturnal habits make them hard to observe. Based on their short adult flight span, their underdeveloped mouth parts, and the large amount of stored fat, researchers postulate that they likely use dew or oozing sap for imbibing moisture (USFWS 2013b). Adults are believed to spend their days attached to host plants or on the bottom of leaves, where their presence is camouflaged.

Mating and egg laying are strictly nocturnal. Females deposit 200 or more eggs in the duff (ground litter) on or near host plants, where eggs overwinter. Larvae emerge from overwintered eggs in late May and immediately begin to bore into the rattlesnake master host. Larvae enter stems near the ground and slowly eat their way into the root of the plant. They continue to feed through early August, at which time mature larvae cease all activity and lie dormant for approximately one week. Pupation appears to take place either in the root of the host plant or in the soil and lasts from two to three weeks. The boring activities of the moth generally result in failed reproduction or death of the host plant.

Rattlesnake-master borer moths are considered relatively sedentary and do not disperse widely (USFWS 2013b).

Status and Distribution

In August 2013, the USFWS (78 FR 49422) found that listing the rattlesnake-master borer moth under the ESA was warranted but precluded by actions on higher priority species (USFWS 2013b).

Rattlesnake-master borer moths are obligate residents of undisturbed prairie and woodland openings that contain their only food plant, rattlesnake master.

The moths occur in low density over a range that includes most of the eastern United States, from Minnesota to Texas and east to Florida. An estimated 82 to 99 percent of tallgrass prairie habitat in that area has been lost, and most remnants are small and discontinuous. Currently, populations are known to occur in Illinois, Arkansas, Kentucky, North Carolina, and Oklahoma. Suitable habitat is found across 26 states for the host plant.

Environmental Baseline

Occurrence in the Action Area

In Oklahoma, the rattlesnake-master borer moth is known only from The Nature Conservancy's Tallgrass Prairie Preserve in Osage County, near Pawhuska (ODWC 2015). During surveys conducted between 2000 and 2005, three populations of between 50 and 200 individual moths were found, approximately 2 to 4 miles (3 to 6 kilometers) apart (USFWS 2013b). The prairie community on the entire site is managed with grazing bison (*Bison* spp.) and a randomized prescribed fire regime designed to mimic the natural forces found on the site before European-American settlement. Although no surveys have been conducted on-site since 2005, the management of the area is unchanged, so this population is considered extant (USFWS 2013b).

Past and Present Impacts

The following factors may have contributed to the moth's decline (USFWS 2013b):

- Conversion of tallgrass prairie habitat, where obligate host plant rattlesnake master occurs, for agricultural or nonagricultural purposes
- Alteration of the natural fire regime, which sustains tallgrass prairie ecosystems, through fire suppression

Critical Habitat

No critical habitat has been proposed or designated for the rattlesnake-master borer moth.

Threats

The *Federal Register* listing of "warranted but precluded" (USFWS 2013b), identifies the following threats to the rattlesnake-master borer moth:

- Pesticide application
- Habitat loss or alteration
- Flooding
- Agricultural and grazing practices
- Noxious weeds and invasive plant species

SECTION 4
IMPACTS OF THE PROPOSED ACTION

4.1 INTRODUCTION

This BA analyzes the impacts of a proposed discretionary federal action. A federal action is defined as anything authorized, funded, or carried out by a federal agency. The proposed action, described in **Section 2** is programmatic, meaning that oil and gas activities under a lease that could affect threatened or endangered species would be subject to Section 7 ESA consultation with the USFWS. The BIA could tier to this BA to streamline the consultation.

4.1.1 Definitions

The impacts of implementing the proposed action can be categorized into direct, indirect, and cumulative impacts:

- **Direct impacts** are those that are caused by the proposed action and occur at the time of the action.
- **Indirect impacts** are those that are caused by the proposed action and occur later in time but are reasonably certain to occur.
- **Cumulative impacts** are those of future state, tribal, local, or private actions that are reasonably certain to occur in the action area considered in this BA. Future federal actions that are unrelated to the proposed action are not considered in a cumulative analysis. This is because they will be subject to separate consultation, in accordance with Section 7 of the ESA.

The following definitions are used for impact determinations:

- **No effect—**This is the appropriate conclusion when the BIA determines that its proposed action would not affect listed species. The principal factor in this determination is that the species and its suitable habitat do not exist in the analysis area or that the proposed action would involve no surface disturbances or other species disruption. In this situation, no further contact with the USFWS is required.

- **May affect, is not likely to adversely affect—**This is the appropriate conclusion when the BIA determines that impacts on listed species under the proposed action are expected to be discountable, insignificant, or completely beneficial. This type of impact requires informal Section 7 consultation with the USFWS and concurrence with the determination.
- **May affect, is likely to adversely affect—**This is the appropriate conclusion when the BIA determines that any adverse impact on listed species may occur as a direct or indirect result of the proposed action, and the impact would not be discountable, insignificant, or beneficial. If the overall impact of the proposed action were beneficial to the listed species but also would be likely to cause some adverse impacts, the proper impact determination for the proposed action would be "likely to adversely affect" the listed species. Such determination requires formal Section 7 consultation with the USFWS.

4.1.2 Methods of Analysis

Although some data on known species locations and habitats in the planning area are available, they are neither complete nor comprehensive. The BIA considered known and potential species and habitat locations in the analysis but also considered the potential for species to occur outside these areas. Impacts were quantified when possible. In the absence of quantitative data, the BIA used best professional judgment, based on scientific reasoning.

No decision would be authorized on BIA-administered lands (including mineral estate) that would jeopardize the continued existence of species that are listed or proposed for listing as threatened or endangered.

The analysis is based on the following assumptions:

- Impacts on T&E or proposed species can occur from actions that result in direct mortality, loss of habitat, or modifications to habitat suitability and actions that displace individuals or disrupt behavior. Because T&E and proposed species have specific habitat requirements, and their habitats are often diminishing, the species or their habitat disturbance could result in population declines, which could adversely affect the viability of local populations.
- Since T&E and proposed species populations are, by their nature, generally small and localized, the total area affected by other activities or restrictions is less important than where the activities or restrictions occur in relation to special status species and their habitat.

- The health of T&E and proposed species populations is directly related to the overall health and functional capabilities of upland, aquatic, riparian, and wetland resources, which in turn are a reflection of overall watershed health.
- Ground-disturbing activities generally lead to negative modification of habitat and loss of individuals. The extent of the impact depends on the nature of the activity, the intensity of the surface disturbance, the amount of area disturbed, the location of the disturbance, and the species affected.
- Species' health, population levels, and habitat conditions fluctuate in response to natural factors. Periods of drought or excessive moisture and outbreaks of diseases or pests that directly affect species or impact habitat (e.g., fire ant infestation) would likely impact T&E and proposed species' population levels.
- As the proposed action analyzed in this BA is programmatic, site-specific surveys for listed T&E or proposed species would be conducted before individual projects involving new ground disturbance were authorized, unless a "no effect" determination is made by the agency on the basis of species range, lack of suitable habitat, or other data. Survey results would indicate what BMPs and other minimization measures would be necessary to protect species and habitat.
- Any covered activities that could affect T&E or proposed species would, unless otherwise covered by a blanket concurrence or agreement or methodology outlined by the BA/BO, be required to undergo ESA Section 7 or Section 10 consultation with the USFWS. The BIA could tier to this BA to streamline the consultation. The activities would need to be mitigated to ensure that T&E species would not be jeopardized on a project-specific basis or at a cumulative level.
- Oil and gas activities are and would continue to be concentrated in areas of high potential for oil and gas development, as identified by BLM GIS (2015). Where listed T&E species or critical habitat occur in these areas, the potential for impacts from oil and gas activities is increased.

Cumulative Impacts

Cumulative impacts under the ESA are those of future state, tribal, local, or private actions that are reasonably certain to occur in the action area. Future federal actions that are unrelated to the proposed action are not considered in the cumulative analysis because they would be subject to separate consultation, in accordance with Section 7 of the ESA. Cumulative impacts address the impact of implementing the proposed action, in combination with other future nonfederal actions outside the scope of the proposed action.

4.2 LISTED SPECIES

4.2.1 American Burying Beetle

Assumptions and Methods of Analysis

Assumptions and methods of analysis are similar to those described in **Section 4.1.2**. Additional assumptions are as follows:

- In order to estimate the acres of annual ground disturbance associated with oil and gas activities in the planning area, the BIA estimated the acres of disturbance associated with a typical drilling permit development. According to 25 CFR, Subpart 226.19(b), the maximum allowable disturbance per well pad is 1.5 acres without special permission from the Superintendent. Because this does not include ancillary disturbance (e.g., from roads or tank batteries), the BIA estimated an additional 0.5 acre for ancillary disturbance. This results in a total of 2 acres of disturbance, on average, for a typical oil and gas permit development.

  The BIA estimates that 1.5 of the 2 acres of disturbance is comprised of temporarily disturbed areas and 0.5 acres is permanently disturbed. The BIA estimated 300 permits per year would be issued. This would result in approximately 600 acres of disturbance associated with oil and gas development activities annually; 450 acres of these acres would be temporary disturbance and 150 acres would be permanent disturbance.

- Impacts on ABB habitat would be concentrated in areas of high to moderate oil and gas potential. This is because these areas are more likely to see continued or increased oil and gas development and associated ground disturbance or vegetation removal.

- Activities conducted entirely outside of the potential ABB range, as determined by the USFWS (see **Figure 3-1**), would have no effect on ABB (USFWS 2015b). Up-to-date ABB range is available on the USFWS Information Planning and Conservation (IPaC) system (https://ecos.fws.gov/ipac/).

Conservation Planning (As It Relates to Section 7[a][1] of the ESA)

The proposed action is summarized in **Section 2** of this BA and incorporates the BMPs described below. Since the proposed action is programmatic, measures described below may not be comprehensive. New measures may be developed as necessary following BIA APD review.

Best Management Practices

Table 2-2 includes a number of BMPs that would directly and indirectly benefit ABB. Lessees would be required to follow the USFWS's established protocol regarding areas where the ABB is known to occur or suspected to occur.

Unless the project will have no new ground disturbance, lessees will have to obtain approval from the BIA under the programmatic incidental take permit or comply with the ICP (see **Section 2.3**).

Further, lessees would be required to conduct activities in a manner that would avoid any potential take of federal T&E species, including ABB, or in a manner that complies with any permit or authorization issued by the USFWS. Additional BMPs as they relate to specific direct and indirect impacts are described in the analysis below.

USFWS American Buying Beetle Industry Conservation Plan

The USFWS ICP for the ABB (USFWS 2014c) provides a mechanism to meet statutory and regulatory requirements by proponents engaged in oil and gas activities while promoting conservation of the ABB. The BIA has incorporated provisions similar to the ICP in this BA, including those found in Attachment A. After the BO is issued, these minimization and mitigation measures will be implemented as part of BIAs obligation under Section 7(a)(1) of the ESA.

In areas where the ABB is known or suspected to occur, based on existing records or suitable habitat, oil and gas project proponents would be required to conduct presence/absence surveys for the beetle following USFWS protocols, or assume presence. In occupied habitat, or where presence is presumed, project proponents would be required to implement minimization and mitigation measures listed in Attachment A. A summary of minimization measures adopted by BIA (see Attachment A) follows:

- Reduce motor vehicle, machinery, and heavy equipment use
- Reduce risk of motor vehicles sparking wildfire
- Increase safety during operation fluid use and storage
- Reduce erosion and increase soil stability
- Train construction personnel
- Limit the use of artificial lighting
- Limit the use of gas flares
- Limit disturbance from mechanical vegetation maintenance
- Limit herbicide use
- Set aside topsoil for replacement following construction

Attachment A lists mitigation measures to employ when projects temporarily or permanently impact ABB habitat or result in other forms of take of the species. On-site measures are to replace topsoil, to remediate topsoil compaction, to reestablish vegetation, and to manage invasive plant species. Off-site measures are to establish mitigation lands under conservation easements or to purchase mitigation bank credits.

Direct and Indirect Impacts

As described in *Assumptions*, the potential impacts on the ABB would be highest in those areas with high or moderate-to-high oil and gas potential. This is because oil and gas development would be concentrated in these areas. **Table 4-1**, Acres of ABB Habitat Classifications in Areas of High or Moderate-to-High Oil and Gas Potential, summarizes the acres of ABB potential range and CPAs (USFWS 2015b; CPAs are discussed in **Section 3.2.1**) in areas of high or moderate-to-high oil and gas potential in the planning area. **Figure 3-1** depicts CPAs, as well as ABB potential range, in the planning area.

Table 4-1
Acres of ABB Habitat Classifications in Areas of High or Moderate-to-High Oil and Gas Potential

Habitat Classification	Acres	Percent of Habitat Classification
CPA	445,700	90
Potential range	1,144,300	84

Source: BLM GIS 2015; USFWS GIS 2016

As shown in **Table 4-1**, approximately 90 percent of ABB CPAs and 84 percent of potential range in the planning area are in areas of high or moderate-to-high oil and gas potential. This indicates that potential impacts on ABB from ongoing and future oil and gas development concentrated in these areas are likely.

The direct and indirect impacts on ABB occur from typical activities associated with oil and gas development, including vegetation removal and maintenance, habitat fragmentation, vehicle and heavy equipment use, soil disturbance and movement, and artificial lighting (USFWS 2014c, 2014d). In general, construction-related, ground-disturbing activities have a higher potential to impact ABB than do exploration and pre- and post-construction activities (USFWS 2014d). Where there is a positive ABB survey or presumed presence, the BIA would implement the minimization and mitigation measures in Attachment A to reduce direct and indirect impacts on the beetle. The BIA would implement BMPs (**Table 2-2**), or other site-specific conditions, to further avoid or minimize impacts. Where there is a negative survey for ABB, BIA may still include appropriate BMPs and site specific conditions in order to avoid unnecessary soil or vegetation disturbance. Together, these measures would reduce adverse direct and indirect impacts on the ABB from activities covered by the proposed action.

Vegetation removal can have direct impacts on the ABB through injury or death. Beetles uncovered during vegetation removal may be wounded or killed from exposure to adverse weather conditions or crushed by vegetation removal equipment. ABBs are sensitive to soil moisture and die quickly when desiccated (Bedick et al. 2006, in USFWS 2014c); therefore, vegetation removal that exposes the soil surface to drying may kill inactive adult beetles in the soil.

Where there are unavoidable impacts on the ABB from vegetation removal, adhering to mitigation measures in Attachment A would mitigate these impacts.

Vegetation removal on undisturbed soils in suitable habitat can also have indirect impacts on the ABB. It could result in breeding, foraging, or sheltering habitat degradation and reduced habitat connectivity, which may limit the reproductive success of the species. Vegetation removal or habitat fragmentation may change wildlife use, resulting in altered carrion prey availability for the beetle (Grant et al. 1982, in USFWS 2014c; USFWS 2014d).

Activities that would reduce leaf litter, including the conversion of forest to grassland habitat, may indirectly impact ABB by removing overnight shelter and overwintering habitat, or increasing potential for mortality via desiccation (USFWS 2014d). Introduction of nonnative, weedy, or invasive plant species, including mat-forming grasses, could reduce ABB's ability to bury carrion, resulting in reduced reproductive success (USFWS 2014d). BMPs 1, 2, and 4 would minimize vegetation disturbance. Minimization measures in Attachment A, along with appropriate BMPs, would ensure that habitat connectivity is maintained to the maximum extent practicable and that changes in wildlife use and carrion prey availability are temporary.

Vegetation maintenance may also have direct impacts on ABBs through injury or death, if it were to occur in suitable habitat on undisturbed soils. Adults, larvae, or eggs may be injured or crushed by mowing or vegetation equipment in the active season; in the inactive season, adults may be crushed or exposed to desiccation. Large mowing equipment being operated in suitable habitat may compact the soil, resulting in the take of buried beetles during the active or inactive season (Hoback et al. 2012; Hoback 2013, in USFWS 2014c). Soil compaction could reduce or eliminate ABB's ability to bury carrion, remove existing burrows that may facilitate carrion burial and reproduction, and eliminate overwintering habitat (USFWS 2014d). BMPs to minimize direct impacts on ABB from vegetation removal would also minimize direct impacts from vegetation maintenance.

If vegetation maintenance in suitable habitat on undisturbed soils were to reduce vegetation height to less than 8 inches, the soil may dry to the point that beetles have difficulty burying carcasses, soil may not structurally support reproductive chambers, or adult or larval beetles may become desiccated (Bedick et al. 2006, in USFWS 2014c). Vegetation maintenance in these areas may result in indirect impacts, including temporary habitat loss or fragmentation or beetle habitat alteration. USFWS minimization measures in Attachment A, along with appropriate BMPs or COAs, would be implemented to minimize the impacts from vegetation maintenance.

Vegetation maintenance as part of workover operations or other operations on existing well pads would be less likely to result in direct and indirect impacts on ABBs. Well pad soils are not conducive to ABB burrowing or burying carrion.

This is because these soils are dry and compacted, with high gravel or rock content.

Unmaintained, volunteer vegetation growing on well pads may provide some foraging habitat for adult beetles but would not provide suitable burial sites for reproduction. Therefore, impacts may be restricted to individual foraging beetles, as opposed to impacts on brood chambers or inactive, overwintering beetles. On well pads where vegetation is consistently mown or otherwise maintained below 8 inches, suitable foraging habitat is not likely present. No effects on ABB would be expected in these areas.

Vehicle, trucks, or heavy equipment use can result in direct impacts on ABBs through injury or death. In the active season, adults can collide with or be struck by vehicles or equipment. Because adult ABBs are winged and moderately mobile, above-ground adults during the active season may avoid some impacts of oil and gas activities (USFWS 2014d). However, brood chambers containing adults, larvae, and eggs can be crushed by off-road vehicles or equipment. In the inactive season, adults in leaf litter or soil can be similarly crushed.

During dry periods, vehicles and equipment may increase the risk of wildfire ignitions, which can injure or kill any exposed beetles in the burned area. Wildfires can have indirect impacts by causing habitat loss, and can temporarily alter the small mammal community and thus available carrion prey (Grant et al. 1982; Kirchner et al. 2011, in USFWS 2014c). Vehicles, trucks, or heavy equipment can also result in indirect impacts. Off-road vehicles can compact soils, rendering them unsuitable for carrion prey burial, and can crush vegetation, degrading breeding, foraging, and sheltering habitat. In order to avoid or minimize these impacts, BMPs 1 and 4 require that vehicles and equipment must remain on approved existing and new roads. Because off-road vehicle use is prohibited, the risk of unintentional wildfire ignition is reduced.

Spills of deleterious materials can have direct impacts on any ABBs in the work area. Spills may injure or kill exposed beetles during the active or inactive season. BMP 5 requires preparation and implementation of an SPCC plan for tank batteries, which would minimize the impacts from spills. BMP 7 mandates that chemicals are labeled and stored properly, further reducing chances of spill impacts on ABBs.

Soil grading can result in direct impacts on ABBs through injury or death. In the active season, brood chambers can be crushed, and in the inactive season adults in the leaf litter or soil can be crushed or exposed to desiccation or adverse weather. Soil erosion occurring during construction or following installation of project facilities may bury adults or broods (during the active season) or overwintering adults (during the inactive season) too deep for them to emerge. To avoid impacts, BMPs 2 and 3 require minimizing soil disturbance and implementation of erosion control measures for soil-moving activities and soil erosion prevention, which would minimize the potential impacts from soil erosion.

Artificial light used during oil and gas operations (including gas flares) may indirectly affect ABB. During the active season, artificial light sources may attract adult beetles (Longcore and Rich 2004), which could injure or destroy them through collision with structures or equipment or exposure to gas flares. This would adversely affect foraging success, increase predation on beetles (USFWS 1991), and cause artificially increased energetic demands on beetles, leading to reduced fitness or breeding success.

Since ABBs are not aboveground during the inactive season, they would not be affected by artificial light sources during this time (USFWS 2014c). Minimization measures in Attachment A and BMP 16 would limit the use of artificial lights and gas flares in the active season in order to minimize or avoid potential impacts on the beetle. For projects that require constantly burning flares throughout the life of the project (i.e., during the active season), the flares should be covered to eliminate or minimize flare visibility to ABBs. BMP 6 (venting of flare gas) would also limit this practice without express permission from the BIA Osage Agency Superintendent.

For the potential impacts described above, regulatory approval would be provided by the programmatic incidental take statement issued to the BIA as a result of formal consultation (see **Section 2.3**). As described in **Section 2.3**, when activities are proposed in suitable ABB habitat, lessees would conduct presence/absence surveys, or assume presence, and would report the findings and acres disturbed to the BIA. For negative findings, lessees would proceed with work and would report the acres disturbed to the BIA. For positive survey results, lessees would be required to mitigate ABB take in accordance with the BIA permit and biological opinion.

Where activities occur outside of the ABB potential range, as delineated by the USFWS (see **Figure 3-1**), no effect on the ABB is expected (USFWS 2015b).

Cumulative Impacts
The cumulative impacts analysis area for ABB is the potential range of the species. Past, present, and reasonably foreseeable future actions and conditions in the cumulative impacts analysis area that have affected and will continue to affect ABB and its habitat are the following:

- Oil and gas leasing and development
- Agriculture, livestock grazing, and similar forest/woodland conversion
- Renewable energy and infrastructure development
- Conservation planning,

Generally, impacts on the ABB and its habitat from the actions described above could occur due to the following:

- Loss or modification of vegetation communities
- Altered species composition and vegetation structure, resulting in alterations to the carrion prey base, including from agricultural pesticide use
- Habitat fragmentation that limits dispersal
- Establishment and spread of noxious weeds and invasive species
- Soil disturbance, including compaction, erosion, and topsoil removal

Alternatively, vegetation conservation and habitat restoration actions would have beneficial impacts on the ABB and its habitat by relieving soil compaction, restoring suitable vegetation for breeding, foraging, and sheltering habitat, and managing weed establishment and spread.

Oil and gas leasing and development, in combination with conversion of tallgrass prairie and other wooded habitats to agriculture, is likely to continue to affect ABBs that use these habitats for breeding, foraging, and sheltering. As described in the Draft Osage EIS, approximately 95 percent of the county is in agricultural use (BIA 2015b), and further conversion of native habitats to agriculture would result in long-term habitat loss or fragmentation.

Land use changes that fragment native forest and prairie habitats, create edge habitats, and remove top-level carnivores have created conditions in which vertebrate scavenger species (e.g., raccoon and striped skunk) have thrived in the action area. With the rise of these species and the local extinction or extirpation of some native species, the availability of preferred carrion prey species including greater prairie-chicken (*Tympanchus cupido*), wild turkey (*Meleagris gallopavo*), and the extinct passenger pigeon (*Ectopistes migratorius*) has decreased substantially. This is because carrion is a widely-scattered but finite resource (Karr 1982; Pimm et al.1988; Peck and Kaulbars 1987, in USFWS 2014c).

Further reductions in carrion prey availability would further limit the beetle's reproductive potential. The imported red fire ant has become a formidable competitor for carrion and a potential source of death for burying beetles when they are collocated at a food source (Warriner 2004; Godwin and Minich 2005, in USFWS 2014c). Of the states with ABB populations, the imported red fire ant now occurs in all or parts of Arkansas**,** Oklahoma, and Texas (USDA 2003, in USFWS 2014c).

It is likely that impacts from climate change will affect vegetation in the planning area within the cumulative impacts horizon, and as a result, will affect ABB breeding, foraging, and sheltering habitat. Current climate change models are projecting a range of potential shifts in climate, including increasing temperatures and more intense rainfall. This is despite a decrease in average amounts of total annual precipitation (Karl et al. 2009). Altered climatic patterns would likely influence species distribution within vegetation communities in the planning area. This may be particularly true in those communities that are sensitive to impacts from drought or altered fire regimes or that are susceptible to weed establishment and spread.

Under the proposed action, the impacts on the ABB and its habitat from oil and gas development in the planning area would cumulatively contribute to the impacts from past, present, and reasonably foreseeable actions. Implementing minimization and mitigation measures in Attachment A or as identified in the Biological Opinion, would ensure that contributions to cumulative impacts from the proposed action are minor or negligible. Where appropriate, implementing mitigation measures such as permanent conservation of lands within CPAs and other suitable habitat, would have beneficial cumulative impacts in the long term.

4.2.2 Whooping Crane

Assumptions and Methods of Analysis

The assumptions and methods of analysis are similar to those described in **Section 4.1.2.** Also, because whooping cranes do not breed in the planning area, no impacts on whooping crane breeding habitat would occur from implementing the proposed action.

Important stopover or roosting habitat for whooping crane, as defined by the USFWS (2015d), occurs in the planning area. The USFWS provides guidance to avoid impacts on whooping crane from oil and gas projects within the ABB range in Oklahoma (USFWS 2015d). Potential impacts from the proposed action, incorporating USFWS avoidance measures, are analyzed in this section.

Additionally, under the proposed action, water bodies would be protected by a 200-foot-wide buffer protecting established watering places in, accordance with 25 CFR, Subpart 226.33. The regulations do allow for a lessee to submit a request and justification to the Superintendent for an exception to the 200-foot-wide buffer, which may be granted with appropriate protective measures. This should be noted for all future references to this regulation.

Conservation Planning (As It Relates to Section 7[a][1] of the ESA)

The proposed action is summarized in **Section 2** of this BA and incorporates the BMPs described below. Since the proposed action is programmatic, measures described below may not be comprehensive; new measures may be developed as necessary following the BIA's site-specific review of applications for drilling or other permits or approvals.

Best Management Practices

Table 2-2 includes a number of BMPs that would directly and indirectly benefit whooping crane. These are detailed below.

Under BMP 15, lessees would be required to follow the USFWS's Oklahoma Ecological Services Field Office guidance for migratory birds and eagles (USFWS 2014b). The guidance lists measures to avoid or minimize impacts on migratory birds and eagles associated with oil and gas projects in Oklahoma. Lessees would be required to implement these avoidance measures for projects authorized under the proposed action. Impact avoidance measures mostly are those to avoid impacts on breeding birds.

Whooping cranes do not breed in the planning area, but may use wetland and other habitat there for stopovers during migration. Therefore, measures for conserving whooping crane are general. However, under the guidance, surveys to determine potential nesting habitat for migratory birds would also document potential whooping crane migratory stopover habitat, and subsequent avoidance measures would be implemented if necessary.

Multiple BMPs would protect wetlands, waters, and water quality in the planning area by prohibiting activities in wetlands and streams without USACE approval (BMP 12), by requiring spill prevention planning (BMPs 5 and 7), and by controlling soil erosion (BMPs 2 and 3). These BMPs would protect whooping crane migratory stopover habitat in the planning area.

Additional measures benefiting whooping cranes are as follows:

- BMP 15 directs lessees to conduct activities to avoid any potential incidental take or harm to federal T&E species
- BMP 11 directs lessees—to the extent possible—to minimize disturbance to wildlife and natural resources from noise, traffic, or other operations

USFWS Avoidance Measures

The USFWS provides guidance to avoid impacts on whooping crane from oil and gas projects within the ABB range in Oklahoma (USFWS 2015d). To comply with this guidance, the BIA will implement the following measures within the 95 percent sighting corridor:

- New overhead power lines within one mile of important stopover or roosting habitat in the 95 percent sighting corridor should be marked according to the guidance in Reducing Avian Collisions with Power Lines (Avian Power Line Interaction Committee [APLIC] 2012).
- Within 200 yards of important stopover or roosting habitat in the 95 percent sighting corridor, new overhead power lines should be

avoided or buried. Lines in forested or wooded habitat can be marked and not buried if the height of the line is equal to or lower than nearby trees.

Direct and Indirect Impacts

As discussed in **Section 3.2.2**, whooping cranes do not breed in the planning area, though they likely pass through the planning area when migrating between winter and summer ranges. No nesting areas occur in the planning area. The Salt Plains National Wildlife Preserve is a major migration stopover area (USFWS and CWS 2007), approximately 60 miles west of the planning area. Important stopover or roosting habitat, as defined by the USFWS, occurs in the planning area.

Despite the lack of breeding habitat in the planning area, limited numbers of whooping cranes may use its wetland habitats as short-term stopover sites. Whooping cranes may also use adjacent grassland or agricultural habitats during migratory stopovers (USFWS and CWA 2007). Osage county is partially within the 200-mile-wide migration path described in the whooping crane recovery plan (USFWS and CWA 2007); crane observations have been recorded outside of this pathway in eastern Oklahoma, as depicted in **Figure 3-2**.

Potential direct impacts could occur from whooping crane interaction with oil and gas project components or infrastructure, including overhead transmission lines, especially where these features are close to important stopover or roosting habitat. To avoid potential direct impacts, the USFWS avoidance measures would be implemented within the 95 percent sighting corridor, as BIA permit conditions or COAs. These measures include marking new overhead lines within one mile of important stopover or roosting habitat, according to APLIC (2012) guidelines. New overhead lines within 200 yards of important stopover or roosting habitat in the 95 percent sighting corridor would be avoided or buried, unless surrounding vegetation is taller than the new lines. In such a case, new lines would be marked according to APLIC (2012) guidelines. If the lessee chooses not to implement USFWS avoidance measures, additional coordination with the USFWS may be required to avoid impacts.

Implementing BMP 15 requires lessees to follow the minimization measures in the USFWS Oklahoma Ecological Services Field Office guidance for migratory birds and eagles (USFWS 2014b). Measures applicable to migrating whooping cranes in this guidance are general. However, under the guidance, surveys to determine potential nesting habitat for other migratory birds would also document potential whooping crane stopover habitat. As discussed, suitable migratory stopover habitat may also include grasslands and agricultural lands next to wetlands. Where such habitat exists close to proposed oil and gas projects, guidance in APLIC (2012) for reducing collision should be implemented where collision risk exists. Implementing these measures would minimize or avoid potential direct impacts on migrating whooping cranes.

Additional indirect impacts on whooping cranes from oil and gas activities are migratory stopover habitat degradation and visual or noise disturbance to whooping cranes from humans (Lewis and Slack 2008). This could result in flight response and unnecessary energy expenditure and elevated stress.

In order to minimize or avoid these indirect impacts, multiple BMPs would protect wetlands, waters, and water quality in the planning area by prohibiting activities in wetlands and streams without USACE approval (BMP 12), by requiring spill prevention planning (BMPs 5 and 7), and by controlling soil erosion (BMPs 2 and 3). These BMPs would protect whooping crane migratory stopover habitat in the planning area, avoiding potential indirect impacts.

Additionally, BMP 11 directs lessees to reduce potential noise and other disturbances to wildlife from oil and gas projects to the extent possible, further reducing impacts on whooping crane from operations.

Under the proposed action, water bodies would be protected by a 200-foot-wide buffer, in accordance with 25 CFR, Subpart 226.33. The 200-foot buffer would further protect migratory habitat and reduce the potential for indirect impacts on whooping crane from the proposed action.

Cumulative Impacts

The cumulative analysis impacts area for whooping crane is the planning area. Past, present, and reasonably foreseeable future actions and conditions in the cumulative impacts analysis area that have affected and will continue to affect whooping crane and its habitat are as follows:

- Loss of wetland habitat due to agricultural conversion, oil and gas development, renewable energy, infrastructure, and other development
- Installation of tall structures, including wind farms and transmission lines
- Implementing the USFWS avoidance measures within the 95 percent sighting corridor, as BIA permit conditions or COAs

Whooping cranes do not breed or winter in the planning area, so no cumulative impacts on breeding or wintering habitat under the proposed action are anticipated.

Whooping cranes have lost much of their historic migratory stopover habitat due to development, agricultural conversion, and other human encroachment (CWS and USFWS 2007), including within the planning area. As described under *Direct and Indirect Impacts*, important stopover or roosting habitat is present in the planning area. Therefore, it is likely that whooping cranes using wetland habitat for migratory stopover have been and will continue to be affected by oil and gas development in the planning area. Potential impacts include chances of collision with oil and gas or other infrastructure near wetlands habitats (e.g., transmission lines and tall drill rigs) and visual or noise disturbance. Impacts from oil and gas activities would be reduced or avoided by implementing the USFWS's avoidance measures in the 95 percent sighting corridor, as described.

Other actions in the planning area could similarly affect whooping cranes. Renewable energy development infrastructure may pose collision risks to migrating whooping cranes. Cranes can collide with transmission lines and wind turbines. The potential for collision increases where these structures are in migratory corridors or next to high-use areas, like migratory stopover sites (APLIC 2012).

Under the proposed action, impacts on whooping cranes from oil and gas development in the planning area would cumulatively contribute to the impacts from past, present, and reasonably foreseeable actions. Implementing BMPs and USFWS avoidance measures, as necessary, would ensure that contributions to cumulative impacts from the proposed action are minor or negligible.

4.2.3 Red Knot

Assumptions and Methods of Analysis

Assumptions and methods of analysis are similar to those described in **Section 4.2.2**, Whooping Crane. Additionally, under the proposed action, water bodies would be protected by a 200-foot-wide buffer protecting established watering places, in accordance with 25 CFR, Subpart 226.33. If oil and gas activities under the proposed action occur within the 200-foot buffer, direct and indirect impacts on red knots may occur.

When oil and gas activities covered under the proposed action occur outside of the 200-foot buffer from established watering places, no impacts on red knot are anticipated due to the distance from suitable habitat.

Conservation Planning (As It Relates to Section 7[a][1] of the ESA)

The proposed action is summarized in **Section 2** of this BA and incorporates the BMPs described below. Since the proposed action is programmatic, measures described below may not be comprehensive. New measures may be developed as necessary following BIA APD review.

Best Management Practices

Table 2-2 includes a number of BMPs that would directly and indirectly benefit red knots. They are the same as those described under **Section 4.2.2**.

Direct and Indirect Impacts

As discussed in **Section 3.2.3**, red knots do not breed in the planning area, though individuals migrating between winter and summer ranges likely pass through. Despite the lack of breeding habitat in the planning area, red knots may use wetland habitats in the planning area as short-term stopover sites during migration.

Wetlands suitable for red knot stopover habitat are a relatively small amount of the land surface in the planning area. As described in the Draft Osage EIS (BIA 2015b), approximately 9,000 acres of emergent herbaceous wetlands and freshwater ponds (excluding forested wetlands, lakes, and river habitats) occur in the planning area. This is less than one percent of the planning area's total land area. However, approximately 7,400 acres (82 percent) of these wetlands occur in areas of high or moderate-to-high oil and gas potential (NWI GIS 2015; BLM GIS 2015). This suggests most wetlands in the planning area could be near existing or future oil and gas activities. Therefore, red knots using wetlands in Osage County as migratory stopover habitat have a high chance of being affected by current and future oil and gas activities.

Potential direct and indirect impacts on red knots from oil and gas activities would be largely the same as those described for whooping cranes in **Section 4.2.2**. This is because neither migratory species breeds nor winters in the planning area but may occasionally use its wetland habitats for migratory stopovers. Potential direct impacts could occur from collisions with oil and gas infrastructure, such as drill rigs or transmission lines. Potential indirect impacts are from degraded water quality in wetland habitats that are suitable migratory stopover areas and from visual or noise disturbances in these habitats.

Under the proposed action, BMPs would be implemented to avoid or minimize these potential direct and indirect impacts, as described in **Section 4.2.2**.

Under the proposed action, water bodies would be protected by a 200-foot-wide buffer, in accordance with 25 CFR, Subpart 226.33. When oil and gas activities covered under the proposed action occur entirely outside of the 200-foot buffer, no direct or indirect impacts on red knot are anticipated due to the distance from suitable migratory stopover habitat.

Cumulative Impacts

The cumulative analysis impacts area for red knots is the planning area. Past, present, and reasonably foreseeable future actions and conditions in the cumulative impacts analysis area that have affected and will continue to affect red knots are similar to those described in **Section 4.2.2**.

As described above under *Direct and Indirect Impacts*, red knots do not breed or winter in the planning area but may use wetlands as migratory stopovers. These stopover habitats are similar to those used by whooping cranes; therefore, the potential cumulative impacts on red knots would be similar to those described for whooping crane.

Under the proposed action, impacts on red knot from oil and gas development in the planning area would cumulatively contribute to the impacts from past, present, and reasonably foreseeable actions. Implementing BMPs would ensure that contributions to cumulative impacts from the proposed action are minor or negligible.

4.2.4 Interior Least Tern

Assumptions and Methods of Analysis

Assumptions and methods of analysis are similar to those described in **Section 4.1.2**. The USFWS provides guidance to avoid impacts on interior least tern from oil and gas projects within the ABB range in Oklahoma (USFWS 2015d). Potential impacts from the proposed action, incorporating USFWS avoidance measures, are analyzed in this section. Additionally, under the proposed action, water bodies (including the Arkansas River) would be protected by a 200-foot-wide buffer protecting established watering places, in accordance with 25 CFR, Subpart 226.33.

When oil and gas activities covered under the proposed action occur outside of the USFWS avoidance buffers, no impacts on interior least tern are anticipated due to the distance from suitable habitat.

Conservation Planning (As It Relates to Section 7[a][1] of the ESA)

The proposed action is summarized in **Section 2** of this BA and incorporates the BMPs described below. Since the proposed action is programmatic, measures described below may not be comprehensive. New measures may be developed as necessary following BIA APD review.

Best Management Practices

Table 2-2 includes BMPs, described below, that would directly and indirectly benefit interior least tern.

Under BMP 15, lessees would be required to follow the USFWS's Oklahoma Ecological Services Field Office guidance for migratory birds and eagles (USFWS 2014b). The guidance lists impact avoidance measures to avoid or minimize impacts on migratory birds and eagles from oil and gas projects in Oklahoma. Lessees would be required to implement avoidance measures within the guidance as part of projects authorized under the proposed action. This would include conducting surveys for suitable habitat for breeding bird species and taking appropriate avoidance measures if breeding birds are observed.

Multiple BMPs would protect wetlands, waters, and water quality within the planning area by prohibiting activities in wetlands and streams without USACE approval (BMP 12), by requiring spill prevention planning (BMPs 5 and 7), and by controlling soil erosion (BMPs 2 and 3). Since interior least terns breed in the Arkansas River floodplain in the planning area, these BMPs would indirectly benefit breeding habitat by protecting upstream water quality.

Additional measures benefiting interior least terns are as follows:

- BMP 15 directs lessees to conduct activities in a manner that avoids any potential incidental take of or harm to federal T&E species.

USFWS Avoidance Measures
The USFWS provides guidance to avoid impacts on interior least tern from oil and gas projects within the ABB range in Oklahoma (USFWS 2015d). To comply with this guidance, project activities will avoid interior least tern nesting areas during the nesting season. New overhead power lines within one mile of suitable habitat (Arkansas River) will be marked according to the guidance in APLIC (2012). Overhead lines, tall drilling rigs, or other tall vertical structures will be avoided within 200 yards of nesting areas and pipelines will be bored under the river in these areas.

Direct and Indirect Impacts
As discussed in **Section 3.2.4**, interior least terns are known to breed along portions of the Arkansas River in Osage County. Breeding habitat is on sand and gravel bars in the river floodplain.

While unlikely, a potential direct impact could occur from interior least terns colliding with oil and gas project components or infrastructure, especially if such infrastructure is installed near breeding colonies. While small agile birds like interior least terns are generally at lower risk of collision (APLIC 2012), interior least tern deaths from power line collisions have been observed near breeding colonies (Dinan et al. 2012). Dinan et al. (2012) noted that size and flight agility may not be the only factors that influence a species' susceptibility to power line collisions; behavior, habitat, time of day, weather, and age may play a role, and interior least terns may be at increased susceptibility due to their courting and pair-bonding behavior.

To avoid potential direct impacts, USFWS avoidance measures would be implemented, including avoiding nesting areas during the breeding season, and marking new overhead lines within one mile of suitable habitat (Arkansas River) according to APLIC (2012) guidelines. New overhead lines, tall drilling rigs or other tall vertical structures will be avoided within 200 yards of nesting areas unless tall vertical structures already exist within the 200-yard buffer. Pipelines will be bored under the river in these areas. Implementing these measures would avoid this potential direct impact on interior least terns from colliding with oil and gas project infrastructure. If the lessee chooses not to implement USFWS avoidance measures, additional coordination with the USFWS may be required to avoid impacts.

Additionally, BMPs (**Table 2-2**) and other measures under the proposed action would avoid and reduce direct and indirect impacts on interior least terns and habitat. BMPs under the proposed action protect interior least tern habitat.

BMP 15 directs lessees to conduct activities in a manner that avoids any potential incidental take of or harm to federal T&E species, including mandating adherence to the USFWS migratory bird and eagle protocol (USFWS 2014b). This includes conducting surveys for breeding birds and habitat before construction and implementing appropriate measures to avoid breeding birds, if present.

Because interior least terns breed and forage in riverine habitat, changes to water quality may indirectly affect the species. Excessive silt deposition resulting from soil erosion and runoff could degrade nesting habitat; water quality alterations marked enough to kill fish species may reduce prey for interior least terns. To avoid such indirect impacts, multiple BMPs in **Table 2-2** would protect water quality by implementing spill prevention planning (BMPs 5 and 7) and soil erosion control (BMPs 2 and 3). These BMPs would indirectly benefit breeding habitat by protecting upstream water quality from both soil erosion and runoff and introduction of deleterious materials (e.g., petroleum products and production fluids) into waterways.

Additional indirect impacts on interior least terns from oil and gas activities are visual or noise disturbance from humans, potentially resulting in flight response and unnecessary energy expenditure and elevated stress. BMP 11 directs lessees to reduce potential noise and other disturbances to wildlife from oil and gas projects. Implementing these measures would minimize or avoid potential indirect impacts on interior least terns.

Under the proposed action, water bodies (including the Arkansas River where interior least terns are known to breed) would be protected by a 200-foot-wide buffer, in accordance with 25 CFR, Subpart 226.33. The 200-foot buffer would further protect habitat and reduce potential for indirect impacts on interior least tern from the proposed action.

When oil and gas activities covered under the proposed action occur entirely outside of the USFWS avoidance measure buffers around suitable breeding habitat, no direct or indirect impacts on interior least terns are anticipated due to the distance from suitable breeding habitat.

Cumulative Impacts

The cumulative analysis impacts area for interior least terns is the planning area. Past, present, and reasonably foreseeable future actions and conditions in the cumulative impacts analysis area that have affected and will continue to affect interior least terns and their habitat are as follows:

- Habitat alteration and destruction, including regulated river flows, channelization, irrigation, and the construction of reservoirs
- Human disturbance, including recreation in river systems where interior least terns breed

Past actions, such as river channel engineering, reservoirs, channelization, channel training structures, and bank stabilization, have reduced available breeding habitat for interior least terns. Recreation has also affected and will likely continue to affect interior least terns. Recreation concentrated in river systems can disturb interior least terns' breeding activity and result in reduced reproductive success.

Under the proposed action, impacts on interior least terns from oil and gas development in the planning area would be unlikely to cumulatively contribute to the impacts from past, present, and reasonably foreseeable actions. Implementing the USFWS avoidance measures and BMPs suggests that contributions to cumulative impacts from the proposed action are unlikely.

4.2.5 Piping Plover

Assumptions and Methods of Analysis

Assumptions and methods of analysis are similar to those described in **Section 4.2.4** for interior least tern. Piping plover is not known to breed in the planning area but may pass through it during migration.

Conservation Planning (As It Relates to Section 7[a][1] of the ESA)

The proposed action is summarized in **Section 2** of this BA and incorporates the BMPs described below. Since the proposed action is programmatic, measures described below may not be comprehensive. New measures may be developed as necessary following BIA APD review.

Best Management Practices

Table 2-2 includes a number of BMPs that would directly and indirectly benefit piping plovers. BMPs that would directly and indirectly benefit piping plovers are the same as those described under **Section 4.2.4**.

Direct and Indirect Impacts

As discussed in **Section 3.2.5**, piping plovers are not known to breed in the planning area but may pass through the planning area during migration. Additionally, potentially suitable breeding habitat, consisting of sparsely vegetated sandbars, lake and reservoir shorelines, and similar areas, are present in the planning area. Further, piping plovers and interior least terns are known to breed in the same discrete locations in the Missouri River system (USFWS 1990); interior least terns are known to breed along portions of the Arkansas River, as described in **Section 3.2.4**. Therefore, it is reasonable to assume that there is a potential for piping plovers to breed in the planning area.

Potential direct and indirect impacts on piping plovers from oil and gas activities would be largely the same as those described for interior least terns in **Section 4.2.4**. This is because both species use similar habitat for breeding and foraging. Potential direct impacts could occur from colliding with oil and gas infrastructure, such as drill rigs or transmission lines, though this may be unlikely

(Dinan et al. 2012). Potential indirect impacts are degradation of water quality in riverine habitats, associated degradation of nesting habitat from excessive siltation, and potential noise or visual disturbance to individual piping plovers.

Under the proposed action, BMPs would be implemented to avoid or minimize these potential direct and indirect impacts, as described in **Section 4.2.4**. Additionally, water bodies, including the Arkansas River, with potential breeding habitat for piping plovers would be protected by a 200-foot-wide buffer, in accordance with 25 CFR, Subpart 226.33.

Under the proposed action, water bodies would be protected by a 200-foot-wide buffer, in accordance with 25 CFR, Subpart 226.33. When oil and gas activities covered under the proposed action occur entirely outside of the 200-foot buffer, no direct or indirect impacts on piping plovers are anticipated due to the distance from suitable foraging and potential breeding habitat.

Cumulative Impacts

The cumulative analysis impacts area for piping plovers is the planning area. Past, present, and reasonably foreseeable future actions and conditions in the cumulative impacts analysis area that have affected and will continue to affect piping plovers are similar to those described in **Section 4.2.4**, for interior least tern. As described under *Direct and Indirect Impacts*, above, piping plovers are not known to breed in the planning area, but suitable breeding habitat may exist. Piping plovers have been documented in the planning area during migration. Therefore, the potential cumulative impacts on piping plover would be similar to those described for interior least terns.

Under the proposed action, the impacts on piping plovers from oil and gas development in the planning area would be unlikely to cumulatively contribute to the impacts from past, present, and reasonably foreseeable actions. Implementing BMPs suggest that contributions to cumulative impacts from the proposed action are unlikely.

4.2.6 Neosho Mucket Mussel

Assumptions and Methods of Analysis

Assumptions and methods of analysis are similar to those described in **Section 4.1.2**. An additional assumption is that, under the proposed action, water bodies would be protected by a 200-foot-wide buffer protecting established watering places, in accordance with 25 CFR, Subpart 226.33. When oil and gas activities covered under the proposed action occur outside of the 200-foot buffer from established watering place, no direct or indirect impacts on Neosho mucket mussel are anticipated.

If oil and gas activities occur within the 200-foot buffer from occupied habitat, indirect impacts may still occur resulting primarily from water quality impacts, as described below.

Conservation Planning (As It Relates to Section 7[a][1] of the ESA)
The proposed action is summarized in **Section 2** of this BA and incorporates the BMPs described below. Since the proposed action is programmatic, measures described below may not be comprehensive. New measures may be developed as necessary following BIA APD review.

Best Management Practices
Table 2-2 includes a number of BMPs that would directly and indirectly benefit Neosho mucket mussel. These are discussed below.

Multiple BMPs would protect wetlands, waters, and water quality in the planning area by prohibiting activities in wetlands and streams without USACE approval (BMP 12), by requiring spill prevention planning (BMPs 5 and 7), and by controlling soil erosion (BMPs 2 and 3). Since Neosho mucket mussels occur in large streams and small rivers in the planning area, these BMPs would indirectly benefit breeding habitat by protecting water quality.

An additional measure benefiting Neosho mucket mussels is BMP 15, which directs lessees to conduct activities in a manner that avoids any potential incidental take of or harm to federal T&E species.

Direct and Indirect Impacts
As discussed in **Section 3.2.7**, Neosho mucket mussels have been observed in large streams and small rivers in Osage County, in shallow riffle-run complexes with swift currents. Under the proposed action, water bodies would be protected by a 200-foot-wide buffer, in accordance with 25 CFR, Subpart 226.33. This would prevent potential direct impacts and would limit potential indirect impacts from oil and gas activities on Neosho mucket mussel habitat.

Indirect impacts on Neosho mucket mussel habitat could occur from oil and gas activities next to river and stream habitat. Indirect impacts are those on water quality from erosion, runoff, and sedimentation and from deleterious substances from unintentional spills.

BMPs (**Table 2-2**) would be sufficient to avoid indirect impacts on Neosho mucket mussel habitat. BMPs under the proposed action prohibit activities in wetlands and streams without USACE approval (BMP 12). Multiple BMPs would protect water quality by implementing spill prevention planning (BMPs 5 and 7) and soil erosion control (BMPs 2 and 3). These BMPs would indirectly benefit Neosho mucket mussel habitat by protecting upstream water quality from both soil erosion and runoff and the introduction into waterways of deleterious materials, such as petroleum products and production fluids.

Under the proposed action, water bodies would be protected by a 200-foot-wide buffer, in accordance with 25 CFR, Subpart 226.33, further minimizing chances for indirect impacts on Neosho mucket mussel from water quality changes associated with oil and gas activities.

Finally, BMP 15 mandates that lessees avoid any potential incidental take of or harm to federally T&E species and to comply with any permit or authorization issued by the USFWS.

Cumulative Impacts

The cumulative impacts analysis area for Neosho mucket mussels is the planning area. Past, present, and reasonably foreseeable future actions and conditions in the cumulative impacts analysis area that have affected and will continue to affect Neosho mucket mussel and its habitat are as follows:

- Surface-disturbing activities that affect water quality, including oil and gas, residential, commercial, infrastructure, and other development
- Habitat alteration and destruction, including regulated river flows, channelization, irrigation, and the construction of reservoirs

Past river channel engineering and reservoir construction have likely reduced available Neosho mucket mussel habitat. As discussed in **Section 3.2.7**, Neosho mucket occurs both upstream and downstream of Hulah Lake (a constructed reservoir) in the Caney River (ODWC 2015). Because Neosho mucket mussels are not known from other rivers in the planning area, this suggests that reservoir construction may have removed much of the suitable habitat there.

Past and current land uses including agriculture, oil and gas development, residential, commercial, infrastructure, and other development have resulted in cumulative impacts on watersheds that support or may support Neosho mucket mussel. Impacts are those on water quality, including increases in sediment and turbidity. Water quality requirements for Neosho mucket are not well understood; however, environmental contamination is a contributing factor to the decline in mussel populations, and excessive sediments can be detrimental to the survival of juvenile mussels and may affect food availability (USFWS 2015c).

Impacts on Neosho mucket mussel as a result of oil and gas development in the planning area would be unlikely to cumulatively contribute to the impacts from past, present, and reasonably foreseeable actions. Implementing BMPs suggests that contributions to cumulative impacts from the proposed action are unlikely.

4.3 CANDIDATE SPECIES

4.3.1 Rattlesnake-Master Borer Moth

Assumptions and Methods of Analysis

Assumption and methods of analysis are similar to those described in **Section 4.1.2**. Additional assumptions are as follows:

- Impacts on the rattlesnake-master borer moth's host plant, rattlesnake master, were used as a proxy to analyze impacts on rattlesnake-master borer moth.
- Impacts would be concentrated in suitable habitat, in areas of high to moderate oil and gas potential. This is because these areas are more likely to see continued or increased oil and gas development and associated ground disturbance or vegetation removal.
- Surveys would not be conducted for the host plant in suitable prairie habitat, except in the event that the applicable RCM requiring surveys is selected during the Osage EIS process.
- Oil and gas activities outside of suitable prairie habitat would have no effect on the rattlesnake-master borer moth, as the host plant does not occur there.

Conservation Planning (as It Relates to Section 7[a][1] of the ESA)

The proposed action is summarized in **Section 2** of this BA and incorporates the conservation measures described below. Since the proposed action is programmatic, standard best management practices described in Attachment B may not be comprehensive. New conditions of approval may be developed as necessary following BIA APD review.

Conservation Measures

Attachment B includes a number of measures that would directly and indirectly benefit rattlesnake-master borer moth.

In general, oil and gas operators must conduct activities in a workman like manner as stated in 25 CFR 226.19. Attachment B best management practices provide more specific guidelines which may be included in permit conditions.

Standard BMP 5 directs lessees to avoid or minimize soil and vegetation disturbance, and avoid removal or damage to trees, shrubs and groundcover to the extent possible. BMP 6 requires erosion control measures to avoid debris or contaminants off the well site to adjacent lands. BMP 7 states that all vehicles and equipment must utilize and stay confined to existing and approved new roads. Where oil and gas projects are in appropriate habitat, such as wet or mesic prairie soils or open woods, these BMPs would minimize potential impacts on the host plant, rattlesnake master, as well as individual moths. BMP 16 provides that disturbed areas should be restored to original contour with clean soil and vegetation should be re-established with native species unless otherwise approved. No noxious or invasive species may be used in revegetation and reclamation activities.

These measures would indirectly benefit habitat for the host plant. An additional measure benefiting rattlesnake-master borer moth is BMP 18, which directs lessees to conduct activities in a manner that avoids any potential incidental take of or harm to federal T&E species.

Direct and Indirect Effects

As discussed in **Section 3.3.1**, in Oklahoma, rattlesnake-master borer moth is known only from The Nature Conservancy's Tallgrass Prairie Preserve, near Pawhuska. However, suitable habitat for the host plant likely occurs in other areas of the planning area in tallgrass prairie. For this reason, undiscovered populations of rattlesnake-master borer moth may occur in these areas.

As described in *Assumptions*, potential impacts on rattlesnake-master borer moth were analyzed by assessing potential impacts on its host plant, rattlesnake-master, including potential impacts on tallgrass prairie, which is habitat for the host plant. The potential for impacts on tallgrass prairie and the host plant would be highest where this habitat occurred in areas of high or moderate-to-high oil and gas potential. This is because oil and gas development will likely continue to be concentrated in these areas.

Table 4-2 summarizes acres of tallgrass prairie habitats in the planning area in areas of high or moderate-to-high oil and gas potential.

Table 4-2
Acres of Tallgrass Prairie in Areas of High or Moderate-to-high Oil and Gas Potential

Habitat Classification	Acres with Oil and Gas Potential	Total Acres in Planning Area	Percent of Habitat Classification
Tallgrass prairie	502,700	656,700	77

Sources: Oklahoma Biological Survey GIS 1943; BLM GIS 2015

As shown in **Table 4-2**, approximately 77 percent of tallgrass prairie in the planning area is in high or moderate-to-high oil and gas potential areas. This suggests that most tallgrass prairie habitat in the planning area could be near existing or future oil and gas activities. Therefore, the potential for effects of current or future oil and gas activities on the rattlesnake-master borer moth may be greater. Further, oil and gas development is found in TNC's Tallgrass Prairie Preserve, with approximately 220 active wells operating there in 2013[11] (TNC 2013).

Potential direct impacts on rattlesnake-master borer moth can include injury or death. During the moth's flight period, adult moths may collide with or be struck by vehicles or equipment, resulting in injury or death. Depending on the season, vegetation removal, soil grading, and off-road vehicle and equipment can

[11] R. G. Hamilton, Director Tallgrass Prairie Preserve, The Nature Conservancy, personal communication with E. Streater, Acting Deputy Regional Director – Trust Services, Eastern Oklahoma Region, BIA, January 25, 2013.

crush eggs in the duff surrounding the host plant or crush or injure burrowed larvae or adults in or on the host plant. During dry periods, vehicle and equipment use may increase the risk of wildfire ignitions, which can injure or kill adults or larvae.

Several BMPs listed in Appendix B, as described above, can work to avoid or minimize these impacts. Additionally, because off-road vehicle and equipment use is prohibited, the risk of unintentional wildfire ignition, and associated impacts on the moth, are reduced.

Vegetation removal can also have indirect effects on the rattlesnake-master borer moth. Vegetation removal may result in breeding, foraging, or sheltering habitat degradation and reduced habitat connectivity, which may limit reproductive success. To minimize or avoid impacts, BMP 5 would minimize vegetation disturbance, as discussed above. Revegetating temporarily disturbed areas, will make recolonization by the host plant more likely in the long term.

Vegetation maintenance may also have direct and indirect effects on rattlesnake-master borer moth. Mowing may injure or kill individual larvae or adults, and mowing equipment may crush eggs in the duff surrounding host plants. Herbicide application can kill the host plant, effectively leaving individuals without a means of forage or reproduction, eventually resulting in death or decreased reproductive success.

Artificial light used during oil and gas operations (including gas flares) may indirectly or directly affect rattlesnake-master borer moth during its flight period. Artificial light sources may attract the moth, resulting in injury or death through collision with structures or equipment or exposure to the gas flare. Artificial lights may adversely affect reproductive success and increase predation on the moth. Artificial lights may artificially increase energetic demands on the moth, leading to reduced fitness or breeding success.

BMP 18 mandates that lessees conduct activities to avoid incidental take or harm to listed species. This BMP may be added as a condition of approval to a permit issued by BIA in appropriate situations, and additional site-specific COAs can also be developed. If listed as a T & E species, BIA may require surveys to determine the presence of the host plant, and specify measures to avoid detrimental impacts on rattlesnake-master borer moth following results of the survey, if necessary.

When oil and gas activities are completely outside of suitable habitat for the host plant, no effects on rattlesnake-master borer moth are anticipated.

Cumulative Effects

The cumulative effects analysis area for rattlesnake-master borer moth is the planning area. Past, present, and reasonably foreseeable future actions and conditions in the area that have affected and will continue to affect rattlesnake-master borer moth and its habitat are as follows:

- Fragmentation and loss of native tallgrass prairie habitat due to various types of development
- Establishment and spread of noxious weeds and nonnative invasive species in tallgrass prairie habitat
- Vegetation management plans, including the Osage Nation Integrated Resource Management Plan (ONENRD 2006)

Tallgrass prairie has declined greatly in acreage due to agricultural conversion throughout the region; however, large expanses of this vegetation type still occur in the planning area (Hoagland 2008). The historical use of tallgrass prairie for pasture (Duck and Fletcher 1943) led to its conversion to exotic pasture grasses and is an ongoing threat in tallgrass prairie in the region.

The frequency and extent of fire in these systems has dramatically declined as a result of fire suppression and reduction in fuels due to grazing. This can give rise to changes in the plant community and invasion of native or nonnative species, potentially reducing suitable habitat for the host plant, rattlesnake master.

Invasive plants are generally spreading or increasing in density in some parts of the planning area. This is especially true in oil and gas fields, along roadways, transmission lines, and other rights-of-way. At the margins of agricultural operations, ground disturbance is concentrated and human activities have increased the number of potential invasive plant introductions (Smith and Knapp 2001).

Invasive plants may outcompete native species, including the host plant, for nutrients and light, eventually reducing the density and distribution of native species. Typically, as ground disturbance increases in areas of weed populations, the likelihood that invasive plants would move into these areas increases. Linear development, such as transmission lines, pipelines, roads, and fences, can facilitate long-distance weed dispersal (Sheley 1996; Forest Service 2012).

It is likely that impacts from climate change will affect vegetation in the planning area within the cumulative impacts planning horizon. Current climate change models are projecting a range of potential shifts in climate, including increasing temperatures and more intense rainfall. This is despite a decrease in average amounts of total annual precipitation (Karl et al. 2009). Altered climatic patterns would likely influence species distribution within vegetation communities in the planning area, potentially affecting density and distribution of the host plant. This may be particularly true in those communities that are sensitive to impacts from drought or altered fire regimes or that are susceptible to weed establishment and spread.

Under the proposed action, impacts on rattlesnake-master borer moth from oil and gas development in the planning area would cumulatively contribute to the impacts from past, present, and reasonably foreseeable actions. Implementing BMPs and appropriate COAs should ensure that contributions to cumulative impacts from the proposed action would be minor. These BMPS are as follows:

- Conducting activities in a manner that avoids incidental take of T&E species or complies with any USFWS permit or authorization
- Avoiding or minimizing vegetation disturbance
- Revegetating temporarily disturbed areas using native seed unless otherwise approved, and
- Prohibiting the use of noxious or invasive species for revegetation

SECTION 5
IMPACTS DETERMINATION

5.1 AMERICAN BURYING BEETLE

Implementing the proposed action **may affect, and is likely to adversely affect**, ABB when oil and gas activities occur within the potential range of ABB. When oil and gas activities under the proposed action occur outside of the potential range of ABB, these activities would have **no effect** on ABB.

5.1.1 Rationale

Direct and indirect impacts on ABB and its habitat can occur from typical activities associated with oil and gas development (USFWS 2014c). To minimize direct and indirect impacts, the BIA would implement and adhere to protocols incorporated into this BA and its Attachments, including but not limited to Attachment A. The BIA may implement additional standardized BMPs from **Table 2-2** or include site-specific COAs to further minimize impacts. Where unavoidable impacts on the ABB remain after measures in Attachment A, standard BMPs and site-specific COAs are implemented, adverse impacts would be mitigated in accordance with Attachment A and this BA.

Under the proposed action, before oil and gas activities begin within the ABB's range in the planning area, a presence/absence survey would be conducted or presence would be assumed. When survey results are negative, lessees would report them to the BIA. After the BIA determines that the results of a valid survey have been submitted to the USFWS, lessees would have approval to proceed. For workover operations that would not require a survey, maintaining vegetation below 8 inches on well pads until operations are complete would minimize potential impacts on any ABBs. The vegetation removal process is described in greater detail in **Section 2.3** above.

When ABB surveys are positive, lessees would be required to minimize or mitigate the proposed disturbance, in accordance with the procedures detailed in this BA, including but not limited to Attachment A.

The BIA would report to the USFWS annually the acres of suitable ABB habitat disturbed, under the programmatic incidental take statement.

The USFWS (2015b) has stated that projects outside of the ABB's potential range would have no effect on ABB. This includes all areas with the potential to be both directly and indirectly affected by oil and gas activities.

5.2 Whooping Crane

Implementing the proposed action outside of the 95 percent sighting corridor will have **no effect** on whooping cranes. Implementing the proposed action within the 95 percent sighting corridor **may affect but is not likely to adversely affect** whooping cranes. Implementing the proposed action would have **no effect** on designated critical habitat for whooping cranes. BIA will utilize geographical information provided by the USFWS to confirm the location of the 95 percent sighting corridor.

5.2.1 Rationale

Whooping cranes do not breed or winter in the planning area, and no nesting habitat occurs there. However, important stopover or roosting habitat within the 95 percent sighting corridor occurs in the planning area. Despite the lack of breeding habitat in the planning area, limited numbers of whooping cranes may use wetland and adjacent agricultural habitats in the planning area as short-term stopover sites during migration. Because most of these habitats in the planning area are in areas with high or moderate-to-high potential for oil and gas activities, the potential for impacts of current or future oil and gas activities on whooping cranes may be greater.

To avoid and minimize direct impacts, the BIA would implement USFWS avoidance measures (USFWS 2015d) for whooping cranes within the 95 percent sighting corridor as described in **Section 4.2.2**. If the lessee chooses not to implement USFWS avoidance measures, additional coordination with the USFWS may be required to avoid impacts.

To avoid and minimize direct and indirect impacts, the BIA would also implement BMPs (**Table 2-2**), as follows:

- Following USFWS guidance on avoiding impacts on migratory birds
- Reducing noise and other project impacts
- Implementing appropriate BMPs to protect wetlands, waters, and water quality in the planning area

When oil and gas activities covered under the proposed action occur outside of the 95 percent sighting corridor, no impacts on whooping cranes are anticipated due to the distance from suitable migratory stopover habitat.

There is no designated critical habitat for whooping cranes in the planning area. The nearest designated critical habitat is the Salt Plains NWR, approximately 60 miles west of the planning area.

5.3 RED KNOT

Implementing the proposed action outside of the 200-foot buffer around established watering places under 25 CFR, Subpart 226.33 will have **no effect** on red knots. Implementing the proposed action within the 200-foot buffer around established watering places **may affect but is not likely to adversely affect** red knots.

5.3.1 Rationale

Red knots do not breed or winter in the planning area, and no nesting or major migratory stopover habitat occurs there. Despite the lack of breeding and major stopover habitat, limited numbers of red knots may use wetland habitats in the planning area as short-term stopover sites during migration. Because most of these habitats are in areas with high or moderate-to-high potential for oil and gas activities, the potential for impacts of current or future oil and gas activities on red knots may be greater.

When oil and gas development activities under the proposed action occur within the 200-foot buffer under 25 CFR, Subpart 226.33, this could expose individuals in these areas to direct and indirect impacts from activities under the proposed action.

The BIA would implement the following BMPs (**Table 2-2**) to avoid or minimize impacts:

- Following USFWS guidance on avoiding impacts on migratory birds
- Taking measures to reduce noise and other project impacts
- Implementing a suite of BMPs to protect wetlands, waters, and water quality within the planning area

When oil and gas activities covered under the proposed action occur outside of the 200-foot buffer from established watering places, no impacts on red knots are anticipated due to the distance from suitable migratory stopover habitat.

5.4 INTERIOR LEAST TERN

Implementing the proposed action outside of the USFWS avoidance measure buffers around breeding habitat will have **no effect** on interior least terns. Implementing the proposed action within the USFWS avoidance buffers **may affect but is not likely to adversely affect** interior least terns.

5.4.1 Rationale

Interior least terns are known to breed along sparsely vegetated sand and gravel bars in the Arkansas River in the planning area. To avoid direct impacts, the BIA would implement USFWS avoidance measures (USFWS 2015d) for interior least terns within the buffer areas described in **Section 4.2.4**. If the lessee chooses not to implement the USFWS avoidance measures, additional coordination with the USFWS may be required to avoid impacts.

These areas would also be protected by a 200-foot-wide buffer under 25 CFR, Subpart 226.33. While direct impacts on least tern breeding habitat would not occur, other potential direct and indirect impacts may occur from current and future oil and gas activities in uplands adjacent to least tern breeding habitat (see **Section 4.2.4**).

Potential direct and indirect impacts on interior least terns would further be minimized or avoided by implementing the following BMPs (**Table 2-2**) throughout the planning area:

- Following USFWS guidance on avoiding impacts on migratory birds
- Taking measures to reduce noise and other project impacts
- Implementing a suite of BMPs to protect wetlands, waters, and water quality in the planning area

When oil and gas activities covered under the proposed action occur outside of the USFWS avoidance buffers, no impacts on interior least terns are anticipated due to the distance from suitable breeding and foraging habitat.

5.5 Piping Plover

Implementing the proposed action outside of the 200-foot buffer around established watering places under 25 CFR, Subpart 226.33 will have **no effect** on piping plover. Implementing the proposed action within the 200-foot buffer around established watering places **may affect but is not likely to adversely affect** piping plover. Implementing the proposed action would have **no effect** on their designated critical habitat.

5.5.1 Rationale

Piping plovers are not known to breed in the planning area; however, they generally use the same breeding habitats as interior least terns, which do breed there. As piping plovers have been observed in the planning area, the assumption is that potential breeding habitat exists. These areas would be protected by a 200-foot-wide buffer under 25 CFR, Subpart 226.33. While direct impacts on breeding habitat would not occur, other potential direct and indirect impacts as described in **Section 4.2.5** may occur from current and future oil and gas activities located adjacent to breeding habitat.

Potential direct and indirect impacts on piping plovers would be avoided by implementing the following BMPs (**Table 2-2**):

- Following USFWS guidance on avoiding impacts on migratory birds

- Taking measures to reduce noise and other project impacts
- Implementing a suite of BMPs to protect wetlands, waters, and water quality within the planning area

When oil and gas activities covered under the proposed action occur outside of the 200-foot buffer from established watering places, no effects on piping plovers are anticipated due to the distance from suitable habitat.

There is no designated critical habitat for piping plover in the planning area. The nearest designated critical habitat to the planning area is in the Platte River in central Nebraska, several hundred miles to the north.

5.6 NEOSHO MUCKET MUSSEL

Implementing the proposed action outside of the 200-foot buffer around established watering places under 25 CFR, Subpart 226.33 will have **no effect** on Neosho mucket mussels. Implementing the proposed action within the 200-foot buffer around established watering places may affect but is not likely to adversely affect Neosho mucket mussels where suitable habitat for these mussels exists. Implementing the proposed action would have **no effect** on designated critical habitat for Neosho mucket mussel.

5.6.1 Rationale

Neosho mucket mussels are known from the Caney River in the planning area. These areas would be protected by a 200-foot-wide buffer under 25 CFR, Subpart 226.33.

Potential impacts on Neosho mucket mussels from oil and gas activities in adjacent areas would be avoided by implementing the 200-foot-wide buffer and by including additional BMPs (**Table 2-2**), including a suite of BMPs to prevent erosion and sedimentation, protect wetlands, waters, and water quality in the planning area.

There is no designated critical habitat for Neosho mucket mussel in the planning area. No critical habitat units are downstream of any streams or rivers in the planning area. The critical habitat nearest to the planning area is in the Fall and Verdigris Rivers, in southeast Kansas, approximately 25 miles to the northeast.

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SECTION 6
REFERENCES

American Bird Conservancy, Audubon Maryland-DC, Audubon New York, Citizens Campaign for the Environment, Defenders of Wildlife, Delaware Audubon Society, National Audubon Society, New Jersey Audubon Society, and Virginia Audubon Council. 2005. Emergency Petition for a Rule to List the Red Knot (*Calidris canutus rufa*) as Endangered under the Endangered Species Act, 16 USC, 1531 et seq. (1973 as amended) within the United States.

APLIC (Avian Power Line Interaction Committee). 2012. Reducing Avian Collisions with Power Lines: The State of the Art in 2012. Edison Electric Institute and APLIC. Washington, DC.

BIA (US Department of the Interior, Bureau of Indian Affairs). 1979. Environmental Assessment for the Oil and Gas Leasing Program of the Osage Indian Tribe, Osage County, Oklahoma. Muskogee Area Office. Muskogee, Oklahoma. May 1979.

______. 2015a. Programmatic Environmental Assessment for Approving Workover Operations. BIA Osage Agency. Pawhuska, Oklahoma.

______. 2015b. Draft Osage County Oil and Gas EIS. BIA Eastern Oklahoma Region, Muskogee, Oklahoma.

BIA NIOGEMS GIS. 2015. GIS data of BIA-administered tribal and allotted lands. Bureau of Indian Affairs, Southern Plains and Eastern Oklahoma Regions.

BLM (US Department of the Interior, Bureau of Land Management) GIS. 2015. Base GIS data on file with the BLM's eGIS Server used for calculations or figures; includes data prepared for the RFD. Bureau of Land Management, Oklahoma Field Office, Tulsa.

Brabander, J. J., R. E. Masters, and R. M. Short. 1985. Bottomland Hardwoods of Eastern Oklahoma—A Special Study of Their Status, Trends, and Values. US Fish and Wildlife Service, Tulsa, Oklahoma, and Oklahoma Department of Wildlife Conservation, Oklahoma City, Oklahoma. December 1985.

CWS and USFWS (Canadian Wildlife Service and US Fish and Wildlife Service). 2007. International Recovery Plan for the Whooping Crane (*Grus americana*), Third Revision. Ottawa: Recovery of Nationally Endangered Wildlife (RENEW), and USFWS, Albuquerque, New Mexico.

Dinan, L. R., J. G. Jorgensen, and M. B. Brown. 2012. "Interior least tern power line collision on the Lower Platte River." *The Prairie Naturalist* 44:109-110.

Duck, L. G., and J. B. Fletcher. 1943. The Game Types of Oklahoma. A Report to the Oklahoma Game and Fish Commission. Adapted by the Oklahoma Biological Survey. Internet website: http://www.biosurvey.ou.edu/duckflt/dfhome.html.

Forest Service (US Department of Agriculture, Forest Service). 2012. Noxious Weed Risk Assessment, Giant Sequoia National Monument Management Plan. Porterville, California. July 2012.

Hoagland, B. W. 2008. "Vegetation of Oklahoma." Poster for the Oklahoma Biological Survey. University of Oklahoma, Norman, Oklahoma.

Karl, T. R., J. M. Melillo, and T. C. Peterson (editors). 2009. *Global Climate Change Impacts in the United States*. US Global Change Research Program, Cambridge University Press, New York, New York.

Longcore, T., and C. Rich. 2004. "Ecological light pollution." *Front Ecol. Environ.* 2:191-198.

Lewis, T. E., and R. D. Slack. 2008. "Whooping cranes and human disturbance: An [sic] historical perspective and literature review." North American Crane Workshop Proceedings. Paper 182.

NatureServe. 2015. Comprehensive Species Report – *Calidris canutus rufa*. Internet website: http://explorer.natureserve.org/index.htm.

NWI (National Wetlands Inventory) GIS. 2015. National Wetlands Inventory. US Department of the Interior, Fish and Wildlife Service, Washington, DC. Internet website: http://www.fws.gov/wetlands/.

Oklahoma Biological Survey GIS. 1943. The Game Types of Oklahoma, map created in 1943 and digitized in 1995. Internet website: http://www.biosurvey.ou.edu/duckflt/dfhome.html.

ODWC (Oklahoma Department of Wildlife Conservation). 2015. An overview of the federally listed and candidate species in Oklahoma – May 2015. Internet website: http://www.wildlifedepartment.com/wildlifemgmt/515listed.pdf.

OK GAP GIS. 2008. USGS Gap Analysis Program (GAP) data symbolized for owner type as a proxy for land status. Internet website: http://gapanalysis.usgs.gov/padus/data/download/.

ONENRD (Osage Nation Environmental and Natural Resources Department). 2006. Osage Nation Integrated Resource Management Plan. Pawhuska, Oklahoma.

Sheley, R., M. Manoukian, and G. Marks. 1996. "Preventing noxious weed invasion." Rangelands 18(3).

Shiver, M. A. 2002. "Reproduction and propagation of the Neosho mucket, *Lampsilis rafinesqueana*." Dissertation, Southwest Missouri State University, Springfield, Missouri.

Smith, M. D., and A. K. Knapp. 2001. "Physiological and morphological traits of exotic, invasive exotic, and native plant species in tallgrass prairie." *Int. J. Plant Sci.* 162(4):785-792.

USFWS (US Fish and Wildlife Service). 1978. Determination of Critical Habitat for the Whooping Crane. 43 FR 20938-20942.

______. 1988. Great Lakes & Northern Great Plains Piping Plover (*Charadrius melodus*) Recovery Plan. Great Lakes/Northern Great Plains Piping Plover Recovery Team.

______. 1990. Recovery Plan for the Interior Population of the Least Tern (*Sterna antillarum*). USFWS, Twin Cities, Minnesota. September 1990.

______. 1991. American Burying Beetle (*Nicrophorus americanus*) Recovery Plan. Newton Corner, Massachusetts.

______. 1998. Final ESA Section 7 Consultation Handbook. USFWS and National Marine Fisheries Service.

______. 2002. Endangered and Threatened Wildlife and Plants; Designation of Critical Habitat for the Northern Great Plains Breeding Population of the Piping Plover. 67 FR 57638.

______. 2008. American Burying Beetle (*Nicrophorus americanus*) 5-Year Review: Summary and Evaluation. USFWS New England Field Office, Concord, New Hampshire. March 2008.

______. 2009. Piping Plover (*Charadrius melodus*) 5-Year Review: Summary and Evaluation. USFWS Northeast Region, Hadley, Massachusetts, and the Midwest Region's East Lansing Field Office, Michigan. September 2009.

______. 2012a. Whooping Crane *(Grus americana)* 5-Year Review: Summary and Evaluation. USFWS, Aransas NWR, Austwell, Texas, and Corpus Christi Ecological Services Field Office, Texas.

______. 2012b. Proposed Endangered Status for the Neosho Mucket, Threatened Status for the Rabbitsfoot and Designation of Critical Habitat for Both Species; Proposed Rule. 77 FR 63440.

______. 2013. Interior Least Tern (*Sternula antillarum*) 5-Year Review: Summary and Evaluation. USFWS Southeast Region, Mississippi Field Office, Jackson.

______. 2014a. Migratory Bird and Eagle Impact Avoidance Measures for Actions Associated with Oil and Gas Projects. Oklahoma Ecological Services Field Office, Tulsa. April 2014.

______. 2014b. American Burying Beetle *Nicrophorus americanus* Oklahoma Presence/Absence Live-trapping Survey Guidance. Oklahoma Ecological Services Field Office, Tulsa. May 2014.

______. 2014c. Final Oil and Gas Industry Conservation Plan Associated with Issuance of ESA Section 10(a)(1)(B) Permits for the American Burying Beetle in Oklahoma. USFWS Oklahoma Ecological Services Field Office. Tulsa.

______. 2014d. Draft Environmental Assessment for the Oil and Gas Industry Conservation Plan for the American Burying Beetle in Oklahoma. USFWS, Tulsa, Oklahoma. April 2014.

______. 2015a. Information for Planning and Conservation (IPaC) Trust Resource Report for Osage County, Oklahoma. Generated October 24, 2015.

______. 2015b. American Burying Beetle Impact Assessment for Project Reviews. USFWS Southwest Region, Oklahoma Ecological Services Field Office, Tulsa, Oklahoma. March 2015.

______. 2015c. Endangered and Threatened Wildlife and Plants; Designation of Critical Habitat for Neosho Mucket and Rabbitsfoot; Final Rule. 80 FR 24692-24774.

______. 2015d. US Fish and Wildlife Service Species Take Avoidance Measures for Non-Covered Species Related to Selected Oil and Gas Projects within the American Burying Beetle Range in Oklahoma. USFWS, Tulsa, Oklahoma. April 2015.

______. 2016a. News Release: US Fish and Wildlife Service Evaluating Status of the American Burying Beetle. USFWS Public Affairs Office, Albuquerque, New Mexico.

______. 2016b. American Burying Beetle: Additional Information. USFWS Oklahoma Ecological Services Field Office, Tulsa, Oklahoma. Internet website: http://www.fws.gov/southwest/es/oklahoma/ABB_Add_Info.htm.

USFWS GIS. 2016. Published GIS data of American Burying Beetle habitat. Internet website: http://www.fws.gov/southwest/es/oklahoma/ABB_Add_Info.htm.

SECTION 7
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ATTACHMENT A
AMERICAN BURYING BEETLE MINIMIZATION AND MITIGATION MEASURES

The following minimization and mitigation measures will be required by BIA in the event of a positive ABB survey:

MINIMIZATION MEASURES

1. Reduce motor vehicle, machinery, or heavy equipment use. Motor vehicles, machinery, and heavy equipment can generate take of American burying beetles (ABBs) by crushing and collisions when individuals of the species are above-ground or by soil compaction when the species is underground. Reducing the number and use of motor vehicles and heavy equipment in occupied ABB habitat can minimize impacts from these activities. Lessees will minimize the number and use of motor vehicles and heavy equipment necessary in occupied ABB habitat to meet the objectives of the activity. If heavy equipment, machinery, or motor vehicle use is required in occupied ABB habitat for an activity, these vehicles will be allowed only in the areas that are necessary. All motor vehicles, machinery, and heavy equipment shall be parked within areas already impacted, areas where disturbance is planned to occur, or areas where occupied ABB habitat impacts and mitigation, as appropriate, have been assessed.
2. Reduce risk of motor vehicles sparking wildfire. Vehicle use or improper maintenance of vehicles and machinery could ignite fires during dry conditions or in areas with dry vegetation, which may cause take of ABBs. Motor vehicles, machinery, and heavy equipment should not be parked where dry grass or vegetation could be ignited. All vehicles will be maintained per the respective service manuals. In dry conditions, grass and debris will be cleaned away from machinery exhaust systems and bearings on a weekly

basis. All bearings will be lubricated and all spark arrestors will be serviced as necessary to reduce risk of sparking a fire. Fire mitigation equipment necessary at each project includes: a shovel, water, and working fire extinguisher in case of accidental ignition of a wildfire.

3. Increase safety during operation fluid use and storage. Operations fluids (fuel, oil, or other fluids for maintenance of equipment) may cause take of ABBs. Lessees must follow all applicable state and federal laws regarding fuel use and storage. Additionally, all operational fluids (fuel and motor vehicle oil) will be stored and all equipment must be fueled within areas already impacted, areas where disturbance is planned to occur, or areas where occupied ABB habitat impacts and mitigation, as appropriate, have been assessed.

4. Reduce erosion and increase soil stability. Land erosion can directly impact ABB habitat and cause take of ABBs. To prevent topsoil loss, gully formation, or other negative impacts to ABB habitat, lessees will implement erosion control techniques in accordance with prudent industry standards for sediment and erosion control. Examples of prudent industry standards are described in the Independent Petroleum Association of America's Reasonable and Prudent Practices for Stabilization of Oil and Natural Gas Exploration and Production Sites found at: http://www.ipaa.org/governmentrelations/reasonable-and-prudent-practices-for-stabilizationrapps-for-oil-and-natural-gas-exploration-and-production-sites/. Lessees must comply with all state and federal laws regarding erosion control and soil stabilization.

5. Provide educational program for construction personnel. Human presence and movement within ABB habitat may cause take of ABBs. All workers operating in the project area will be trained about ABB habitat, biology, reasons for ABB decline, and the responsibility of all workers to protect the ABB. Standardized ABB educational information is provided on the USFWS website: www.fws.gov/southwest/es/oklahoma/ABBICP. Lessees will provide each worker with a full color Endangered Species Card with a picture of the ABB and a summary of information about the ABB before conducting soil disturbing activities. Lessees will post signs at all access points to the project area highlighting the areas as occupied ABB habitat and reminding workers to follow special restrictions in the area. All workers are required to report any ABB sightings to the project manager or environmental inspector, remove all food wastes from the work area each day, and prohibit dogs or cats on the work area (workers may not bring animals or pets to the job site). Additionally, all workers must park their vehicles within already impacted areas, areas where disturbance is

planned to occur, or areas where impacts and mitigation, as appropriate, have been assessed.

6. Limit use of artificial lighting. Artificial lighting (i.e., from construction or operations at night) can cause take of ABBs by interfering with normal behavior patterns. Therefore, activities occurring during the ABB active season within occupied ABB habitat will be limited to daylight hours, other than situations described below.

   Necessary lighting associated with operations or in limited instances where it is necessary to extend construction activities beyond daylight hours (e.g. to maintain the integrity of a bore hole during horizontal directional drill activities when installing a pipeline) must be down-shielded to minimize the effect on ABBs. Additionally, sodium vapor lights are required, rather than ultraviolet or mercury vapor lights near occupied ABB habitat, because they have been shown to be the least attractive to ABBs (Anshutz et al. 2007).

   Drilling rigs used during production, communication towers, or emergency response situations that require lighting are not required to use sodium vapor lighting or down shield lighting.

7. Limit use of gas flares. Light sources can cause take of ABBs by interfering with the species' normal behavior patterns and increasing energetic demands. Current technology allows for enclosure of the flame for some types of flares, thus minimizing or eliminating emitted light. Projects requiring small, constantly burning flares throughout the life of the project will cover the flame to eliminate the visibility of all natural gas flares to minimize artificial light sources that are attractive to ABBs.

8. Limit disturbance from mechanical vegetation maintenance. Vegetation maintenance following construction in areas already restored to ABB habitat (areas with temporary and permanent cover change impacts) may disturb individuals of the species and alter their normal behavior. Vegetation maintenance frequency and duration should be restricted to that necessary to allow for visual surveys and prevent hazards (e.g., fire). Vegetation must be maintained at a height of 8 inches or more to maintain soil moisture. Vegetation maintenance activities will be completed during the ABB inactive season (approximately late September – early May) because these activities may cause take of ABBs during the active season. Given the implementation of this minimization measure, USFWS believes that no additional mitigation is necessary for post-construction, intermittent non-soil disturbing operations and maintenance (e.g., mowing using tractor equipment or vehicle traffic along ROW) within ABB habitat.

9. Limit herbicide use. Removal of vegetation within ABB habitat may cause take of ABBs. Herbicides necessary for vegetation maintenance or removal in areas already restored to ABB habitat (areas with temporary and permanent cover change impacts) must be applied by licensed applicators in accordance with label directions. Herbicides must be applied using methods that minimize spray drift. If broadcast application of herbicides is necessary for effective ROW vegetation control (e.g., in areas with dense stands of target woody plants and/or invasive forbs or grasses), application equipment must be equipped with spray nozzles designed to produce an herbicide spray pattern of uniform water droplet size and apply herbicides at a calibrated rate and at a set pattern on the ROW, thus ensuring precise application. Aerial broadcast application of herbicides cannot be used. Following complete restoration of ABB habitat, herbicides used for vegetation maintenance following construction may only be applied if vegetation can be maintained at a height of 8 inches or more (to maintain soil moisture). Large equipment and vehicles necessary for application of herbicides may only be used once in a given area during the ABB active season. Any additional use of herbicide during the ABB active season must be done by hand application instead of large equipment and vehicles.

10. Set aside topsoil for replacement following construction. Projects with temporary or permanent cover change impacts that require removal of top soil within occupied ABB habitat will set aside the top soil during construction activities for restoration following construction.

MITIGATION MEASURES

Post-construction Restoration

1. Replace topsoil. During restoration of project areas within occupied ABB habitat that required top soil removal during project activities (as described under *Minimization Measures*), top soil will be replaced at the original location.

2. Relieve soil compaction. Immediately following Covered Activities that removed vegetation and compacted soil by heavy equipment or other means, and prior to vegetation re-establishment, the impacted area will be ripped to a depth of 24 inches (or to rock, if present, whichever is less), to relieve soil compaction at depths used by ABBs. This effort will improve or enhance ABB habitat by making soils easier for ABBs to bury carrion or themselves. This measure is not required for small project areas (such as maintenance work on a pipeline) where the use of tractors and ripping equipment would result in increasing the impact area.

3. Re-establish vegetation. Following vegetation removal within a project area containing occupied ABB habitat prior to impacts, vegetation will be re-established with a native species composition like the surrounding area or, if requested by the landowner, the same vegetation type that existed prior to impacts. Preference should be given to the establishment of native vegetation if the landowner does not have specific requests and restoration of native vegetation is feasible. If construction/soil disturbance ends during the dormant vegetation season, bare soil will be temporarily stabilized if necessary to prevent erosion. At the beginning of the next growing season (preferably prior to the start of the ABB active season in mid-late May), these areas will be re-established with vegetation. Seeds used during vegetation reestablishment must be free of invasive species seeds. Invasive species to be avoided are listed at http://ok-invasive-plant-council.org/images/OKinvasivespp.pdf. For an impact to be considered temporary, vegetation must be re-established to the original density (based on visual comparison of before/after photographs of the project area and comparison to adjacent undisturbed areas) within 5 years of the initial impact. Vegetation reestablished for permanent cover change impacts should be restored to the density of the grasslands or pastures nearest to the project area, preferably restored with native species.

4. Inspection of invasive plant species. Because vegetation composition may change the carrion base (small mammal and bird composition) of an area, lessees will monitor project sites with temporary or permanent cover change impacts following post-construction restoration and document any invasive species (as listed at http://ok-invasive-plant-council.org/images/OKinvasivespp.pdf) in their annual reports during the 5-year restoration period.

Offsite Habitat Mitigation through Mitigation Lands

This section describes how impacts to occupied ABB habitat will be offset through conservation and management of ABB habitat in perpetuity.

All mitigation proposals must, to the maximum extent practicable, meet the minimum standards and other requirements described in *American Burying Beetle Conservation Strategy for the Establishment, Management, and Operations of Mitigation Lands* found at http://www.fws.gov/southwest/es/oklahoma/ABBICP.

1. Individual- or Lessee-responsible for mitigation lands. These consist of mitigation lands established by the lessee. Such mitigation tracts must be described in detail and included in the project description. Such lands must, to the maximum extent practicable, meet the minimum standards and other requirements described in USFWS guidelines, *American Burying Beetle Conservation Strategy for the*

Establishment, Management, and Operations of Mitigation Lands found at http://www.fws.gov/southwest/es/oklahoma/ABBICP. Also described in USFWS guidelines, conservation easements and agreements must be approved by the USFWS prior to any habitat impacts that could result in take of ABBs. The lessee or their designee is responsible for ensuring the success of and managing the mitigation land in perpetuity, even if the project is finite in duration.

2. Conservation Banks. Conservation banks are mitigation lands that are established by a Bank Sponsor. These sites are usually established to mitigate for the effects of multiple projects. A USFWS-approved conservation bank meets the minimum standards and other requirements described in USFWS guidelines (*American Burying Beetle Conservation Strategy for the Establishment, Management, and Operations of Mitigation Lands and Guidance for the Establishment, Use, and Operation of Conservation Banks*, found at http://www.fws.gov/southwest/es/oklahoma/ABBICP). Conservation banks are established through a conservation bank agreement with the USFWS and conservation easements for the bank must be approved by the USFWS. When a lessee chooses to mitigate through the purchase of credits in an approved conservation bank, the bank sponsor is responsible for ensuring the success of and managing the mitigation land in perpetuity upon sale of the credits. If a lessee chooses this option, lessee must purchase appropriate credits prior to any habitat impacts that could result in take of the ABB. Lessees can visit http://geo.usace.army.mil/ribits/index.html, the Regulatory In-lieu Fee and Bank Information and Tracking System (RIBITS) for information on USFWS-approved conservation banks with available ABB credits.

3. Third party mitigation lands. These mitigation lands are usually established for a single project or project proponent rather than multiple projects or proponents as are conservation banks. Such lands and agreements must, to the maximum extent practicable, meet the minimum standards and other requirements described in USFWS guidelines, *American Burying Beetle Conservation Strategy for the Establishment, Management, and Operations of Mitigation Lands* found at http://www.fws.gov/southwest/es/oklahoma/ABBICP. Conservation easements and agreements must be approved by the USFWS prior to any habitat impacts that could result in take of ABB. The mitigation land sponsor (landowner or easement holder) is responsible for and assumes liability for the success of and management of the approved mitigation land in perpetuity.

ATTACHMENT B
STANDARD BMPS FOR WORKOVERS AND DRILLING PERMITS

DRILLING PERMIT BMPS – BIA OSAGE AGENCY

Applicant will comply with the requirements of 25 CFR 226, including but not limited to:

- §226.22 – Prohibition of Pollution
- §226.33 – Line Drilling – Prohibiting location of any well or tank battery within 200 feet of a public highway, established watering place, or building used as a dwelling, granary, or barn unless prior written permission is granted by the Superintendent.
- §226.19 – Use of Surface Lands – Lessee must conduct operations in a workman like manner, commit no waste and allow none to be committed upon the land, nor permit any unavoidable nuisance to be maintained on the premises under his/her control.

Standard BMPs

Applicants, their agents, operators, and contractors will follow the BMPs listed below.

1. Avoid impacts on National Register-eligible or unevaluated cultural resources on well sites and access roads. If cultural resources are discovered during construction or operation, stop work immediately, secure the affected site, and notify the BIA and Tribal Historic Preservation Officer. In the event of a discovery, work in that area shall halt and not resume until written authorization to proceed has been received from the BIA. All surface disturbances must be kept within the proposed ground disturbance area described in the EA. Expansion or relocation of the well pads, access roads, or other implementation of additional activities not

included in the approved EA is prohibited unless an appropriate cultural resources survey has been submitted and determined adequate, approve by the BIA Osage Agency and all appropriate permits have been obtained.

2. Avoid or minimize soil and vegetation disturbance. Avoid removal of or damage to trees, shrubs, and groundcover the extent possible. Avoid or minimize alteration of the natural topography, and limit activities on steep slopes.

3. Erosion control measures are required for the duration of the construction, drilling and completion phases of the project. Erosion control measures must minimize the impact of soil, debris, or contaminants moving from the well site to adjacent lands and waterways.

4. All vehicles and equipment must utilize and stay confined to existing and new roads described in the approved EA. These roads must be maintained and upgraded as needed according to the BIA's direction and agreements between the operator and surface owners.

5. Tank batteries must have a Spill Prevention and Control and Countermeasure Plan (SPCC) in compliance with EPA Regulations under 40 CFR Part 112. A fluid impermeable secondary containment dike/berm must be constructed around any tank battery and facilities according to 40 CFR 112.7. The dike/berm and entire containment area must be graveled. No water collected within the secondary containment shall be discharged. In accordance with the SPCC plan and the BIA regulations, the lessee will immediately notify the BIA of all spill incidents.

6. No venting or flaring of gas is allowed unless prior written approval of the BIA Osage Agency Superintendent has been obtained.

7. Store and label chemicals properly (including secondary containment). Do not store equipment or chemicals onsite if they are not being used on site. Do not leave open containers of chemicals or wastes on site.

8. Keep sites clean and free of any litter, trash, old equipment, contaminated soil or unused containers. Promptly dispose of any wastes at appropriate recycling facility, approved landfill or other approved location based on type of waste. Remove any unused equipment not necessary to the operation of the lease after drilling activities have been completed.

9. If the well is successful, all production equipment, facilities and tanks including well-head and above-ground piping/equipment shall be properly enclosed to exclude livestock if present.

10. All pits (including tank batteries contained within a dike/berm) must be enclosed with a fence of at least four strands of barbed wire, or approved substitute. Unlined earthen pits shall not be used for the continued storage of saltwater or other deleterious substances. Temporary pits must be filled and leveled upon completion of the activity.
11. To the extent possible, minimize disturbance to land owners, wildlife, and natural resources due to noise, excessive traffic, dust or other impacts associated with operations.
12. Do not conduct activities within stream channels or wetlands without proper authorization, and avoid any discharge of soil or contaminants or removal of stream water that could result in a violation of applicable federally-approved water quality standards.
13. Return area to original contour or as directed by the surface owner. If needed, add clean soil to disturbed areas. Restore disturbed areas by re-establishing vegetation using seed, sod or other approved method. Restore with native species unless otherwise directed by the surface owner in writing and approved by the BIA. No noxious or invasive species may be used in revegetation and reclamation activities.
14. If well drilling, completion and development are successful; all areas of the surface disturbance (i.e. well pad, access road, pipeline, etc.) that are not needed or used in the production or operation of the well shall be promptly reclaimed as described in the approved EA. If well drilling, completion and development are not successful, reclamation of the entire area will begin promptly. After a completed well is no longer in production, reclamation of the site will begin promptly. Reclamation shall be completed not later than ninety (90) days from rig removal, well abandonment or final plugging of a well, unless otherwise approved by the BIA.
15. The applicant shall conduct activities in a manner that avoids any potential incidental take or harm to federally-listed threatened and endangered species, or in a manner that complies with any permit or authorization issued by the USFWS. Applicant will follow guidance in the USFWS's "Oklahoma Ecological Services Field Office Migratory Bird and Eagle Impact Avoidance Measures for Actions Associated with Oil and Gas Projects" (April 2014).
16. Applicant will follow the USFWS's established protocol regarding areas where the ABB is known or suspected to exist. (See http://www.fws.gov/southwest/es/oklahoma/ABBICP.htm.)

    If proposed operations require the construction of a drilling pit or other excavation activity by heavy equipment, then the lessee must ensure that suitable habitat for the ABB does not exist. If proposed operations will impact suitable habitat for the ABB, it will be the responsibility of the lessee to obtain authorization from the USFWS to proceed with that portion of the project.

Air Quality BMPs

For proposed drilling operations in areas where formations will be penetrated which have zones suspected of containing H2S of 100 ppm in the gas stream, the Applicant will implement the following Air Quality BMPs in an effort to mitigate exposure to personnel and contractors, and to protect the public:

1. Conduct the appropriate H2S training and install H2S related safety equipment which is operational when drilling commences.
2. If H2S was not suspected, but is encountered in excess of 100 ppm in the gas stream, the following measures shall be taken:
    a. Operator shall immediately ensure control of the well, suspend drilling operations, and obtain materials and safety equipment in order to protect all personnel or individuals in risk of exposure.
    b. Operator shall notify the appropriate company personnel of the event and mitigating steps that have or are being taken as soon as possible.
3. The operator will ensure that all personnel who will be working at the well site once drilling operations resume, will be properly trained in H2S drilling procedures and use of applicable safety equipment including:
    a. Respiratory protection.
    b. H2S detection and monitoring equipment.
    c. Visible warning system:
        i. Wind direction indicators
        ii. Post appropriate warning signs.

In the event that the company anticipates the continued risk of exposure to H2S emissions during ongoing production operations, BMPs will be implemented that follow the guidelines listed in BLM Onshore Order 6.

Bureau of Indian Affairs, Osage Agency Conditions for Workover Operations

The following forms must be kept at the project site at all times during the workover operation(s): (1) the Osage Agency Form No. 139, (2) Attachment A for Osage Form No. 139 which identifies all of the COAs of workover operations in Osage County (listed below), and (3) the Workover Review form which will be provided to the Lessee/Operator upon confirmation of approval by the Agency.

General Requirements

All lessees must comply with the requirements of 25 CFR 226, including but not limited to:

- § 226.22 Prohibition of Pollution.
- § 226.19 Use of Surface Lands – Lessee must conduct operations in a workmanlike manner, commit no waste and not create any unavoidable nuisance on the premises under his/her control.

Workover operations must be contained to the historic well pad in order to minimize impacts on the affected environment. This must be documented through the submission to the Osage Agency of photographs taken before the proposed activities commence and after activities have ceased.

For each workover operation a minimum of seven (7) dated photographs must be submitted as supporting documentation with the Form 139 in order to depict the existing condition of the well pad and existing facilities as described below.

- 1 photo of the well sign
- 1 photo of the well head (well bore/pumping unit location
- 1 photo of the lease road, showing ingress and egress to the proposed workover location
- 4 photos taken in the following manner: stand at the center of the well pad and take 1 photo facing each direction (North, East, South and West)

All lessees must comply with, and obtain any necessary permits or authorizations required under the federal Clean Water Act, Clean Air Act, Safe Drinking Water Act, Endangered Species Act and other applicable federal laws.

In addition, the standard BIA Osage Agency Best Management Practices, listed below, will apply, unless the Superintendent has given prior written approval of either an exemption to a specific standard BIA Osage Agency BMP or an equivalent set of BMPs developed by the lessee.

Standard BMPs

1. Avoid impacts on National Register-eligible or unevaluated cultural resources on well sites and access roads. If cultural resources are discovered during construction or operation, stop work immediately, secure the affected site, and notify the BIA and Tribal Historic Preservation Officer. In the event of a discovery, work in

that area shall halt and not resume until written authorization to proceed has been received from the BIA. All surface disturbances must be kept within the confines of the historic well pad described in the application package. Expansion or relocation of the well pads, access roads, or other implementation of additional activities outside of the area specified in the application is prohibited unless an appropriate cultural resources survey has been submitted and determined adequate, approved by the BIA Osage Agency and all appropriate authorizations have been obtained.

2. Avoid or minimize soil and vegetation disturbance. Avoid removal of or damage to trees, shrubs, and groundcover to the extent possible. Avoid or minimize alteration of the natural topography, and limit activities on steep slopes.

3. Erosion control measures are required for the duration of all implementation phases of the proposed project. Erosion control measures must minimize the impact of soil, debris, or contaminants moving from the project site to adjacent lands and waterways.

4. All vehicles and equipment must utilize and stay confined to existing roads described in the approved EA. These roads must be maintained and upgraded as needed according to BIA direction and agreements between the operator and surface owners.

5. Tank batteries must have a Spill Prevention and Control and Countermeasure Plan (SPCC) in compliance with EPA Regulations under 40 CFR Part 112. A fluid impermeable secondary containment dike/berm must be constructed around any tank battery and facilities according to 40 CFR 112.7. The dike/berm and entire containment area must be graveled. No water collected within the secondary containment shall be discharged. In accordance with the SPCC plan and the BIA regulations, the lessee will immediately notify the BIA of all spill incidents.

6. No venting or flaring of gas is allowed unless prior written approval of the BIA Osage Agency Superintendent has been obtained.

7. Store and label chemicals properly (including secondary containment). Do not store equipment or chemicals onsite if they are not being used on site. Do not leave open containers of chemicals or wastes on site.

8. Keep sites clean and free of any litter, trash, old equipment, contaminated soil or unused containers. Promptly dispose of any wastes at appropriate recycling facility, approved landfill or other approved location. Remove any unused equipment not necessary to the operation of the lease after drilling activities have been completed.

9. All production equipment, facilities and tanks including well-head and above-ground piping/equipment shall be properly enclosed to exclude livestock if present.

10. All pits (including tank batteries contained within a dike/berm) must be enclosed with a fence of at least four strands of barbed wire, or approved substitute. All earthen pits to be used for storage of salt water or other deleterious substances must be lined with an impermeable layer to prevent contamination of soils and groundwater. Temporary pits must be filled and leveled immediately upon completion of the activity.

11. To the extent possible, minimize disturbance to land owners, wildlife, and natural resources due to noise, excessive traffic, dust or other impacts associated with operations.

12. Do not conduct activities within stream channels or wetlands without proper authorization, and avoid any discharge of soil or contaminants or removal of stream water that could result in a violation of applicable federally-approved water quality standards.

13. Restore disturbed areas by re-establishing vegetation using seed, sod or other approved method, and add clean soil to disturbed areas if necessary. Restore with native species unless otherwise directed by the surface owner in writing and approved by the BIA. No noxious or invasive species may be used in revegetation and reclamation activities.

14. Upon conclusion of workover operations all areas of the surface disturbance (i.e. well pad, access road, pipeline, etc.) shall be promptly reclaimed as described in the permit and approved Programmatic EA for workover operations. After a well is no longer in production, reclamation of the site will begin promptly. Reclamation shall be completed not later than ninety (90) days from rig removal, well abandonment, conclusion of workover operations or final plugging of a well, unless otherwise approved by the BIA.

15. The lessee shall conduct activities in a manner that avoids any potential incidental take or harm to federally-listed threatened and endangered species, or in a manner that complies with any permit or authorization issued by the US Fish and Wildlife Service (USFWS).

    Lessee must follow guidance in the USFWS "Oklahoma Ecological Services Field Office Migratory Bird and Eagle Impact Avoidance Measures for Actions Associated with Oil and Gas Projects (April 2014), found at the following website: http://www.fws.gov/southwest/es/oklahoma/documents/abb/abb_icp/migbird%20and%20eagle%20avoidance%20measures%20april2014.pdf

16. Lessee must follow the USFWS's established protocol regarding areas where the American burying beetle (ABB) is known or suspected to exist. (See http://www.fws.gov/southwest/es/oklahoma/ABBICP.htm.)

    If proposed operations require the construction of a drilling pit or other excavation activity by heavy equipment, then the lessee must ensure that suitable habitat for the ABB does not exist.

    If proposed operations will impact suitable habitat for the ABB, it will be the responsibility of the lessee to obtain authorization from the USFWS to proceed with that portion of the project.

17. Approval must be obtained from the Environmental Protection Agency prior to the commencement of workover operations related to underground injection, construction or conversion of saltwater injection/disposal wells.

Site-Specific BMPs and Special Instructions

1. Review of the proposed project location determined that suitable habitat for the endangered American Burying Beetle is present. Therefore, no ground disturbing activities may occur during implementation of the proposed workover operation. If a pit is needed to conduct the operation, then the lessee is advised to utilize a temporary above-ground storage tank, or other mitigating efforts approved by the Superintendent, and may not conduct any soil excavation in association with the workover. The temporary tank must be removed from the location after the operation is completed.

Appendix C

Acronyms and Abbreviations

Appendix C. Acronyms and Abbreviations

ACRONYMS AND ABBREVIATIONS	Full Phrase
1906 Act	Osage Allotment Act of 1906
AADT	annual average daily traffic
ABB	American Burying Beetle
ACS	American Community Survey
AD	Anno Domini
APD	application for permit to drill
AQRV	air quality related values
ARPA	Archaeological Resources Protection Act of 1979
BA	biological assessment
BC	Before Christ
BIA	United States Department of the Interior, Bureau of Indian Affairs
BLM	United States Department of the Interior, Bureau of Land Management
BMP	best management practice
BO	biological opinion
CAA	Clean Air Act of 1963
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CFR	Code of Federal Regulations
CO_2e	carbon dioxide equivalent
COA	condition of approval
CPTS	Cimarron Public Transit System
CWA	Clean Water Act of 1972
dB	decibel
dBA	A-weighted decibel scale
DIR	dividends, interest, and rent
DOI	United States Department of the Interior
EA	Environmental Assessment
EIS	Environmental Impact Statement
EO	executive order
EPA	United States Environmental Protection Agency
ESA	Endangered Species Act of 1973
FEMA	Federal Emergency Management Agency
FMP	fire management plan
FONSI	Finding of No Significant Impact
GHG	greenhouse gas
GIS	geographic information system

H_2S	hydrogen sulfide
HAP	hazardous air pollutant
INCOG	Indian Nations Council of Governments
IPCC	International Panel on Climate Change
Leasing PEA	Programmatic Environmental Assessment for Leasing Activities
Ma	millions of years ago
MBTA	Migratory Bird Treaty Act of 1918
MCF	thousand cubic feet
mg/L	milligrams per liter
MMT	million metric tons
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act of 1969
NHPA	National Historic Preservation Act of 1966
NOI	Notice of Intent
NPMS	National Pipeline Mapping System
NRCS	United States Department of Agriculture Natural Resource Conservation Service
NTL	notice to lessees
OAS	Oklahoma Archeological Survey
OCC	Oklahoma Corporation Commission
ODM	Oklahoma Department of Mines
ODOT	Oklahoma Department of Transportation
ODWC	Oklahoma Department of Wildlife Conservation
OGS	Oklahoma Geological Survey
OkIPC	Oklahoma Invasive Plant Council
OKT	Oklahoma, Kansas, and Texas
Osage Mineral Estate	subsurface mineral estate in Osage County, Oklahoma
PEA	Programmatic Environmental Assessment
PM_{10}	particulate matter less than 10 microns in diameter
$PM_{2.5}$	particulate matter less than 2.5 microns in diameter
ppb	parts per billion
ppm	parts per million
PSD	prevention of significant deterioration
RCRA	Resource Conservation and Recovery Act of 1976
RFD	reasonably foreseeable development scenario
RMP	Resource Management Plan
ROD	Record of Decision
ROW	right-of-way
SHPO	State Historic Preservation Office(r)
SPCC	spill prevention, control, and countermeasure
THPO	Osage Nation Tribal Historic Preservation Office(r)
TNC	The Nature Conservancy

Tribe(s)	Federally-recognized Tribe(s)
TTP	Tribal Transportation Program
US	United States
USC	United States Code
USFWS	United States Department of the Interior, Fish and Wildlife Service
USFWS Impact Avoidance	United States Department of the Interior, Fish and Wildlife Service, Oklahoma Ecological Services Field Office Migratory Bird and Eagle Impact Avoidance Measures for Actions Associated with Oil and Gas Projects
USGS	United States Geological Survey
VOC	volatile organic compound
VRI	visual resource inventory
WMA	wildlife management area
Workover PEA	Programmatic Environmental Assessment for Approving Workover Operations
WRI	World Resources Institute

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Appendix D

Table 2-4: Summary Comparison of Environmental Consequences of the Alternatives

Appendix D. Table 2-4: Summary Comparison of Environmental Consequences of the Alternatives

Resource/ Resource Use	Alternative 1 (No Action)	Alternative 2	Alternative 3	Alternative 4
Topography, geology, paleontology, and soils	COAs would continue to limit surface disturbance by enforcing the confinement of work vehicles to existing roads. Limiting vehicle disturbance of areas beyond existing roads would continue to reduce the footprint of impacts on soils, which may result in lower compaction or erosion rates during exploration and production. Erosion-control measures would effectively minimize soil movement during workovers and result in less soil loss from these activities. Impacts on geology, paleontology, and topography due to the installation of well pads, tank batteries, and other oil and gas infrastructure would continue. COAs requiring returning land to its original contour would minimize long-term impacts on topography.	Applying COA 27 prohibiting land application of waste oil, wastewater, contaminated soil, and other contaminated substances would reduce the risk of soil contamination and salt scarring, compared with Alternative 1 (No Action). Removing requirements that lessees implement erosion-control measures and promptly remediate areas of the site not needed for production after drilling would increase the possibility of erosion and soils damage. Not requiring that waste and old equipment be removed from sites could increase the risk of soil contamination and salt scarring, compared with Alternative 1 (No Action). Waiving COAs that limit surface disturbance could also increase soil compaction and erosion, compared with all other alternatives.	In addition to COAs applied under Alternative 1 (No Action), this alternative would provide some additional protection of soil resources in low-density sections, compared with Alternative 1 (No Action). Requirements in low-density sections would include testing for hydrogen sulfide, mitigating, and locating wells and pits away from streams and outside of areas prone to flooding. This would protect soils from contamination, erosion, and loss of productivity in low-density sections. Under this alternative, COAs requiring returning land to its original contour would minimize long-term impacts on topography in low-density sections. This would reduce impacts, compared with Alternative 2. In these areas, impacts would be the same as under Alternative 1 (No Action). Impacts on topography, geology,	The BIA would apply well spacing requirements and additional protective COAs (COAs 24–31), beyond those applied under Alternative 1 (No Action), to all new development within the planning area. Further, the BIA would not approve new ground-disturbing activities in the sensitive areas identified under Alternative 3 and additional sensitive areas (described in **Section 2.3.5**). The types of impacts on topography, paleontological resources, geology, and soils under Alternative 4 would be the same as those described for Alternative 3, low-density sections. The scope of those impacts, however, would be further reduced under Alternative 4 due to the application of protective COAs planning area wide and restrictions on ground-disturbance in a larger number of sensitive areas. This alternative would provide some

Resource/ Resource Use	Alternative 1 (No Action)	Alternative 2	Alternative 3	Alternative 4
Topography, geology, paleontology, and soils *(continued)*	*(see above)*	Overall, this alternative would result in the highest risk of impacts on soils out of all the alternatives. These impacts would be from erosion, soil compaction, and brine contamination and salt scarring. Under this alternative, impacts on geology, paleontology, and topography from installing well pads, tank batteries, and other oil and gas infrastructure could increase, compared with other alternatives, by removing COAs to avoid or minimize altering topography, by returning land to its original contour, and by remediating unneeded areas following drilling or workover. Of all the alternatives, this one would result in the highest levels of impacts on topography, paleontology and geology.	paleontology and soils in high-density sections would be the similar to those under Alternative 2. Under this alternative, the BIA would not approve new drilling permits near certain sensitive waterbodies and in groundwater protection areas and municipalities. Topography, geology, paleontology, and soil resources would be protected in these areas.	additional protection of soil resources in all areas. Requirements would include locating wells and pits away from streams and outside of areas prone to flooding. This would protect soils from contamination, erosion, and loss of productivity. Under this alternative, impacts on geology, paleontology, and topography from installing well pads, tank batteries, and other oil and gas infrastructure would be reduced, compared with Alternatives 2 and 3 high-density. This would be due to COAs limiting surface disturbance. Impacts would be the same as under Alternative 1 (No Action). COA 15 requiring that land be returned to its original contour would minimize long-term impacts on topography. Under this alternative, the BIA would not approve new drilling permits in certain sensitive areas. Topography, geology, paleontology, and soil resources would be protected in these areas.

Resource/ Resource Use	Alternative 1 (No Action)	Alternative 2	Alternative 3	Alternative 4
Water resources	Applying COAs 8, 11, and 14 under Alternative 1 (No Action) would continue to limit impacts from oil and gas development activities on groundwater and surface water. COAs 8, 11, and 14 would protect water resources. COAs 8 and 11 require proper storage of chemicals and preparation of SPCC plans for tank batteries; COA 14 prevents oil and gas development activities within aquatic environments without proper authorization. It also requires avoiding any discharge of soil or contaminants.	Alternative 2 applies the fewest COAs and would generally provide the least protection for surface water and groundwater. COA 27, which prohibits the land application of waste, wastewater, contaminated soil, or other deleterious substances, would protect water sources from contamination due to seepage and infiltration. Less stringent requirements on leases may permanently adversely affect water resources by increasing the risk of erosion runoff and contamination; therefore, this alternative would have the greatest impacts on water resources.	Applying COAs based on the density of well development would result in location-specific water resource impacts; this is because fewer COAs would be applied in high-density sections and more COAs would be applied in low-density sections, compared with Alternative 1 (No Action). COAs 26, 27, 28, and 29, applied in low-density sections, limit surface disturbance, avoid stream crossings, and provide buffer zones from streams and waterways would protect surface water and groundwater, compared with Alternative 1 (No Action). In high-density sections, COAs would be applied in the same way as under Alternative 2. This reduction in protective measures could have short-term and long-term impacts on both surface water and groundwater resources by increasing the risk of erosion runoff and contamination.	The addition of COAs 26, 27, 28, and 29 would protect water resources, compared with Alternative 1 (No Action). Additional COAs, such as buffer zones and restrictions on surface waste pits near water supply wells, applied to all oil and gas development activities would make this alternative the most protective of water resources and would limit the location and type of new oil and gas development. This would in turn protect surface water and groundwater from contamination. Under this alternative, the BIA would not approve new drilling permits in certain sensitive areas. Water resources would have a reduced risk of contamination in these areas.

Resource/ Resource Use	Alternative 1 (No Action)	Alternative 2	Alternative 3	Alternative 4
Air quality and climate	Oil and gas leasing would have no direct impact on air quality but would have indirect impacts from subsequent oil and gas development, such as emissions from equipment used in workovers, drilling, and production operations. Under Alternative 1 (No Action), COAs 3, 4, 5, 6, and 15 would continue to limit impacts of dust from development activities on air quality in the planning area. Such requirements are those to keep all disturbance within the confines of the historic well pad (COA 2), to avoid or minimize soil and vegetation disturbance (COA 3), to keep vehicles and equipment confined to roads described in the approved APD (COA 6), and to promptly remediate disturbed areas associated with workovers (COA 15). COA 18 would continue to reduce the H_2S exposure by requiring air quality BMPs for wells in formations having zones suspected of containing, or known to contain, H_2S.	Under Alternative 2, the BIA would apply fewer standardized COAs to oil and gas development activities. The COAs related to limiting surface disturbance described under Alternative 1 (No Action) would not apply under Alternative 2. This would increase localized fugitive dust, compared with Alternative 1 (No Action). Fugitive dust emissions would be the highest out of all alternatives under Alternative 2. Emissions from equipment used in workovers, drilling, and production operations would be similar to those under Alternative 1 (No Action). COA 18 would not apply under Alternative 2 which could result in higher H_2S emissions compared to Alternative 1.	Under Alternative 3, the BIA would apply COAs based on the density of well development. The COAs related to limiting surface disturbance described under Alternative 1 (No Action) would not apply in high-density sections; this would increase localized fugitive dust in these areas, compared with Alternative 1 (No Action). The COAs related to limiting surface disturbance described under Alternative 1 (No Action) would apply in low-density sections; impacts in these areas would be the same as those under Alternative 1 (No Action). Overall, localized fugitive dust emissions may be higher in some areas, compared with Alternative 1 (No Action), while emissions from equipment used in workovers, drilling, and production operations would be similar to those under Alternative 1 (No Action). COA 25 would apply in low-density sections and would require lessees to conduct an initial test of H_2S in the gas	Under Alternative 4, the BIA would apply the COAs described in Alternative 1 (No Action) as well as additional COAs to protect sensitive cultural and environmental resources. With one exception, the COAs to minimize impacts would be the same as those described for Alternative 1 (No Action); therefore, impacts on air quality from localized fugitive dust and emissions from workovers, drilling, and production would be the same as under Alternative 1 (No Action). Under Alternative 4, the BIA would apply the additional COA 25, which would require lessees to conduct an initial test of hydrogen sulfide in the gas stream for each well and production facility. This would provide additional protections to workers and the public related to potential public health hazards from hydrogen sulfide exposure, compared with all other alternatives. Emissions from equipment used in workovers, drilling, and production operations would be similar to those under Alternative 1 (No Action).

Resource/ Resource Use	**Alternative 1 (No Action)**	**Alternative 2**	**Alternative 3**	**Alternative 4**
Air quality and climate *(continued)*	*(see above)*	*(see above)*	stream for each well and production facility. If the concentrations exceed 100 ppm, lessees would determine the 100 ppm and 500 ppm radius of exposure and post signs warning of the effects of exposure. Compared with Alternative 1 (No Action), Alternative 3 would provide additional protections to workers and the public related to potential public health hazards from H_2S exposure.	*(see above)*
Fish, wildlife, and migratory birds	In addition to the COAs applied under all alternatives, several COAs would be applied under Alternative 1 (No Action). COAs 3, 4, 5, 6, 13, and 14 would help reduce the extent of habitat disturbance or direct disturbance to fish, wildlife, and migratory birds from these activities, such as minimizing noise, excessive traffic, and dust and restricting the discharge of contaminants into waterways.	The BIA would apply fewer standardized COAs under Alternative 2. COA 24 would limit audible or visual disturbance and COA 27 would prohibit land application of wastewater, waste oil, and contaminated soil. Compared with all other Alternatives, Alternative 2 would have the greatest impact on fish, wildlife, and migratory birds.	COAs would be based on the density of well development and would result in location-specific impacts. Impacts on fish, wildlife, and migratory birds in high-density sections would be similar to those under Alternative 2. Additional COAs would be applied in low-density sections, so these areas would be more protected from impacts. These additional COAs emphasize protections for streams, lakes, wetlands, and areas prone to flooding, lessening impacts on species found in these systems. Impacts on low-density sections would be similar to those under Alternative 4 and would offer more protections,	Impacts from applying COAs COAs 3, 4, 5, 6, 13, 14, 24, 26, 27, 28, 29, 30, and 31 under Alternative 4 would make it the most protective of fish, wildlife, and migratory birds. Under this alternative, the BIA would not approve new drilling permits in certain sensitive areas. These areas would offer additional protections for water quality and wildlife habitat. In addition, avoiding new road and pipeline crossings of streams or wetlands, altering hydrology, and burying pipelines, to the extent practicable, would help to eliminate impacts on riparian

Resource/ Resource Use	Alternative 1 (No Action)	Alternative 2	Alternative 3	Alternative 4
Fish, wildlife, and migratory birds *(continued)*	*(see above)*	*(see above)*	compared with Alternative 1 (No Action) and 2. In low-density areas the BIA would not approve new drilling permits near certain sensitive waterbodies and in groundwater protection areas and municipalities. These areas would offer additional protections for water quality and wildlife habitat.	and wetland species of fish, wildlife, and migratory birds. Benefits may also occur from non-wildlife-specific COAs, such as buffer zones around sensitive cultural sites and streams, rivers, ponds, reservoirs, lakes, and wetlands.
Special status species	COAs would reduce the extent of habitat disturbance or direct disturbance to special status species, such as minimizing noise, excessive traffic, and dust and restricting the discharge of contaminants into waterways. COAs to control noxious weeds and reduce drilling footprints for air quality and cultural resource protection would also indirectly benefit the special status species in the vicinity. COAs would protect migratory birds by requiring screening or netting on open-top tanks and pits. For ABB compliance, the BIA prepared a BA, and the USFWS would issue a BO, describing	Under Alternative 2, applying fewer standardized COAs to all oil and gas development activities would have the greatest impact on special status species. COAs aimed at preventing disturbance to vegetation, and degradation to wetlands may be waived; however, COAs 24 and 27 would reduce some impacts on special status species by limiting audible or visual disturbances; this would prevent site avoidance or nest abandonment. Additionally, prohibiting land application of wastewater, waste oil, and contaminated soil would reduce the likelihood of direct mortality from chemical ingestion, potential drowning, cold stress	In high-density sections, the BIA would apply the COAs described in Alternative 2; however, additional COAs applied under Alternative 3 in low-density sections would make these sections more protective of special status species. Buffers around culturally sensitive areas, such as historic sites, sacred sites, and grave sites, would preserve vegetation and habitat for the ABB and other special status species by reducing surface disturbance. Low-density sections would have specific COAs, discussed under Alternative 4, in place to reduce impacts on waterways, streams, and wetland habitats, as well as covering or netting	Additional COAs applied under Alternative 4 would make this alternative the most protective of special status species. COA 16 would require an ABB presence/absence survey to be conducted prior to commencing ground-disturbing activities or using heavy equipment. There would be an exception if the USFWS had characterized the habitat as being an area unfavorable for the ABB. COA 27, prohibiting the land application of wastewater, waste oil, and contaminated soil, would likely keep injurious material out of important habitat, such as wetlands. Applying a buffer around culturally sensitive areas, such as historic sites, sacred sites,

Resource/ Resource Use	Alternative 1 (No Action)	Alternative 2	Alternative 3	Alternative 4
Special status species *(continued)*	the total amount of acreage in the county where incidental take of ABB can occur. COA 16 would require an ABB presence/absence survey to be conducted prior to commencing ground-disturbing activities or using heavy equipment. There would be an exception if the USFWS had characterized the habitat as being an area unfavorable for the ABB. If an area is being used by eagles, then installing power lines would be avoided, when possible, flared gas pipes would be fitted with anti-perching devices, existing poles would be marked, and new poles would be designed according to APLIC guidelines.	from loss of insulation, and susceptibility to disease. ESA compliance would still be required under this alternative. Impacts on the ABB would be the same as those described under Alternative 1 (No Action).	open-top tanks and pits to reduce bird injury and mortality. Under this alternative, the BIA would not approve new drilling permits near certain sensitive waterbodies and in groundwater protection areas and municipalities. The reduction in new surface disturbance in these areas would protect vegetation and habitat for the ABB and other special status species.	and grave sites, would preserve vegetation and habitat for the ABB and other special status species found in these areas by reducing surface disturbance. Under COA 29 lessees would avoid new road and pipeline crossings of streams, wetlands, or other alterations to hydrology, lessening habitat disturbance for special status species found in these systems. Under this alternative, the BIA would not approve new drilling permits in certain sensitive areas. The reduction in new surface disturbance in these areas would protect vegetation and habitat for the ABB and other special status species.
Vegetation, wetlands, and noxious weeds	Applying the COAs under Alternative 1 (No Action) would continue to limit the extent of surface disturbance from oil and gas development activities. COAs limiting surface disturbance would continue to limit direct and indirect impacts on native vegetation from vegetation removal.	Alternative 2 would apply fewer standardized COAs and would generally provide the least protection to wetlands and vegetation and would allow the most noxious weed spread. As a result, vegetation would become more fragmented, compared with other alternatives. Acres of ground-disturbing activity, the potential for	Under Alternative 3, the BIA would apply COAs based on the density of well development. This would result in location-specific vegetation, wetland, and noxious weed impacts. Applying COAs 26, 27, and 29 in low-density sections would protect vegetation and wetlands and would reduce the spread of noxious weeds.	Applying the same COAs as Alternative 1 (No Action), plus additional COAs, under Alternative 4 would protect vegetation and wetlands and prevent the spread of noxious weeds to the greatest degree of all the alternatives. Under COAs 26, 28 and 29, there would be less obstruction to hydrology in the area by locating well sites and

Resource/ Resource Use	Alternative 1 (No Action)	Alternative 2	Alternative 3	Alternative 4
Vegetation, wetlands, and noxious weeds *(continued)*	COAs prohibiting noxious weed use during revegetation and reclamation and requiring prompt site reclamation would limit the potential for the spread of noxious weeds. Prohibiting lessees from conducting activities within stream channels or wetlands without proper authorization would continue to protect wetlands and riparian vegetation communities from the impacts of surface disturbance. Requiring lessees to minimize excessive dust to the extent possible would continue to provide some level of protection from dust covering plants and impairing their respiration and photosynthesis.	erosion and sedimentation into waterways, and the potential for noxious weeds or invasive species introduction and spread would increase.	Under this alternative, the BIA would not approve new drilling permits near certain sensitive waterbodies and in groundwater protection areas and municipalities. Vegetation and wetlands in these areas would be protected from disturbance, and potential for the spread of noxious weeds would be reduced.	pits outside of areas subject to frequent flooding, locating drilling pits at least 200 feet from streams and waterways, and avoiding wetlands with new roads and pipelines. This would maintain the extent of wetland areas. COA 31, requiring collocation of new facilities with existing facilities, when feasible, would reduce surface disturbance. Under this alternative, the BIA would not approve new drilling permits in certain sensitive areas. Vegetation and wetlands in these areas would be protected from disturbance, and potential for the spread of noxious weeds would be reduced.
Agriculture	Applying the COAs 3, 6, 10, and 15 under Alternative 1 (No Action) would continue to limit short- and long-term impacts on farmland through prompt reclamation of surface disturbance, off-road restrictions, and fencing, which would reduce the risk of injury to or mortality of livestock.	Alternative 2 would apply the fewest COAs to oil and gas development activities. Such COAs are designed to minimize surface disturbance, require erosion control, minimize alterations to the natural topography, require restoring vegetation, require fencing, and require reclaiming land promptly.	Applying COAs based on the density of well development would result in concentrating development and effects on farmland and agricultural uses in specific areas, when compared with Alternative 1 (No Action). COAs 3, 6, 10, and 15 would be applied in low-density sections where prime farmland is and could protect farm and	Application of COAs 3, 6, 10, 15, and 31 would minimize impacts on farmland and agricultural uses would be similar to those under Alternative 1 (No Action), as would the impacts due to surface disturbance and livestock interaction. Buffers applied as COAs for protecting cultural sites could further reduce ground

Resource/ Resource Use	Alternative 1 (No Action)	Alternative 2	Alternative 3	Alternative 4
Agriculture *(continued)*	*(see above)*	The risk of disturbance or loss of farmland and livestock injury or mortality would be greater than under the other alternatives.	pastureland from conversion and other impacts. Prime farmland would be more likely to be converted or disturbed in high-density sections because COAs that are less protective would be applied and more oil and gas development and access facilities would be concentrated. There would likely be more fragmentation of productive land and pasture. Buffers applied as COAs for protecting cultural sites in low-density sections could reduce ground disturbance, farmland conversion, and impacts on agricultural uses. Under this alternative, the BIA would not approve new drilling permits near certain sensitive waterbodies and in groundwater protection areas and municipalities. Farmland in these areas would be protected from new oil and gas-related disturbance.	disturbance, farmland conversion, and impacts on agricultural uses, compared with Alternative 1 (No Action). Overall, Alternative 4 would result in the least impact on farmland and livestock out of all the alternatives. Under this alternative, the BIA would not approve new drilling permits in certain sensitive areas. Farmland in these areas would be protected from new oil and gas-related disturbance.

Resource/ Resource Use	Alternative 1 (No Action)	Alternative 2	Alternative 3	Alternative 4
Cultural resources	Resolving adverse impacts through the NHPA Section 106 process would mitigate any significant impacts under NEPA. The infrastructure and access roads remaining in place for operations and maintenance could lead to indirect impacts on cultural resources from increased access, trespass, vandalism, erosion, and changes to setting. Applying the COAs under Alternative 1 (No Action) would continue to reduce potential impacts on cultural resources through avoidance, minimized surface disturbance, discovery provisions, and the NHPA Section 106 process.	Many of the COAs applied under Alternative 1 (No Action) would not apply under Alternative 2; however, standard NHPA compliance procedures, as implemented at 36 CFR 800, would apply, and special COAs could be included to protect cultural resources. Resolving adverse impacts identified in NEPA analysis, through the NHPA Section 106 process would mitigate any significant impacts.	Under Alternative 3, COAs would concentrate new facilities and therefore increase the potential for impacts on cultural resources in specific areas where there is already oil and would be based on the density of well development. More COAs would be applied in low-density sections under Alternative 3. This could reduce the potential for impacts on cultural resources in those areas and possibly preserve their settings. For low-density sections, Alternative 3 would include proactive guidance on minimum, expected, no-drilling, buffer zones for cultural resource protection. This would have a beneficial impact on cultural resources by providing more predictable guidance and standards for siting facilities and avoiding impacts on cultural resources. In low-density sections, potential impacts from oil and gas development on cultural resources would likely be less than under Alternative 1 (No Action) and Alternative 2;	The COAs that would minimize the potential for impacts on cultural resources would be similar to those under Alternative 1 (No Action). Alternative 4 would include proactive guidance on minimum, expected, no-drilling, buffer zones. Applying these additional COAs would have a beneficial impact on cultural resources by providing more predictable guidance and standards for siting facilities and avoiding impacts on cultural resources; therefore, impacts on cultural resources are expected to be least frequent and least severe under this alternative. Standard NHPA compliance procedures would apply and special COAs can be included to protect cultural resources. Resolving adverse impacts identified in NEPA analysis through the NHPA Section 106 process would mitigate any significant impacts. Under this alternative, the BIA would not approve new drilling permits in certain sensitive areas totaling approximately 36 percent of the county. The

Resource/ Resource Use	Alternative 1 (No Action)	Alternative 2	Alternative 3	Alternative 4
Cultural resources *(continued)*	*(see above)*	*(see above)*	however, standard NHPA compliance procedures would apply, and special COAs can be included to protect cultural resources. Resolving adverse impacts identified in NEPA analysis through the Section NHPA 106 process would mitigate any significant impacts. Under this alternative, the BIA would not approve new drilling permits near certain sensitive waterbodies and in groundwater protection areas and municipalities. The possibility of damage to cultural resources would be reduced, as would the possibility of new discoveries in these areas.	possibility of damage to cultural resources would be reduced, as would the possibility of new discoveries in these areas.
Socioeconomics and environmental justice	Applying the COAs under Alternative 1 (No Action) would continue to restrict operations and siting for development; however, COAs would not reduce the overall number of operations or result in substantially increased costs for developers. Economic contributions from drilling and production would continue or would increase, depending on market conditions. Applying COAs could minimize impacts from development on	Under Alternative 2, management actions would emphasize oil and gas development to a greater extent than under Alternative 1 (No Action) by minimizing or waiving most COAs. Lessees would have a greater degree of flexibility in how to comply, reducing development costs. The time required for permitting and site preparation would be reduced, maximizing economic output; however, this alternative would increase regulatory uncertainty and	In high-density sections, the impacts would be as described under Alternative 2. In low-density sections, additional protective COAs would be applied, and the impacts of restrictions on siting and timing of development may be increased, compared with Alternative 1 (No Action). Under Alternative 3, total development and economic output are expected to be similar to those under Alternative 1 (No Action).	Total development levels over the planning period under Alternative 4 are expected to be similar to those under Alternative 1 (No Action). The surface area of long-term disturbance associated with oil and gas development could be reduced from Alternative 1 (No Action). This could increase the potential for economic contributions from other activities and reduce the impacts on nonmarket and quality of life factors.

Resource/ Resource Use	Alternative 1 (No Action)	Alternative 2	Alternative 3	Alternative 4
Socioeconomics and environmental justice *(continued)*	quality-of-life factors and on market values and could minimize impacts on other land uses and their economic contributions. Project activities would not result in disproportionate adverse impacts on identified minority or Tribal populations.	open up lessees to liability and additional expense, compared with Alternative 1 (No Action). This would be the case if methods of compliance with applicable laws and regulations are judged to be inadequate. Impacts on quality of life and on other land uses would likely be increased. Because impacts would be spread throughout the planning area and the region, proposed oil and gas development is not anticipated to result in disproportionate adverse impacts on identified minority or Tribal populations.	Concentrating development could reduce the overall impacts on other land uses, nonmarket values, and quality-of-life factors. Potential impacts may be more likely in census tracts in high-density sections. Of those tracts with minority populations, 42 percent of census tract 9400.2 and 55 percent of census tract 9400.6 are within high-density sections.	Project activities are not anticipated to result in disproportionate adverse impacts on low-income, minority, or Tribal populations.

Resource/ Resource Use	Alternative 1 (No Action)	Alternative 2	Alternative 3	Alternative 4
Public health and safety	Current BMPs would continue to be required as COAs in order to protect public health and safety. COAs requiring secondary containment for tank batteries and prompt removal of waste and unused chemicals would reduce the risk of hazardous chemicals being released into the environment. COA 8 requires chemicals to be stored and labeled properly and may not be kept on drill sites if they are not being used. COA 9 requires waste containers and contaminated soil to be disposed of promptly and appropriately. COA 11 requires tank batteries to have secondary containment. These requirements would reduce the risk of hazardous chemicals being released into the environment, where groundwater could be contaminated or the public could consume contaminated agricultural products. COA 18 would protect workers and the general public from the impacts of hydrogen sulfide exposure in areas where hydrogen sulfide levels of 100 ppm or greater are expected in	This alternative would not apply COAs for handling chemicals or potentially contaminated water. Applicable laws and regulations would still apply, but this alternative would provide fewer protections for public health and safety than all other alternatives.	In high-density sections, management would be the same as under Alternative 2. In low-density sections, additional COAs, described under Alternative 4, requiring secondary containment for tank batteries and prompt removal of waste and unused chemicals would be applied. This would reduce the risk of accidental releases of potentially contaminated water and hazardous chemicals. COAs 18 and 25, requiring hydrogen sulfide testing and mitigation, would protect workers and the general public from the impacts of hydrogen sulfide exposure. This alternative would provide additional protections to public health in some areas, when compared with Alternative 2. Under this alternative, the BIA would not approve new drilling permits near certain sensitive waterbodies and in groundwater protection areas and municipalities. The reduction in new drilling in these areas, especially municipalities, which tend to be population centers, would reduce the potential for human exposure to hazardous	Throughout the planning area, COAs would be applied requiring secondary containment for tank batteries and prompt removal of waste and unused chemicals. These COAs would reduce the risk of contaminated water and hazardous chemical releases. COAs 18 and 25 would require hydrogen sulfide testing and mitigation to protect workers and the general public from the impacts of hydrogen sulfide exposure. This alternative would provide the highest level of protection to public health and safety. Under this alternative, the BIA would not approve new drilling permits in certain sensitive areas totaling approximately 36 percent of the county. The reduction in new drilling in these areas would reduce the potential for human exposure to hazardous materials and fumes from oil and gas development activities. COA 8 requires chemicals to be stored and labeled properly; they may not be kept on drill sites if they are not being used. COA 9 requires waste containers and contaminated

Resource/ Resource Use	Alternative 1 (No Action)	Alternative 2	Alternative 3	Alternative 4
Public health and safety *(continued)*	the gas stream. This would come about by requiring the air quality BMPs listed in the site-specific EA for the drilling permit.	*(see above)*	materials and fumes from oil and gas development activities.	soil to be disposed of promptly and appropriately. COA 11 requires tank batteries to have secondary containment. These requirements would reduce the risk of hazardous chemicals being released into the environment, where groundwater could be contaminated or the public could consume contaminated agricultural products.
Visual resources	Under this alternative, COAs that require lessees to minimize surface disturbance and topography alterations, reclaim promptly, and remove unused equipment would continue to limit impacts on visual resources.	Under this alternative, COA 24 would specifically prohibit adverse visual impacts that may constitute a public nuisance that is harmful to people or sensitive environmental receptors; however, other COAs that minimize surface disturbance and topography alterations would not be applied, so overall impacts on visual resources could increase under this alternative.	In low-density sections, COAs from Alternative 1 (No action) would be applied, as well as additional COAs that would require burying pipelines, where appropriate (COA 30), collocating roads and pipelines (COA 31), and avoiding cultural sites and wetlands (COA 29). This alternative would provide additional protections to generally more pristine low-density sections. COA 24, which specifically prohibits adverse visual impacts that may constitute a public nuisance that is harmful to people or sensitive environmental receptors, would be applied to all areas under this alternative.	COAs from Alternative 1 (No Action) would be applied to all areas, as well as additional COAs that would require burying pipelines, where appropriate (COA 30), collocating roads and pipelines (COA 31), and avoiding cultural sites and wetlands (COA 29). COA 24, which specifically prohibits adverse visual impacts that may constitute a public nuisance that is harmful to people or sensitive environmental receptors would be applied to all areas under this alternative. This would result in the fewest impacts on visual resources out of all alternatives.

Resource/ Resource Use	Alternative 1 (No Action)	Alternative 2	Alternative 3	Alternative 4
Visual resources *(continued)*	*(see above)*	*(see above)*	Under this alternative, the BIA would not approve new drilling permits near certain sensitive waterbodies and in groundwater protection areas and municipalities encompassing approximately 17 percent of the county. Visual impacts from new oil and gas development activities would be reduced in these areas.	Under this alternative, the BIA would not approve new drilling permits in certain sensitive areas totaling approximately 36 percent of the county. Visual impacts from new oil and gas development activities would be reduced in these areas.
Noise	The application of certain standardized COAs may indirectly limit noise impacts by confining operations to existing roads where possible COAs instructing lessees to minimize vegetation removal and disturbance to the surface owner could also help reduce noise impacts. COA 13 directs lessees to minimize noise disturbance to surface owners, wildlife, and natural resources.	Under this alternative fewer COAs would be applied; however, COA 24, which specifically prohibits noise levels that may constitute a public nuisance considered harmful to people or sensitive environmental receptors, would be applied. Depending on how COA 24 is applied, this alternative could provide additional noise protections over Alternative 1 (No Action).	COA 24, which specifically prohibits noise levels that may constitute a public nuisance that is harmful to people or sensitive environmental receptors, would be applied in all areas. Additionally, the same COAs as Alternative 1 (No Action), which could incidentally reduce noise impacts, would be applied in low-density sections. This alternative would provide more protections in low-density sections, compared with Alternative 1 (No Action) and Alternative 2; however, it would provide fewer protections in the entire planning area, when compared with Alternative 4. Under this alternative, the BIA would not approve new drilling	COA 24, which specifically prohibits noise levels that may constitute a public nuisance that is harmful to people or sensitive environmental receptors would be applied in all areas. In addition, COAs instructing lessees to minimize vegetation removal and disturbance to the surface owner, which could incidentally reduce noise pollution, would be applied in all areas. This alternative would provide the greatest level of protection from noise impacts. COA 13 directs lessees to minimize noise disturbance to surface owners, wildlife, and natural resources. Under this alternative, the BIA would not approve new drilling

Resource/ Resource Use	Alternative 1 (No Action)	Alternative 2	Alternative 3	Alternative 4
Noise *(continued)*	*(see above)*	*(see above)*	permits near certain sensitive waterbodies and in groundwater protection areas and municipalities encompassing approximately 17 percent of the county. Noise impacts from new oil and gas development activities would be reduced in these areas.	permits in certain sensitive areas totaling approximately 36 percent of the county. Noise impacts from new oil and gas development activities would be reduced in these areas.
Land use plans, utilities, and timber harvesting	Existing and proposed oil and gas development would continue to increase the need for new or expanded utilities, such as pipelines and electrical distribution and transmission lines. COA 15 requires remediation to continue on all areas of surface disturbance that are not needed or used in the production or operation of the well. This would ensure that lands are remediate for other land uses and developments in a timely manner. Impacts on Timber harvesting are expected to be minimal under all alternatives. As of 2018, Osage County has not had any timber sales in the last 10 years on BIA-managed lands.	Under Alternative 2, in addition to COAs applied under Alternative 1 (No Action), the BIA would apply COAs that would prohibit applying waste oil, wastewater, or contaminated soil to land. The exception would be if the lessee submits a written request for such application. The degree of this impact would be evaluated on a site-specific, case-by-case basis. Overall, this alternative would apply the fewest COAs, resulting in the fewest restrictions on land use authorizations of all alternatives.	In high-density sections, impacts on land use plans, utilities, and timber harvesting would be the same as those described under Alternative 2. In low-density sections, the BIA would apply COAs 15 and 31, which limit the spatial extent of surface disturbance associated with oil and gas development more than under Alternative 1 (No Action). This management approach would impose more restrictions on land use authorizations for oil and gas development but would continue to provide opportunities for non-oil and gas activities outside of concentrated oil and gas development sections.	This alternative would apply the most COAs of all the alternatives. COAs 15 and 31 would minimize surface disturbance associated with oil and gas development, allowing a greater area for other land uses.

Resource/ Resource Use	Alternative 1 (No Action)	Alternative 2	Alternative 3	Alternative 4
Traffic and transportation	Applying COA 6 would limit impacts by requiring lessees to maintain and upgrade roads as needed. This COA would facilitate current and anticipated traffic levels and reduce damage to public roads. Building roadways through riparian areas or over stream crossings could subject those roadways to inundation and excessive erosion, which would decrease roadway quality and access. Building roadways over streams and in riparian areas would require frequent maintenance.	Impacts would be the same as under Alternative 1 (No Action), with the exception that fewer COAs that require maintaining and upgrading roadways to support new oil and gas development would allow roadways to deteriorate over time, which would reduce access. An inability to meet desired levels of service would be inconsistent with long-range transportation plans.	There would be location-specific impacts depending on COAs applied in high- or low-density sections. Impacts from roadway maintenance on access would be the same as those under Alternative 1 (No Action) in low-density locations. Also, in low-density locations, applying COA 29 would preclude new road crossings of streams and through areas subject to inundation. This would avoid impacts from roadway flooding on access. In high-density locations, impacts would be the same as under Alternative 2.	Impacts would be the same as under Alternative 1 (No Action), except that COA 29, preventing new roadway crossings of streams and other waterways, would protect new roadways from flooding and deterioration.

Resource/ Resource Use	Alternative 1 (No Action)	Alternative 2	Alternative 3	Alternative 4
Mineral extraction	Mineral extraction would continue according to current trends. All standard BMPs would continue to be applied as COAs, with special conditions added if necessary, based on a site-specific EA. It is projected that 4,761 new wells would be drilled in Osage County in the 20 years following the publication of the ROD for this EIS.	Some COAs would be waived. The BIA could approve a CE for all wells in a quarter-section in some situations, potentially accelerating permit issuance. The BIA would determine cultural site setbacks on a case-by-case basis, with site-specific COAs applied as necessary for NHPA compliance. The level of mineral extraction under this alternative is expected to be approximately the same as under Alternative 1 (No Action).	High-density sections would be managed the same as under Alternative 2. Low-density sections would have the same COAs as under Alternative 1 (No Action), plus additional COAs stipulating required setbacks from certain sensitive and cultural resources. In high-density sections, the BIA would determine cultural site setbacks on a case-by-case basis, with site-specific COAs applied as necessary for NHPA compliance. This could require adjusting well placement in some high-density sections. The level of mineral extraction under this alternative is expected to be approximately the same as that under Alternative 1 (No Action).	Alternative 4 would apply the same COAs as those under Alternative 1 (No Action), plus additional COAs. These would require setbacks from cultural resources and other sensitive resources. This alternative could require adjusting well placement in some areas. The level of mineral extraction under this alternative is expected to be approximately the same as that under Alternative 1 (No Action).

Resource/ Resource Use	Alternative 1 (No Action)	Alternative 2	Alternative 3	Alternative 4
Recreation and special use areas	COA 9 requires operators to keep sites clean and free of any litter or old equipment. This would continue to protect the overall naturalness of recreation and special use areas and would help prevent the creation of new dump sites.	In addition to the COAs that apply to all alternatives, the BIA would apply COAs 24 and 27. These COAs would limit noise levels, visual impacts, and land applications for waste oil, wastewater, and contaminated soil. Limiting these impacts would enhance recreation, such as fishing and wildlife viewing. Overall, Alternative 2 emphasizes oil and gas development and would apply the fewest COAs. This would result in the most potential for surface disturbance in areas used for recreation of all the alternatives.	In addition to the COAs that apply to all alternatives, the BIA would apply COAs based on well development density. In low-density sections, COAs would be applied to minimize soil and vegetation disturbance. This would reduce wildlife habitat fragmentation and impacts on recreation, such as hunting and wildlife viewing. In high-density sections, the impacts on recreation and special use areas would be the same as those under Alternative 2. In areas where BIA would not approve new drilling permits, impacts on recreation would be reduced compared to Alternative 1 (No Action).	Alternative 4 emphasizes enhanced resource protection. This would limit surface disturbance associated with oil and gas development activities more than under Alternative 1 (No Action). COAs 24 and 27 would limit noise levels, visual impacts, and land applications for waste oil, wastewater, and contaminated soil. Limiting these impacts would enhance recreation, such as fishing and wildlife viewing. COAs 24, 28, 29, and 30 would be applied to the entire planning area. This would prohibi nuisance from noise or adverse visual impacts, would require burying pipelines, where appropriate, and would avoid disturbance in and near streams and waterways. Due to the COAs applied, there would be fewer impacts on recreation and special use areas under Alternative 4, compared with the other alternatives. In areas where BIA would not approve new drilling permits, impacts on recreation would be reduced compared to Alternative 1 (No Action).

Resource/ Resource Use	Alternative 1 (No Action)	Alternative 2	Alternative 3	Alternative 4
Trust assets and Osage Nation interests	Under all alternatives, oil and gas production from the Osage Mineral Estate would result in royalties distributed to Osage headright owners, as well as a portion of royalties for the Osage Minerals Council's operation. Well development levels are not likely to be substantially affected by proposed management activities. COAs may represent site-specific restrictions, but drilling would not be made uneconomical, and royalties to Osage Nation and headright owners would continue or increase, depending on market conditions. Under all alternatives, the BIA would comply with the NHPA Section 106 process and would consult with the Osage Nation THPO and the SHPO, when applicable. As part of that process, the THPO would review projects for impacts on locations, sacred sites, resources, and settings that are traditionally important, culturally significant, or sacred to the Osage Nation.	As under Alternative 1 (No Action) and depending on market conditions, Alternative 2 would continue or increase economic contributions from production royalties to Osage Nation and headright owners. The potential for increased surface disturbance from oil and gas development under Alternative 2 would increase the potential for oil and gas-related impacts on locations, sacred sites, resources, and settings that are traditionally important, culturally significant, or sacred to the Osage Nation. Many of the COAs that reduce or minimize surface disturbance would not apply under this alternative, and the potential for impacts on cultural properties that are considered significant and sacred to Tribes as established through consultation with the THPO would be greater than under Alternative 1 (No Action).	Under Alternative 3, management actions would support a varied level of development in high- and low-density sections. Management may result in preferential development in high-density sections; total development and economic output (royalty payments) would be similar to those under Alternative 1 (No Action). Alternative 3 would concentrate facility development in high-density sections; therefore, the potential for impacts of surface disturbance on locations, sacred sites, resources, and settings could be greater in these areas. Additional COAs would be applied in low-density sections. This would reduce the potential for impacts from surface disturbance in these areas. For low-density sections, a COA specifies buffers that would be applied for protecting cultural sites. This would reduce ground disturbance and the potential for other impacts.	Under Alternative 4, increased use of COAs would increase restrictions for developers. Total development levels over the 20-year planning period, and economic contributions from production royalties to Osage Nation and headright owners would be similar to those under Alternative 1 (No Action). The actual level of development and production and related economic impacts would continue to be affected by oil and gas market conditions. Applying COAs to protect sensitive cultural and environmental resources would reduce the potential for impacts on locations, sacred sites, resources, and settings that are traditionally important, culturally significant, or sacred to the Osage Nation. Buffers applied as COAs for protecting cultural sites throughout the planning area could further reduce the potential for impacts. In areas where the BIA would not approve permits for new ground-disturbing activities,

Resource/ Resource Use	Alternative 1 (No Action)	Alternative 2	Alternative 3	Alternative 4
Trust assets and Osage Nation interests *(continued)*	All alternatives include COAs to avoid impacts on cultural sites and any other sensitive sites identified by the Osage Nation, and procedures addressing unanticipated discoveries. The reviews may reduce impacts on these resources by requiring that potential impacts are identified and mitigated.	*(see above)*	Also, in low-density sections, impacts on locations, sacred sites, resources, and settings would likely be less than under Alternative 1 (No Action) and Alternative 2. This is because the COAs would reduce impacts. In high-density sections, impacts would be greater than under Alternative 1 (No Action), because fewer protective COAs would be applied. In areas where the BIA would not approve permits for new ground-disturbing activities, impacts on locations, sacred sites, resources, and settings would likely be reduced compared with Alternative 1 (No Action) and Alternative 2.	impacts on locations, sacred sites, resources, and settings would likely be reduced compared with Alternative 1 (No Action) and Alternative 2.

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Appendix E
Figures

Appendix E. Figures

Figure 1-1
Current Leasing Process

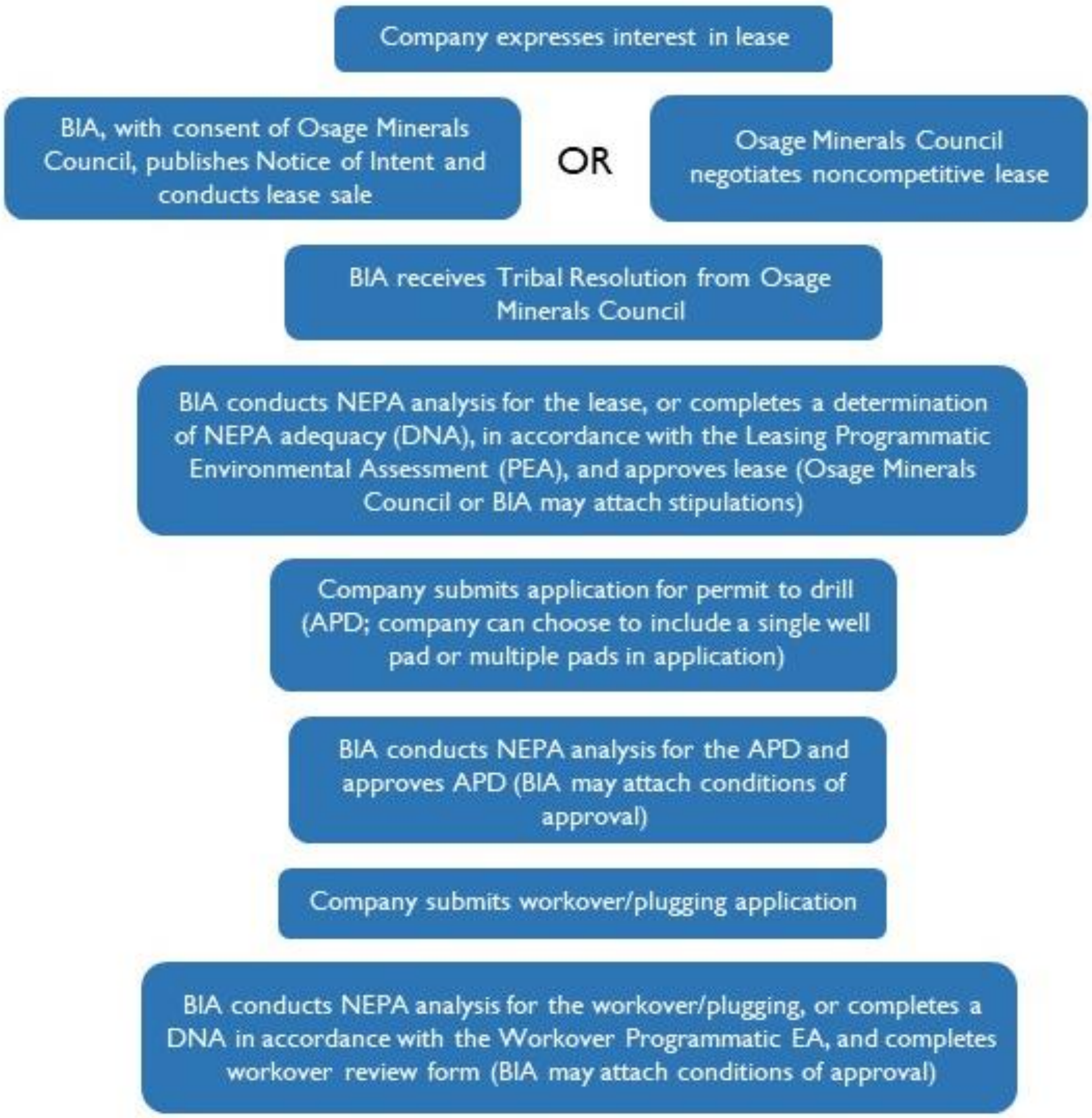
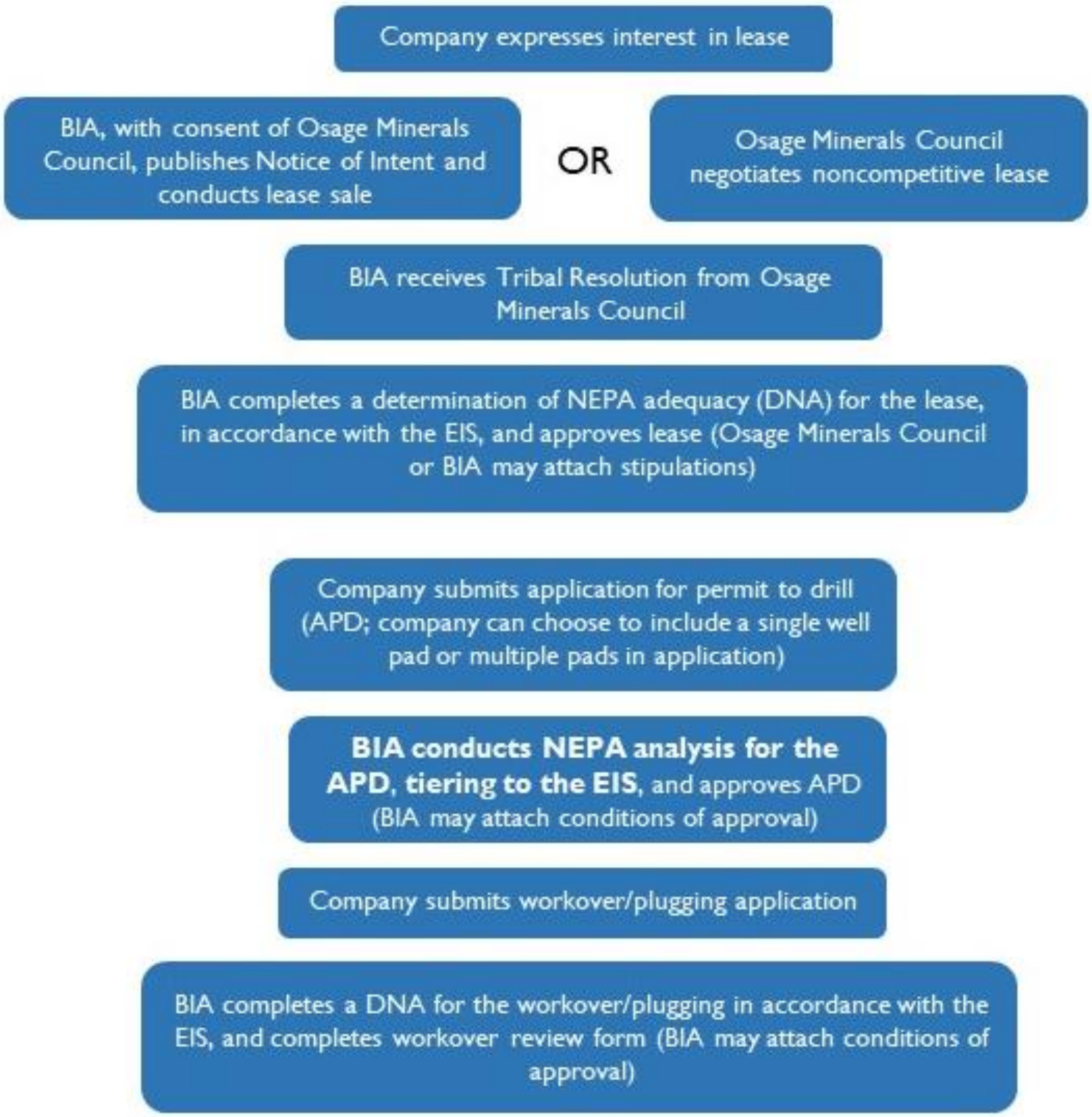
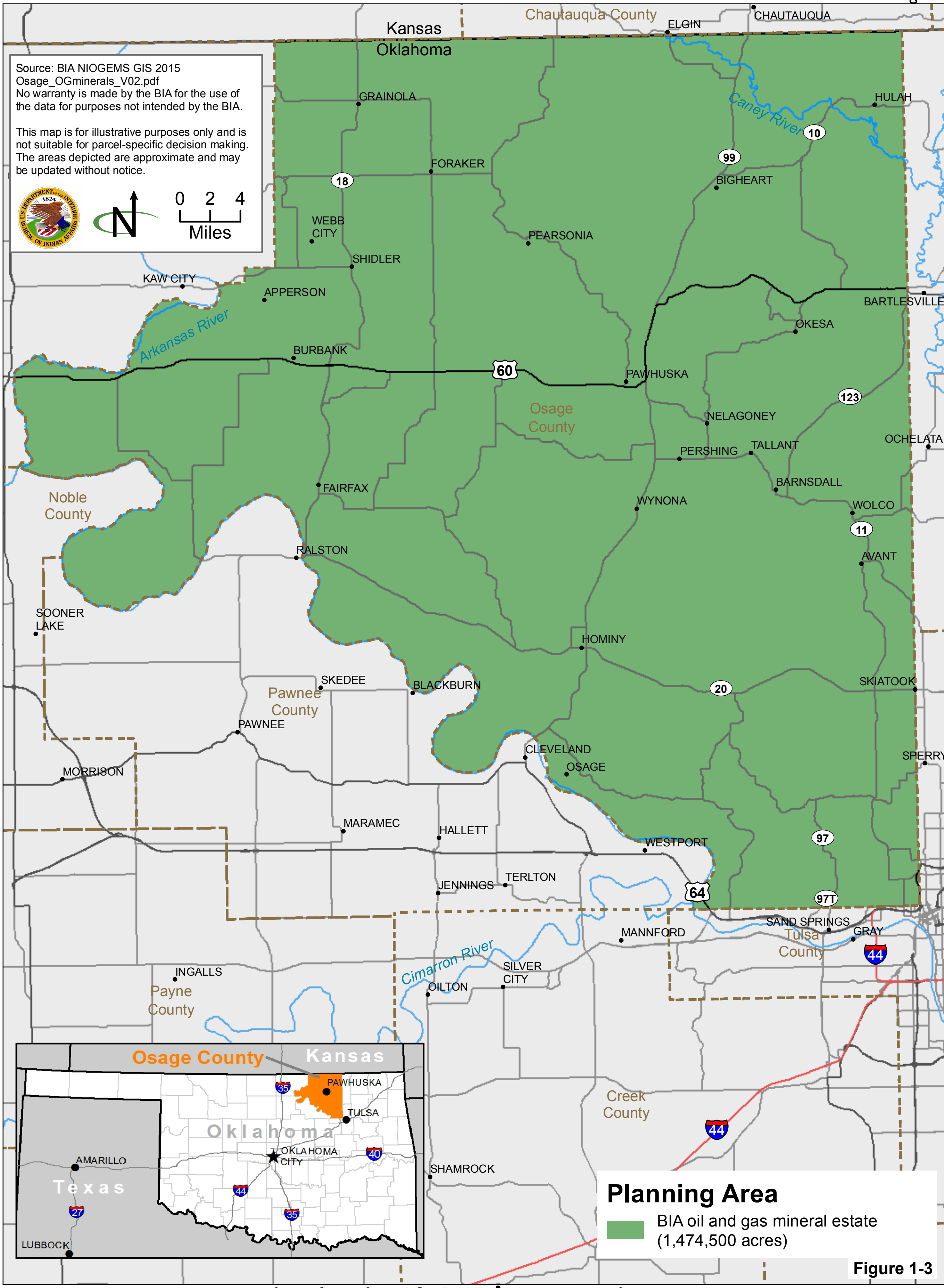


Figure 1-2
Streamlined Leasing Process




Source: BIA NIOGEMS GIS 2015
Osage_OGminerals_V02.pdf
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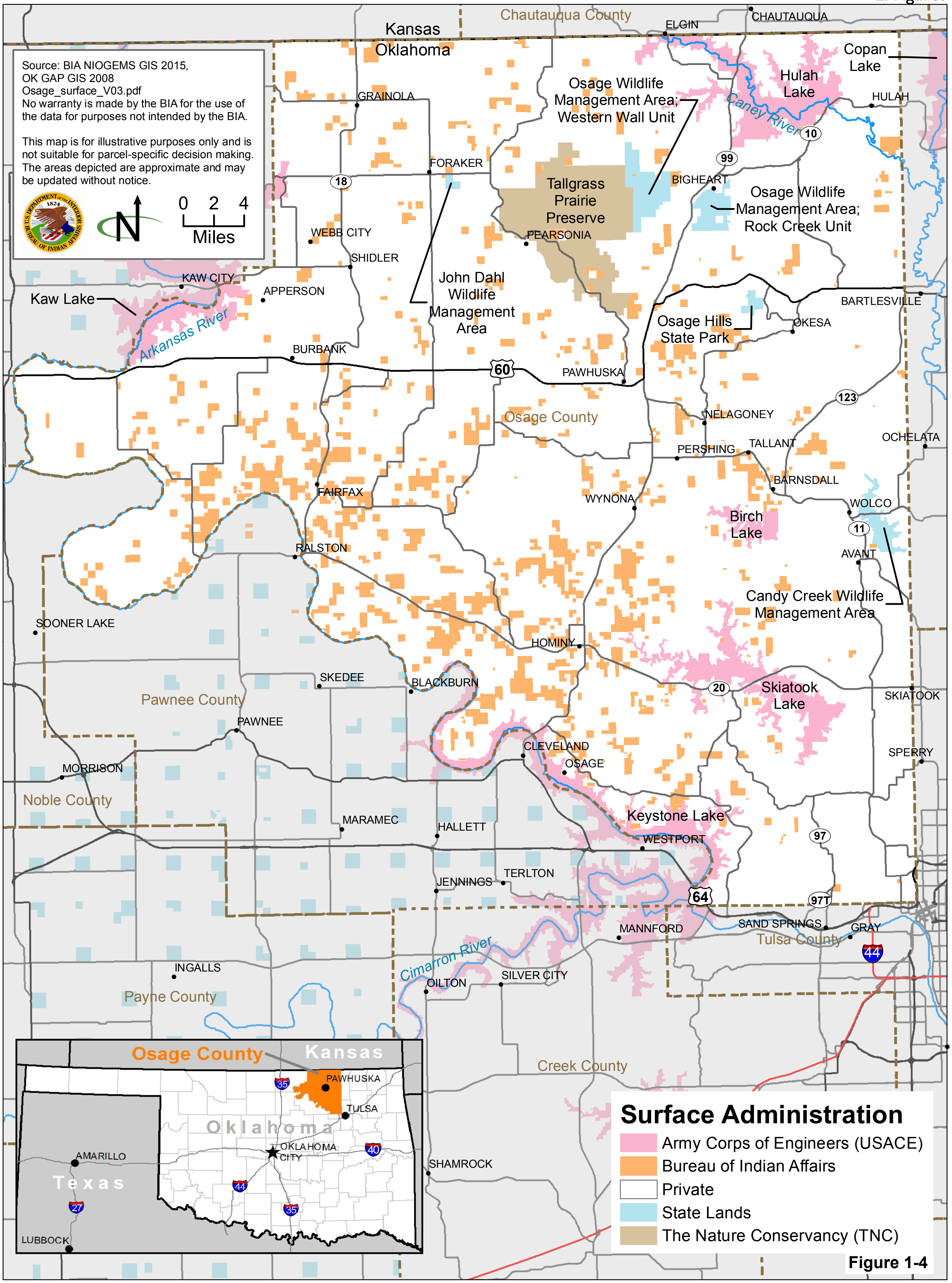
This map is for illustrative purposes only and is not suitable for parcel-specific decision making. The areas depicted are approximate and may be updated without notice.
0 2 4
Miles
N
Kansas
Oklahoma
Chautauqua County
ELGIN
CHAUTAUQUA
GRAINOLA
HULAH
Caney River
10
99
BIGHEART
FORAKER
18
WEBB CITY
PEARSONIA
SHIDLER
KAW CITY
APPERSON
BARTLESVILLE
OKESA
Arkansas River
BURBANK
60
PAWHUSKA
123
Osage County
NELAGONEY
OCHELATA
PERSHING
TALLANT
BARNSDALL
Noble County
FAIRFAX
WYNONA
WOLCO
11
RALSTON
AVANT
SOONER LAKE
HOMINY
SKEDEE
BLACKBURN
SKIATOOK
20
Pawnee County
PAWNEE
CLEVELAND
OSAGE
SPERRY
MORRISON
MARAMEC
HALLETT
WESTPORT
97
JENNINGS
TERLTON
64
97T
SAND SPRINGS
GRAY
MANNFORD
Tulsa County
44
Cimarron River
INGALLS
SILVER CITY
OILTON
Payne County
Osage County
Kansas
PAWHUSKA
35
TULSA
Oklahoma
OKLAHOMA CITY
40
AMARILLO
Texas
44
27
35
LUBBOCK
Creek County
44
SHAMROCK
Planning Area
BIA oil and gas mineral estate (1,474,500 acres)

Figure 1-3


Source: BIA NIOGEMS GIS 2015,
OK GAP GIS 2008
Osage_surface_V03.pdf
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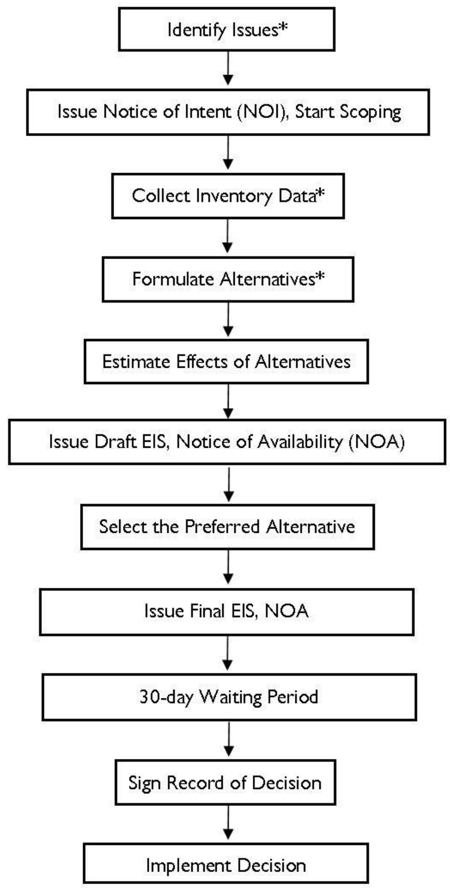
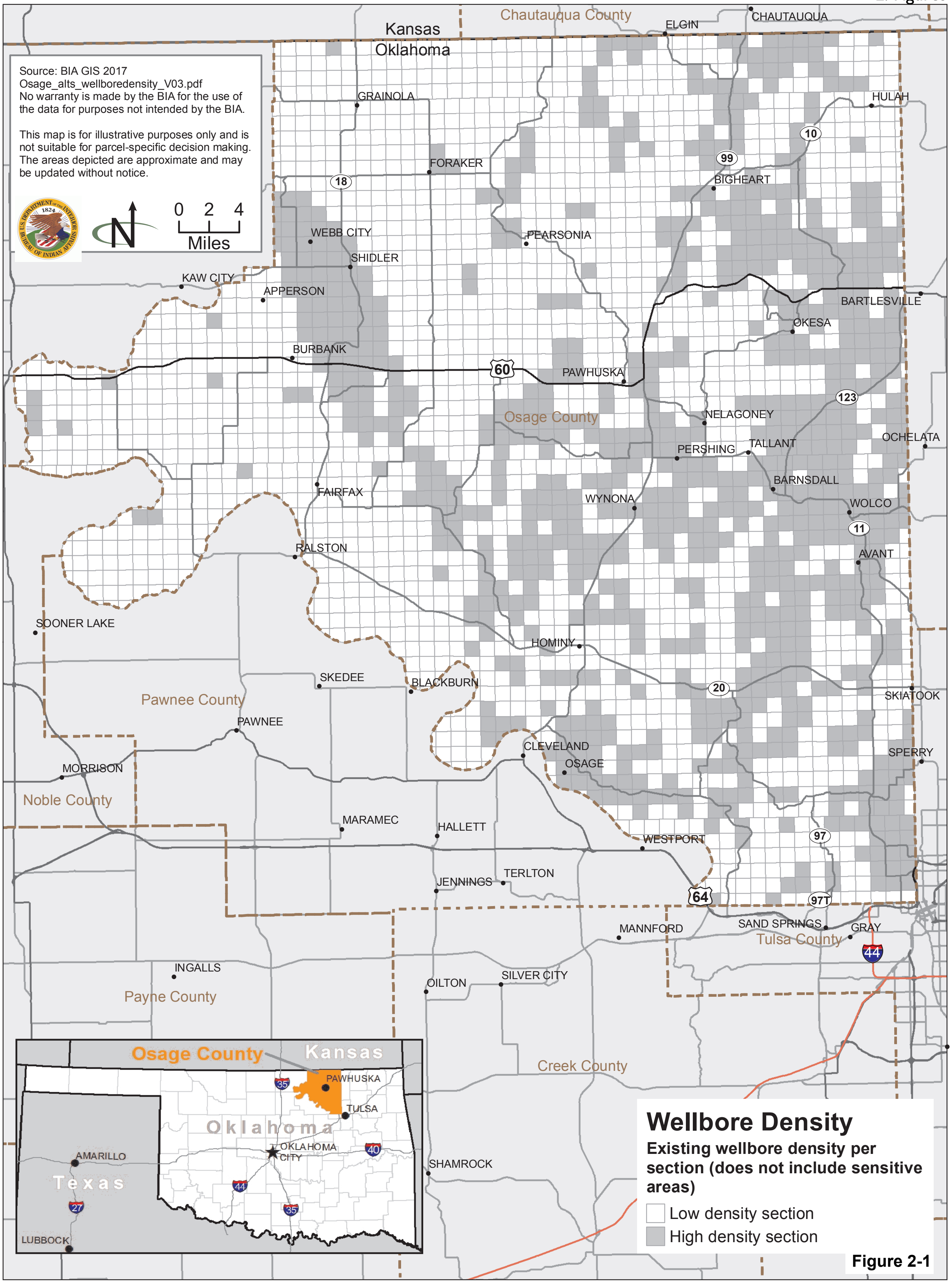
This map is for illustrative purposes only and is not suitable for parcel-specific decision making. The areas depicted are approximate and may be updated without notice.
0 2 4
Miles
Kansas
Oklahoma
Chautauqua County
Osage County
Pawnee County
Noble County
Payne County
Creek County
Tulsa County
Osage Wildlife Management Area; Western Wall Unit
Osage Wildlife Management Area; Rock Creek Unit
Tallgrass Prairie Preserve
John Dahl Wildlife Management Area
Osage Hills State Park
Candy Creek Wildlife Management Area
Copan Lake
Hulah Lake
Kaw Lake
Birch Lake
Skiatook Lake
Keystone Lake
Caney River
Arkansas River
Cimarron River
ELGIN
CHAUTAUQUA
HULAH
GRAINOLA
FORAKER
BIGHEART
PEARSONIA
WEBB CITY
SHIDLER
KAW CITY
APPERSON
BURBANK
PAWHUSKA
BARTLESVILLE
OKESA
NELAGONEY
PERSHING
TALLANT
OCHELATA
BARNSDALL
WOLCO
FAIRFAX
WYNONA
RALSTON
AVANT
SOONER LAKE
HOMINY
SKEDEE
BLACKBURN
SKIATOOK
PAWNEE
CLEVELAND
OSAGE
SPERRY
MORRISON
MARAMEC
HALLETT
WESTPORT
JENNINGS
TERLTON
SAND SPRINGS
GRAY
MANNFORD
INGALLS
OILTON
SILVER CITY
SHAMROCK
10
99
18
60
123
11
20
97
97T
64
44
Osage County
Kansas
Oklahoma
Texas
PAWHUSKA
TULSA
OKLAHOMA CITY
AMARILLO
LUBBOCK
35
40
44
27
Surface Administration
Army Corps of Engineers (USACE)
Bureau of Indian Affairs
Private
State Lands
The Nature Conservancy (TNC)
Figure 1-4

Figure 1-5
The BIA EIS Process



*These steps may be revised throughout the EIS process and may overlap other steps


Source: BIA GIS 2017
Osage_alts_wellboredensity_V03.pdf
No warranty is made by the BIA for the use of the data for purposes not intended by the BIA.
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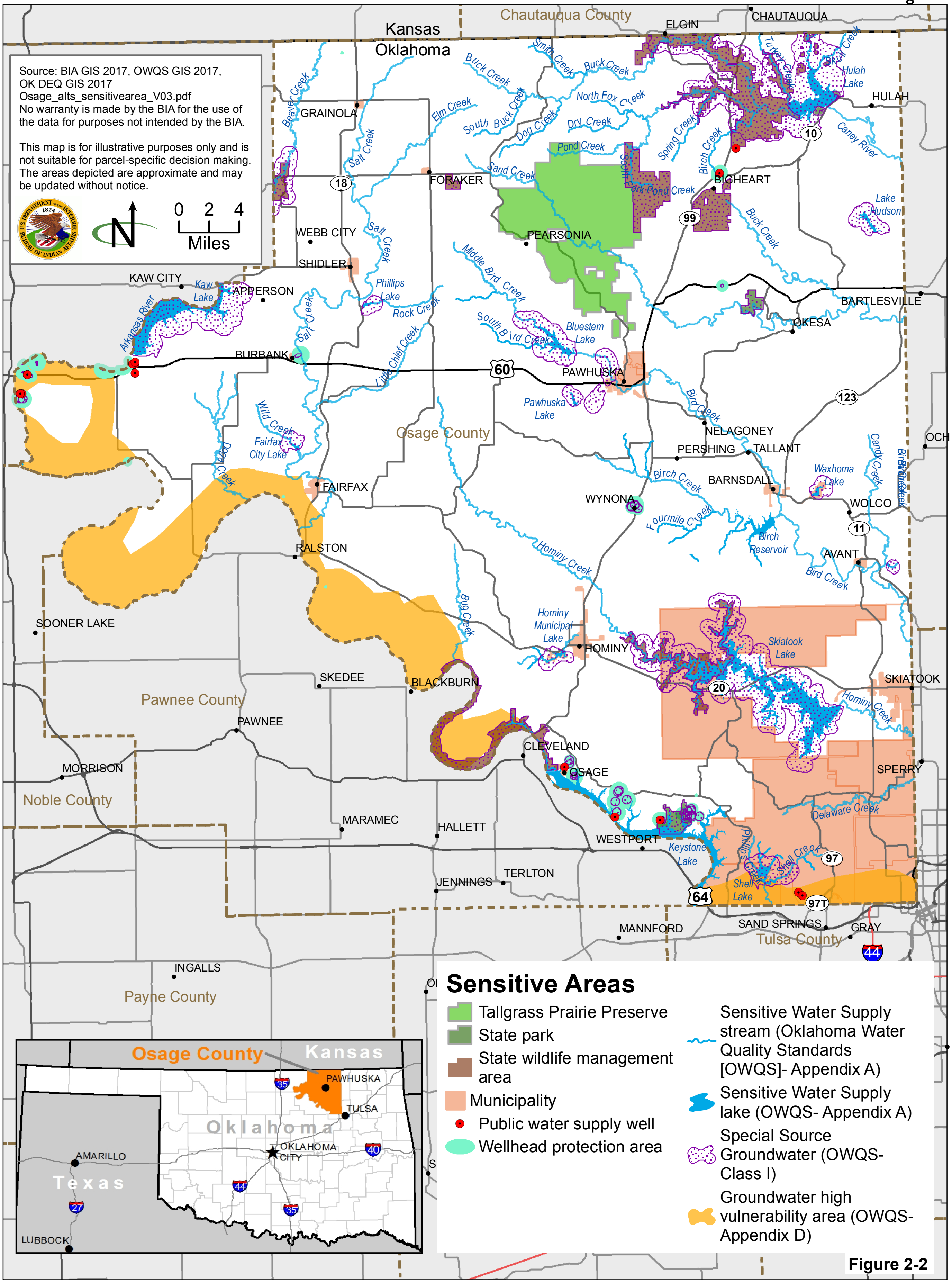
0 2 4
Miles
Kansas
Oklahoma
Chautauqua County
ELGIN
CHAUTAUQUA
GRAINOLA
HULAH
FORAKER
BIGHEART
WEBB CITY
SHIDLER
PEARSONIA
KAW CITY
APPERSON
BARTLESVILLE
OKESA
BURBANK
PAWHUSKA
Osage County
NELAGONEY
PERSHING
TALLANT
OCHELATA
BARNSDALL
FAIRFAX
WYNONA
WOLCO
RALSTON
AVANT
SOONER LAKE
HOMINY
SKEDEE
BLACKBURN
SKIATOOK
Pawnee County
PAWNEE
CLEVELAND
OSAGE
SPERRY
MORRISON
Noble County
MARAMEC
HALLETT
WESTPORT
JENNINGS
TERLTON
MANNFORD
SAND SPRINGS
GRAY
Tulsa County
INGALLS
OILTON
SILVER CITY
Payne County
Creek County
SHAMROCK
Osage County
Kansas
PAWHUSKA
TULSA
Oklahoma
OKLAHOMA CITY
AMARILLO
Texas
LUBBOCK
Wellbore Density
Existing wellbore density per section (does not include sensitive areas)
Low density section
High density section

Figure 2-1


Source: BIA GIS 2017, OWQS GIS 2017,
OK DEQ GIS 2017
Osage_alts_sensitivearea_V03.pdf
No warranty is made by the BIA for the use of
the data for purposes not intended by the BIA.
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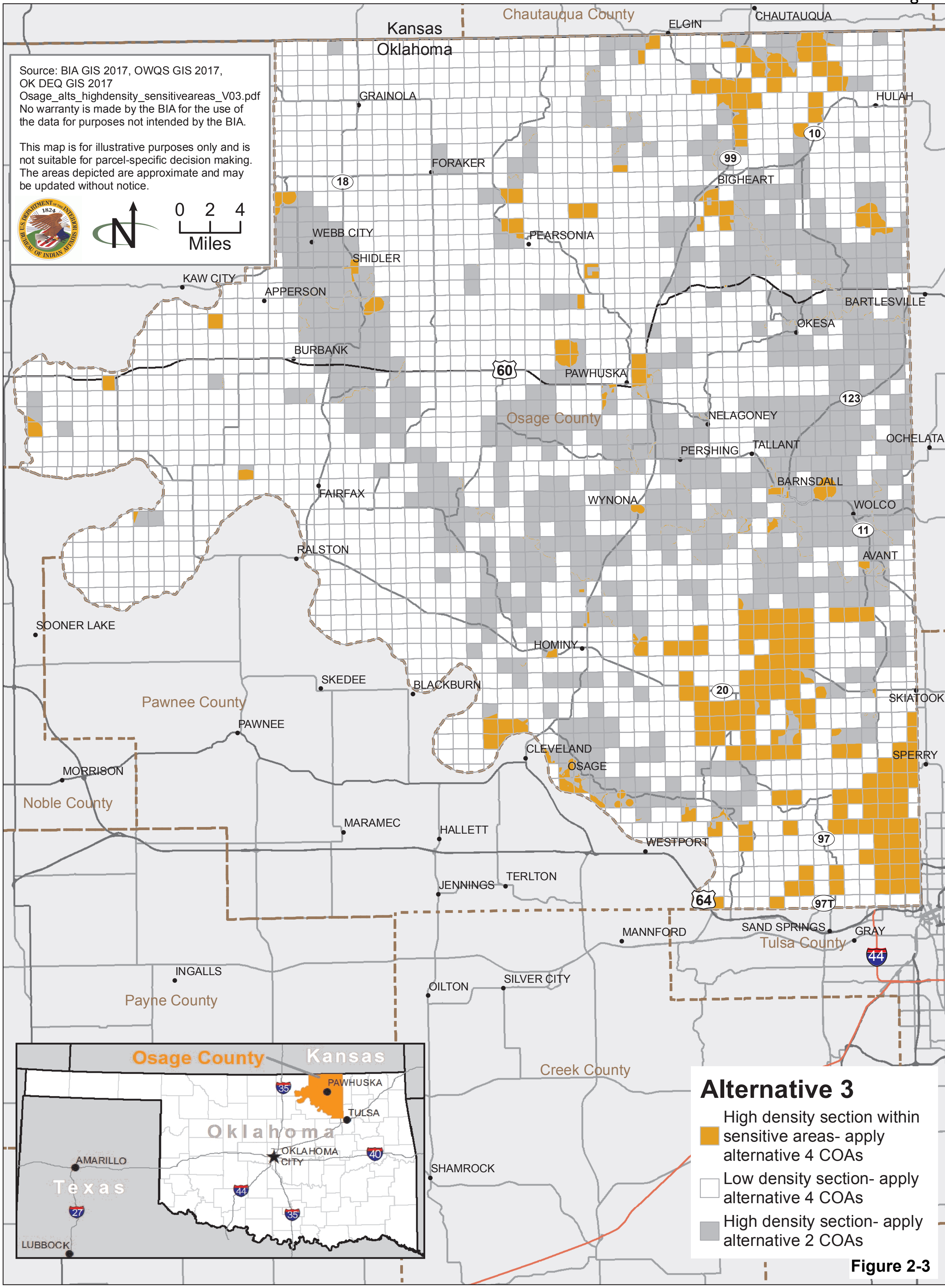
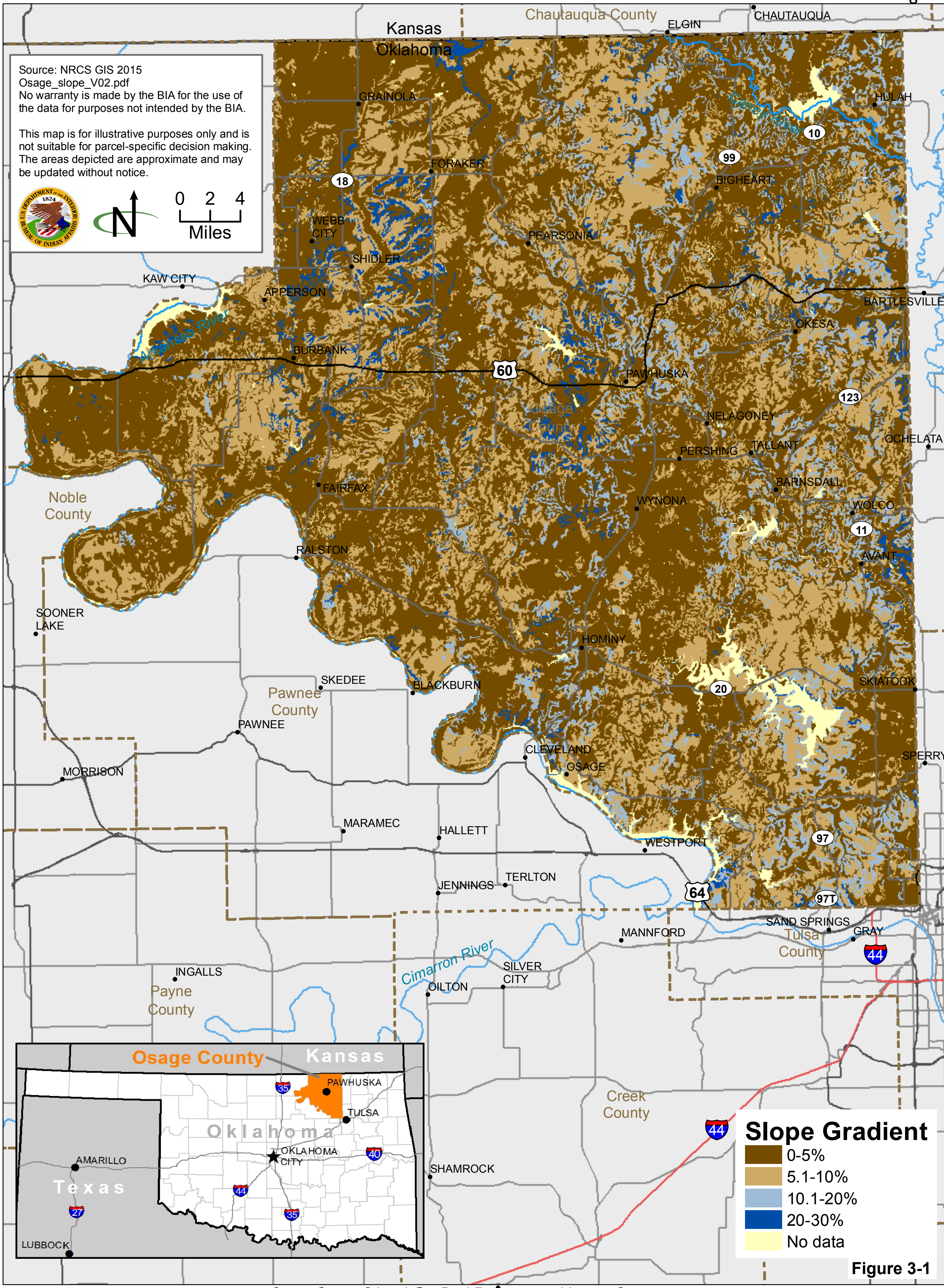
be updated without notice.
0 2 4
Miles
N
Kansas
Oklahoma
Chautauqua County
Osage County
Pawnee County
Noble County
Payne County
Tulsa County
ELGIN
CHAUTAUQUA
HULAH
GRAINOLA
FORAKER
BIGHEART
PEARSONIA
WEBB CITY
SHIDLER
KAW CITY
APPERSON
BURBANK
BARTLESVILLE
OKESA
PAWHUSKA
NELAGONEY
PERSHING
TALLANT
BARNSDALL
WOLCO
WYNONA
FAIRFAX
RALSTON
AVANT
SOONER LAKE
HOMINY
SKIATOOK
SKEDEE
BLACKBURN
PAWNEE
CLEVELAND
OSAGE
SPERRY
MORRISON
MARAMEC
HALLETT
WESTPORT
JENNINGS
TERLTON
MANNFORD
SAND SPRINGS
GRAY
INGALLS
OCH
Beaver Creek
Buck Creek
Smith Creek
Turkey Creek
Hulah Lake
Elm Creek
South Buck Creek
North Fox Creek
Dog Creek
Dry Creek
Spring Creek
Birch Creek
Caney River
Salt Creek
Pond Creek
Sand Creek
Lake Hudson
Middle Bird Creek
Phillips Lake
Rock Creek
Kaw Lake
Arkansas River
South Bird Creek
Bluestem Lake
Little Chief Creek
Pawhuska Lake
Bird Creek
Wild Creek
Fairfax City Lake
Candy Creek
Waxhoma Lake
Fourmile Creek
Birch Reservoir
Hominy Creek
Big Creek
Hominy Municipal Lake
Skiatook Lake
Delaware Creek
Keystone Lake
Shell Creek
Shell Lake
18
10
99
60
123
11
20
97
64
97T
44
Osage County
Kansas
Oklahoma
Texas
PAWHUSKA
TULSA
OKLAHOMA CITY
AMARILLO
LUBBOCK
35
40
44
27
Sensitive Areas
Tallgrass Prairie Preserve
State park
State wildlife management area
Municipality
Public water supply well
Wellhead protection area
Sensitive Water Supply stream (Oklahoma Water Quality Standards [OWQS]- Appendix A)
Sensitive Water Supply lake (OWQS- Appendix A)
Special Source Groundwater (OWQS- Class I)
Groundwater high vulnerability area (OWQS- Appendix D)

Figure 2-2


Source: BIA GIS 2017, OWQS GIS 2017, OK DEQ GIS 2017
Osage_alts_highdensity_sensitiveareas_V03.pdf
No warranty is made by the BIA for the use of the data for purposes not intended by the BIA.
This map is for illustrative purposes only and is not suitable for parcel-specific decision making. The areas depicted are approximate and may be updated without notice.
0 2 4
Miles
N
Kansas
Oklahoma
Chautauqua County
Osage County
Pawnee County
Noble County
Payne County
Creek County
Tulsa County
ELGIN
CHAUTAUQUA
HULAH
GRAINOLA
FORAKER
BIGHEART
WEBB CITY
SHIDLER
PEARSONIA
KAW CITY
APPERSON
BARTLESVILLE
OKESA
BURBANK
PAWHUSKA
NELAGONEY
OCHELATA
PERSHING
TALLANT
BARNSDALL
FAIRFAX
WYNONA
WOLCO
AVANT
RALSTON
SOONER LAKE
HOMINY
SKEDEE
BLACKBURN
SKIATOOK
PAWNEE
CLEVELAND
OSAGE
SPERRY
MORRISON
MARAMEC
HALLETT
WESTPORT
JENNINGS
TERLTON
MANNFORD
SAND SPRINGS
GRAY
INGALLS
OILTON
SILVER CITY
SHAMROCK
10
99
18
60
123
11
20
97
64
97T
44
Kansas
Oklahoma
Texas
AMARILLO
LUBBOCK
TULSA
OKLAHOMA CITY
35
40
27
Alternative 3
High density section within sensitive areas- apply alternative 4 COAs
Low density section- apply alternative 4 COAs
High density section- apply alternative 2 COAs
Figure 2-3


Source: NRCS GIS 2015
Osage_slope_V02.pdf
No warranty is made by the BIA for the use of the data for purposes not intended by the BIA.
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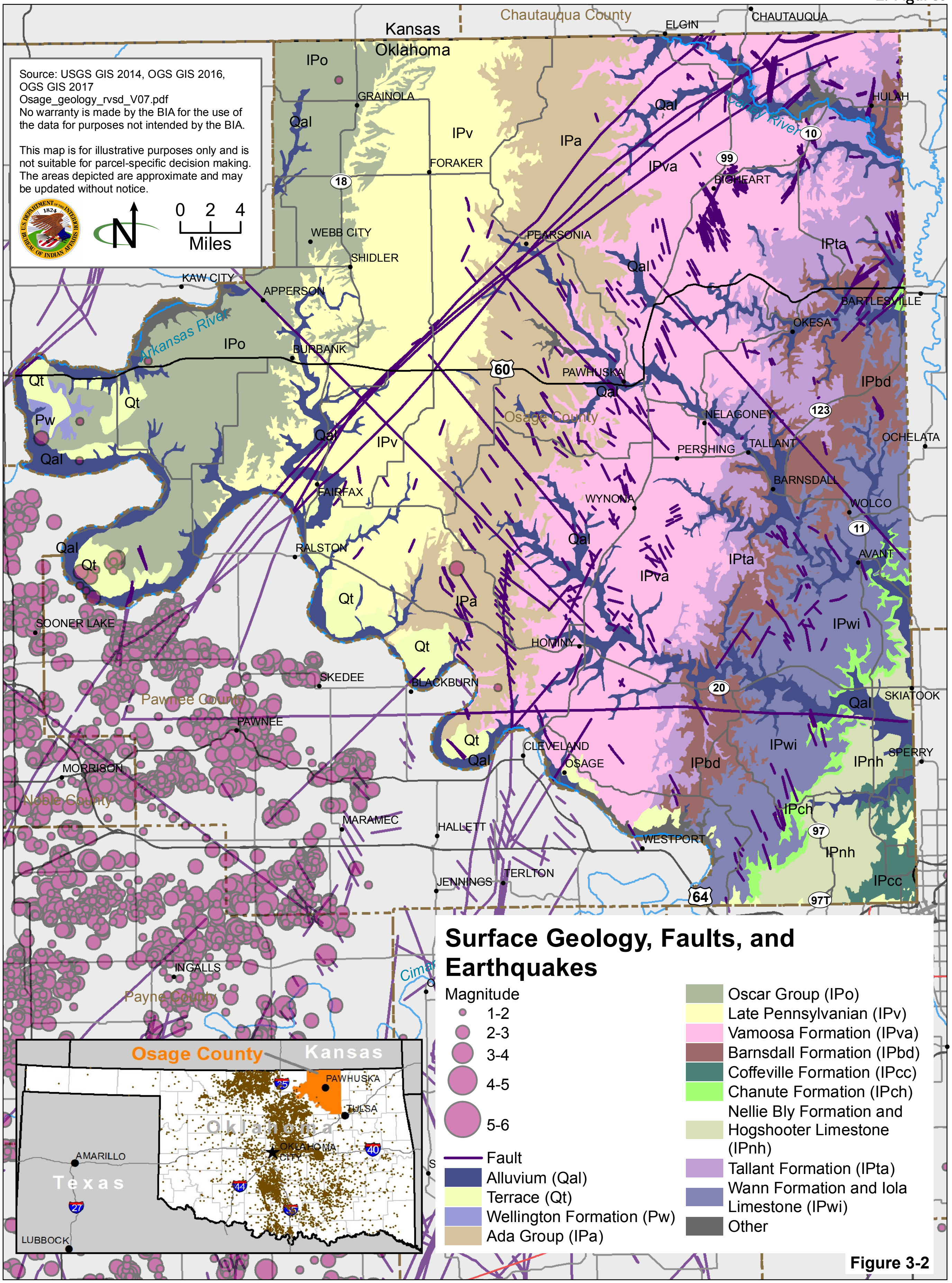
0 2 4
Miles
Kansas
Oklahoma
Chautauqua County
Noble County
Pawnee County
Payne County
Creek County
Tulsa County
ELGIN
CHAUTAUQUA
HULAH
GRAINOLA
FORAKER
BIGHEART
WEBB CITY
SHIDLER
PEARSONIA
KAW CITY
APPERSON
BARTLESVILLE
OKESA
BURBANK
PAWHUSKA
NELAGONEY
OCHELATA
PERSHING
TALLANT
BARNSDALL
FAIRFAX
WYNONA
WOLCO
RALSTON
AVANT
SOONER LAKE
HOMINY
SKIATOOK
SKEDEE
BLACKBURN
PAWNEE
CLEVELAND
OSAGE
SPERRY
MORRISON
MARAMEC
HALLETT
WESTPORT
JENNINGS
TERLTON
SAND SPRINGS
GRAY
MANNFORD
INGALLS
SILVER CITY
OILTON
SHAMROCK
Arkansas River
Cimarron River
Caney River
18
60
99
10
123
11
20
97
97T
64
44
Osage County
Kansas
Oklahoma
Texas
PAWHUSKA
TULSA
OKLAHOMA CITY
AMARILLO
LUBBOCK
35
40
27
Slope Gradient
0-5%
5.1-10%
10.1-20%
20-30%
No data
Figure 3-1



Surface Geology, Faults, and Earthquakes
Source: USGS GIS 2014, OGS GIS 2016, OGS GIS 2017
Osage_geology_rvsd_V07.pdf
No warranty is made by the BIA for the use of the data for purposes not intended by the BIA.
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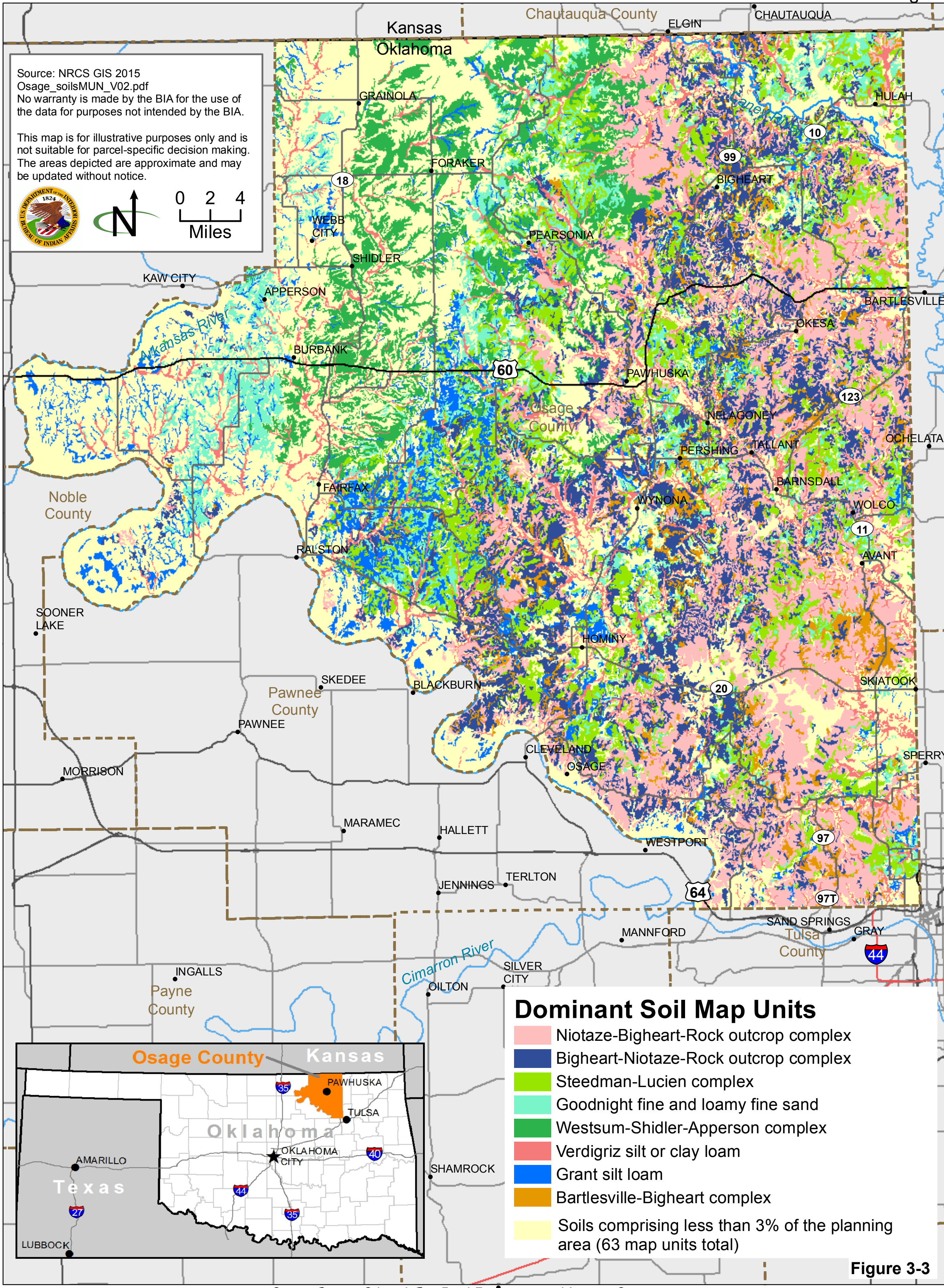
0 2 4
Miles
N
Kansas
Oklahoma
Chautauqua County
Osage County
Pawnee County
Noble County
Payne County
Arkansas River
Caney River
ELGIN
CHAUTAUQUA
HULAH
GRAINOLA
FORAKER
BIGHEART
PEARSONIA
WEBB CITY
SHIDLER
KAW CITY
APPERSON
BURBANK
BARTLESVILLE
OKESA
PAWHUSKA
NELAGONEY
PERSHING
TALLANT
OCHELATA
BARNSDALL
FAIRFAX
WYNONA
WOLCO
RALSTON
AVANT
SOONER LAKE
HOMINY
SKEDEE
BLACKBURN
SKIATOOK
PAWNEE
CLEVELAND
OSAGE
SPERRY
MORRISON
MARAMEC
HALLETT
WESTPORT
JENNINGS
TERLTON
INGALLS
Magnitude
1-2
2-3
3-4
4-5
5-6
Fault
Alluvium (Qal)
Terrace (Qt)
Wellington Formation (Pw)
Ada Group (IPa)
Oscar Group (IPo)
Late Pennsylvanian (IPv)
Vamoosa Formation (IPva)
Barnsdall Formation (IPbd)
Coffeville Formation (IPcc)
Chanute Formation (IPch)
Nellie Bly Formation and Hogshooter Limestone (IPnh)
Tallant Formation (IPta)
Wann Formation and Iola Limestone (IPwi)
Other
Osage County
Kansas
Oklahoma
Texas
PAWHUSKA
TULSA
OKLAHOMA CITY
AMARILLO
LUBBOCK

Figure 3-2


Source: NRCS GIS 2015
Osage_soilsMUN_V02.pdf
No warranty is made by the BIA for the use of the data for purposes not intended by the BIA.
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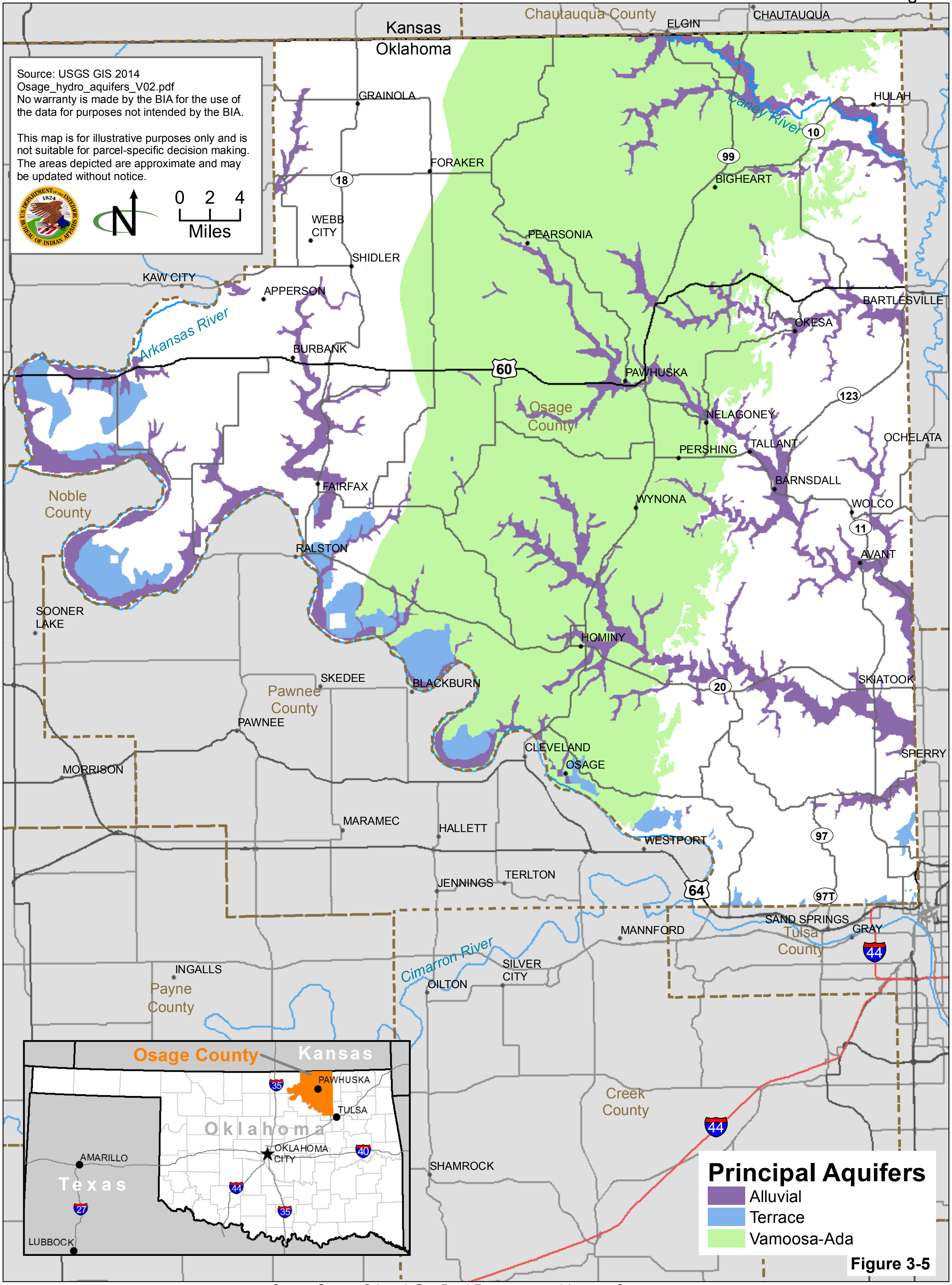
0 2 4
Miles
Kansas
Oklahoma
Chautauqua County
ELGIN
CHAUTAUQUA
GRAINOLA
HULAH
FORAKER
BIGHEART
WEBB CITY
SHIDLER
PEARSONIA
KAW CITY
APPERSON
BARTLESVILLE
OKESA
Arkansas River
BURBANK
PAWHUSKA
Osage County
NELAGONEY
OCHELATA
PERSHING
TALLANT
BARNSDALL
FAIRFAX
WYNONA
WOLCO
Noble County
RALSTON
AVANT
SOONER LAKE
HOMINY
SKEDEE
BLACKBURN
SKIATOOK
Pawnee County
PAWNEE
CLEVELAND
OSAGE
SPERRY
MORRISON
MARAMEC
HALLETT
WESTPORT
JENNINGS
TERLTON
SAND SPRINGS
MANNFORD
GRAY
Tulsa County
Cimarron River
SILVER CITY
INGALLS
OILTON
Payne County
SHAMROCK
Osage County
Kansas
PAWHUSKA
TULSA
Oklahoma
OKLAHOMA CITY
AMARILLO
Texas
LUBBOCK
Dominant Soil Map Units
Niotaze-Bigheart-Rock outcrop complex
Bigheart-Niotaze-Rock outcrop complex
Steedman-Lucien complex
Goodnight fine and loamy fine sand
Westsum-Shidler-Apperson complex
Verdigriz silt or clay loam
Grant silt loam
Bartlesville-Bigheart complex
Soils comprising less than 3% of the planning area (63 map units total)

Figure 3-3

Figure 3-4
Example Salt-scarred Site in the Planning Area

Source: USGS 2015b


Chautauqua County
ELGIN
CHAUTAUQUA
Kansas
Oklahoma
Source: USGS GIS 2014
Osage_hydro_aquifers_V02.pdf
No warranty is made by the BIA for the use of the data for purposes not intended by the BIA.
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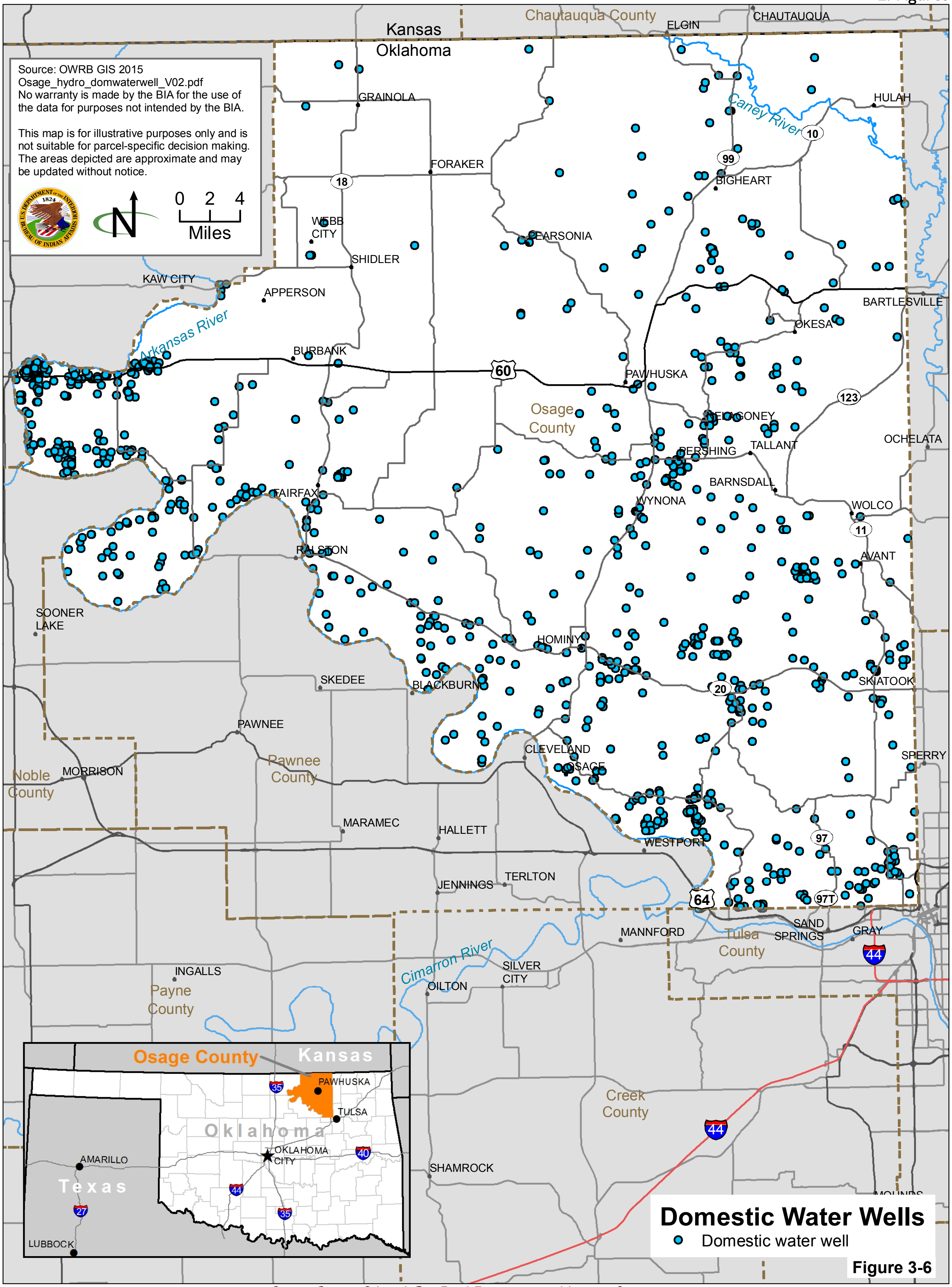
0 2 4
Miles
GRAINOLA
HULAH
Caney River
10
99
FORAKER
18
BIGHEART
WEBB CITY
PEARSONIA
SHIDLER
KAW CITY
APPERSON
BARTLESVILLE
Arkansas River
OKESA
BURBANK
60
PAWHUSKA
123
Osage County
NELAGONEY
OCHELATA
PERSHING
TALLANT
BARNSDALL
FAIRFAX
Noble County
WYNONA
WOLCO
11
RALSTON
AVANT
SOONER LAKE
HOMINY
SKIATOOK
SKEDEE
BLACKBURN
20
Pawnee County
PAWNEE
SPERRY
CLEVELAND
OSAGE
MORRISON
MARAMEC
HALLETT
WESTPORT
97
JENNINGS
TERLTON
64
97T
SAND SPRINGS
MANNFORD
Tulsa County
GRAY
44
Cimarron River
SILVER CITY
INGALLS
OILTON
Payne County
Osage County
Kansas
PAWHUSKA
35
TULSA
Oklahoma
OKLAHOMA CITY
40
AMARILLO
Texas
44
27
35
LUBBOCK
Creek County
44
SHAMROCK
Principal Aquifers
Alluvial
Terrace
Vamoosa-Ada

Figure 3-5


Source: OWRB GIS 2015
Osage_hydro_domwaterwell_V02.pdf
No warranty is made by the BIA for the use of the data for purposes not intended by the BIA.
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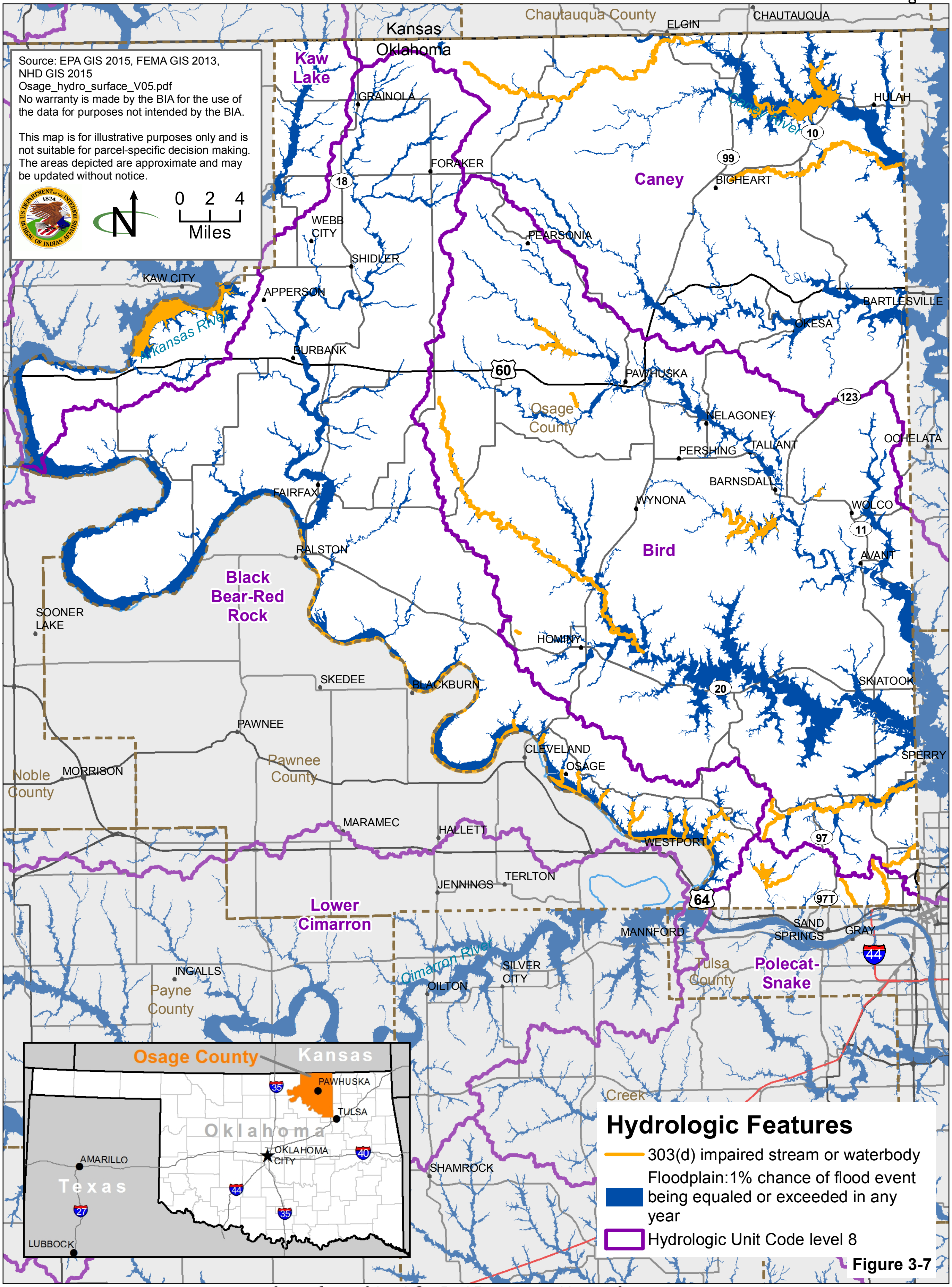
0 2 4
Miles
Kansas
Oklahoma
Chautauqua County
ELGIN
CHAUTAUQUA
GRAINOLA
HULAH
Caney River
FORAKER
BIGHEART
WEBB CITY
PEARSONIA
SHIDLER
KAW CITY
APPERSON
Arkansas River
BARTLESVILLE
OKESA
BURBANK
PAWHUSKA
Osage County
NELAGONEY
OCHELATA
PERSHING
TALLANT
BARNSDALL
FAIRFAX
WYNONA
WOLCO
RALSTON
AVANT
SOONER LAKE
HOMINY
SKEDEE
BLACKBURN
SKIATOOK
PAWNEE
Pawnee County
CLEVELAND
OSAGE
SPERRY
Noble County
MORRISON
MARAMEC
HALLETT
WESTPORT
JENNINGS
TERLTON
MANNFORD
Tulsa County
SAND SPRINGS
GRAY
Cimarron River
INGALLS
Payne County
SILVER CITY
OILTON
Creek County
SHAMROCK
MOUNDS
Osage County
Kansas
PAWHUSKA
TULSA
Oklahoma
OKLAHOMA CITY
AMARILLO
Texas
LUBBOCK
Domestic Water Wells
Domestic water well
Figure 3-6


Source: EPA GIS 2015, FEMA GIS 2013, NHD GIS 2015
Osage_hydro_surface_V05.pdf
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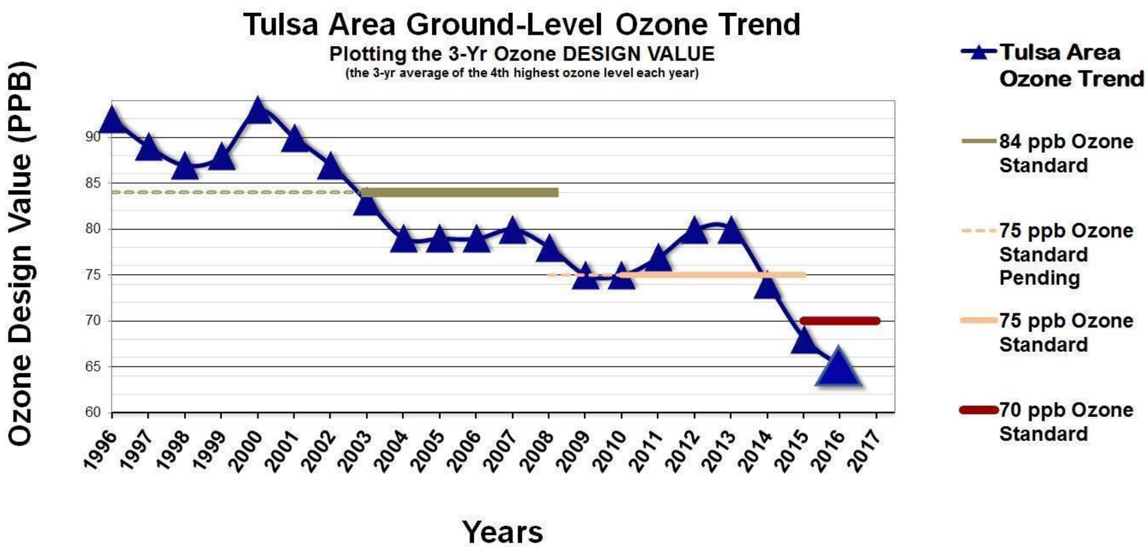
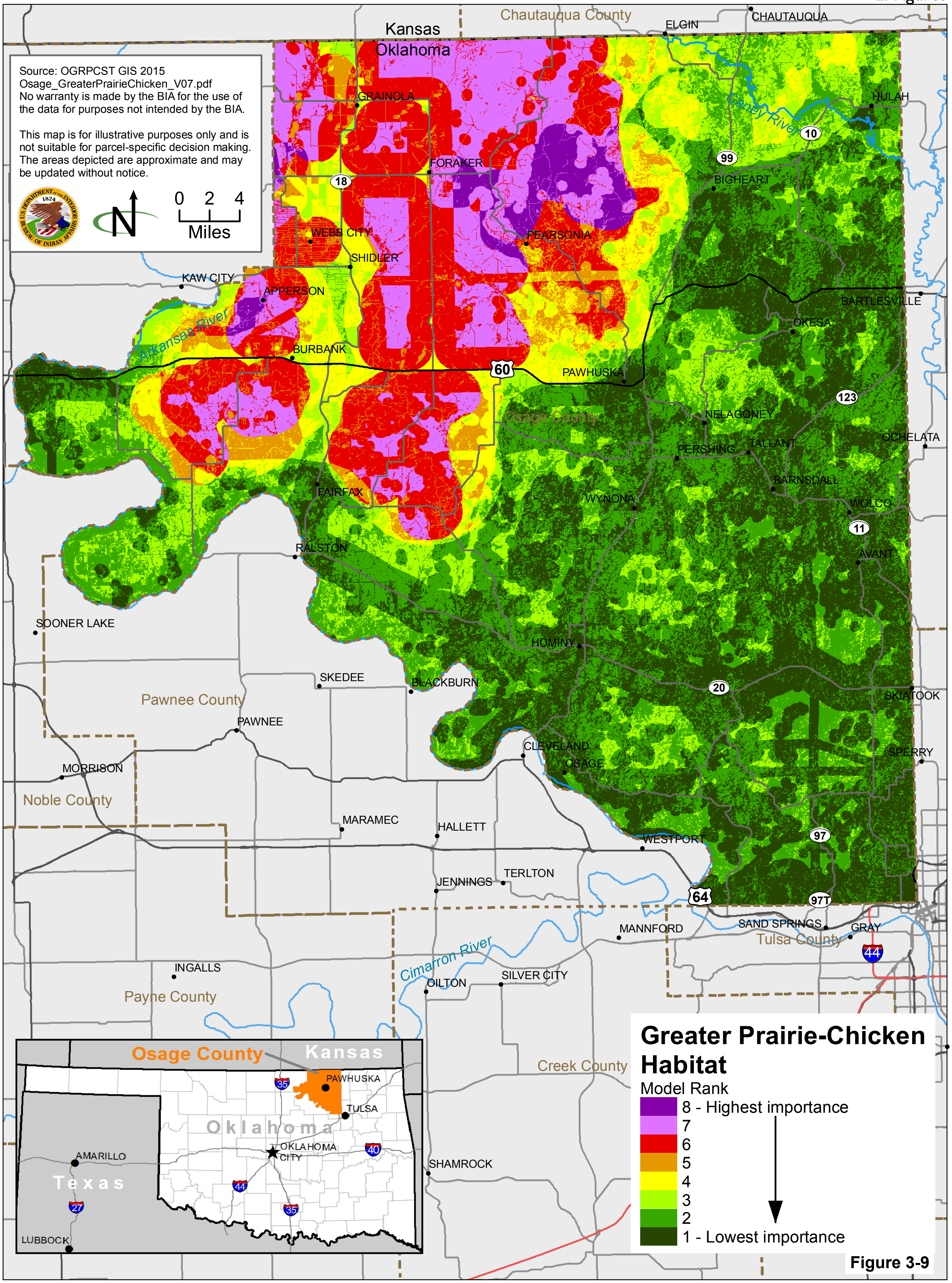
0 2 4
Miles
Kansas
Oklahoma
Chautauqua County
ELGIN
CHAUTAUQUA
Kaw Lake
GRAINOLA
HULAH
10
99
Caney
BIGHEART
FORAKER
18
WEBB CITY
PEARSONIA
SHIDLER
KAW CITY
APPERSON
Arkansas River
BURBANK
BARTLESVILLE
OKESA
60
PAWHUSKA
123
Osage County
NELAGONEY
OCHELATA
PERSHING
TALLANT
BARNSDALL
FAIRFAX
WYNONA
WOLCO
11
Bird
RALSTON
AVANT
Black Bear-Red Rock
SOONER LAKE
HOMINY
SKEDEE
BLACKBURN
SKIATOOK
20
PAWNEE
CLEVELAND
SPERRY
OSAGE
Pawnee County
Noble County
MORRISON
MARAMEC
HALLETT
97
WESTPORT
JENNINGS
TERLTON
64
97T
Lower Cimarron
SAND SPRINGS
GRAY
MANNFORD
44
Tulsa County
Polecat-Snake
SILVER CITY
Cimarron River
INGALLS
Payne County
OILTON
Osage County
Kansas
PAWHUSKA
35
TULSA
Oklahoma
OKLAHOMA CITY
40
AMARILLO
Texas
44
27
35
LUBBOCK
Creek
SHAMROCK
Hydrologic Features
303(d) impaired stream or waterbody
Floodplain:1% chance of flood event being equaled or exceeded in any year
Hydrologic Unit Code level 8

Figure 3-7

Figure 3-8
Ground Level Ozone Trend (1996–2016)



Source: INCOG and OK DEQ 2017



Source: OGRPCST GIS 2015
Osage_GreaterPrairieChicken_V07.pdf
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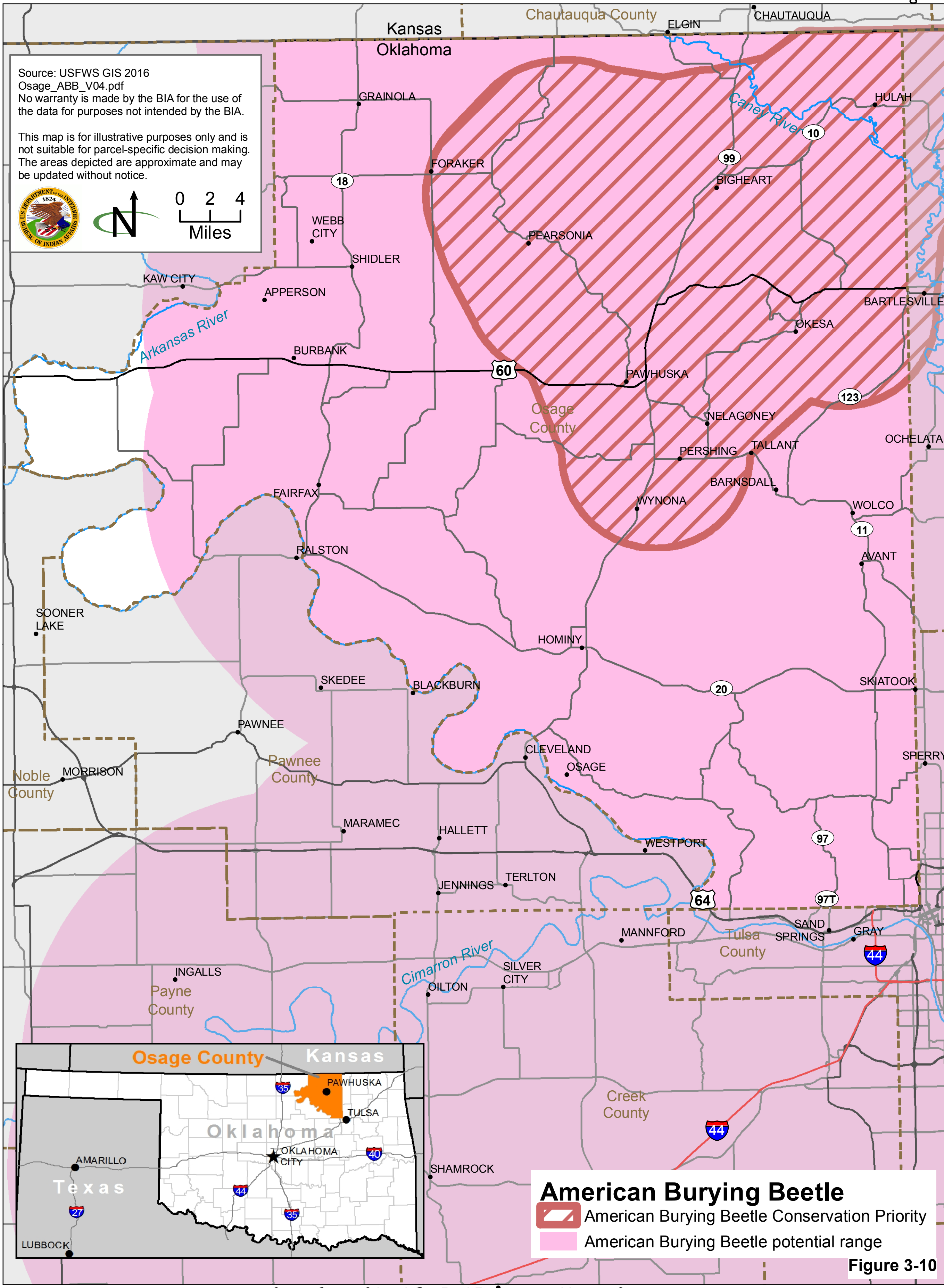
0 2 4
Miles
Kansas
Oklahoma
Chautauqua County
Osage County
Pawnee County
Noble County
Payne County
Creek County
Tulsa County
Arkansas River
Caney River
Cimarron River
Greater Prairie-Chicken Habitat
Model Rank
8 - Highest importance
7
6
5
4
3
2
1 - Lowest importance
Texas
Oklahoma
PAWHUSKA
TULSA
OKLAHOMA CITY
AMARILLO
LUBBOCK

Figure 3-9



Source: USFWS GIS 2016
Osage_ABB_V04.pdf
No warranty is made by the BIA for the use of the data for purposes not intended by the BIA.
This map is for illustrative purposes only and is not suitable for parcel-specific decision making. The areas depicted are approximate and may be updated without notice.
0 2 4
Miles
Kansas
Oklahoma
Chautauqua County
ELGIN
CHAUTAUQUA
GRAINOLA
HULAH
Caney River
FORAKER
BIGHEART
WEBB CITY
SHIDLER
PEARSONIA
KAW CITY
APPERSON
BARTLESVILLE
OKESA
Arkansas River
BURBANK
PAWHUSKA
Osage County
NELAGONEY
OCHELATA
PERSHING
TALLANT
FAIRFAX
BARNSDALL
WYNONA
WOLCO
RALSTON
AVANT
SOONER LAKE
HOMINY
SKEDEE
BLACKBURN
SKIATOOK
PAWNEE
CLEVELAND
OSAGE
SPERRY
Pawnee County
Noble County
MORRISON
MARAMEC
HALLETT
WESTPORT
JENNINGS
TERLTON
MANNFORD
Tulsa County
SAND SPRINGS
GRAY
INGALLS
Payne County
Cimarron River
SILVER CITY
OILTON
Creek County
SHAMROCK
Osage County
Kansas
PAWHUSKA
TULSA
Oklahoma
OKLAHOMA CITY
AMARILLO
Texas
LUBBOCK
American Burying Beetle
American Burying Beetle Conservation Priority
American Burying Beetle potential range
Figure 3-10

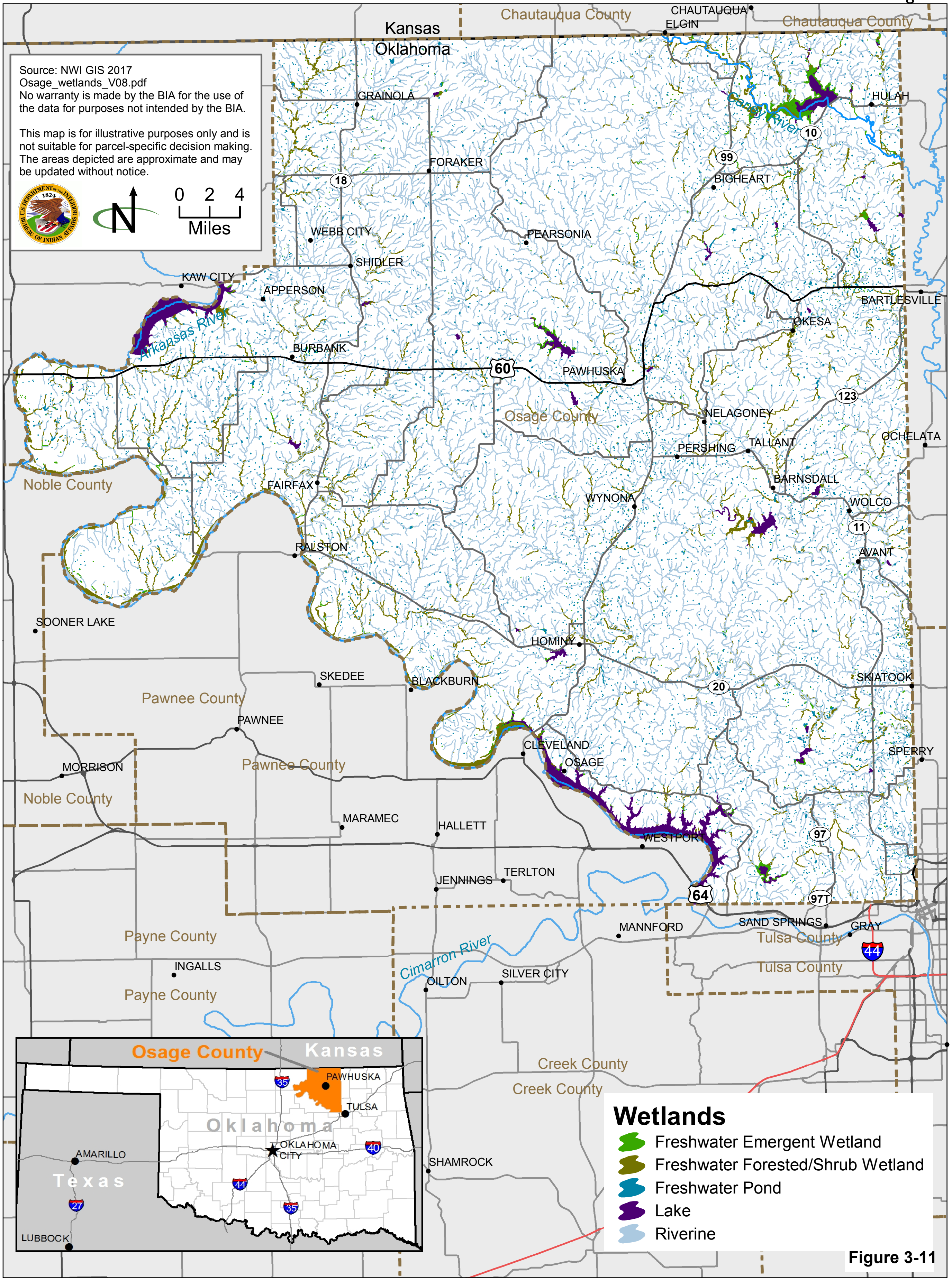
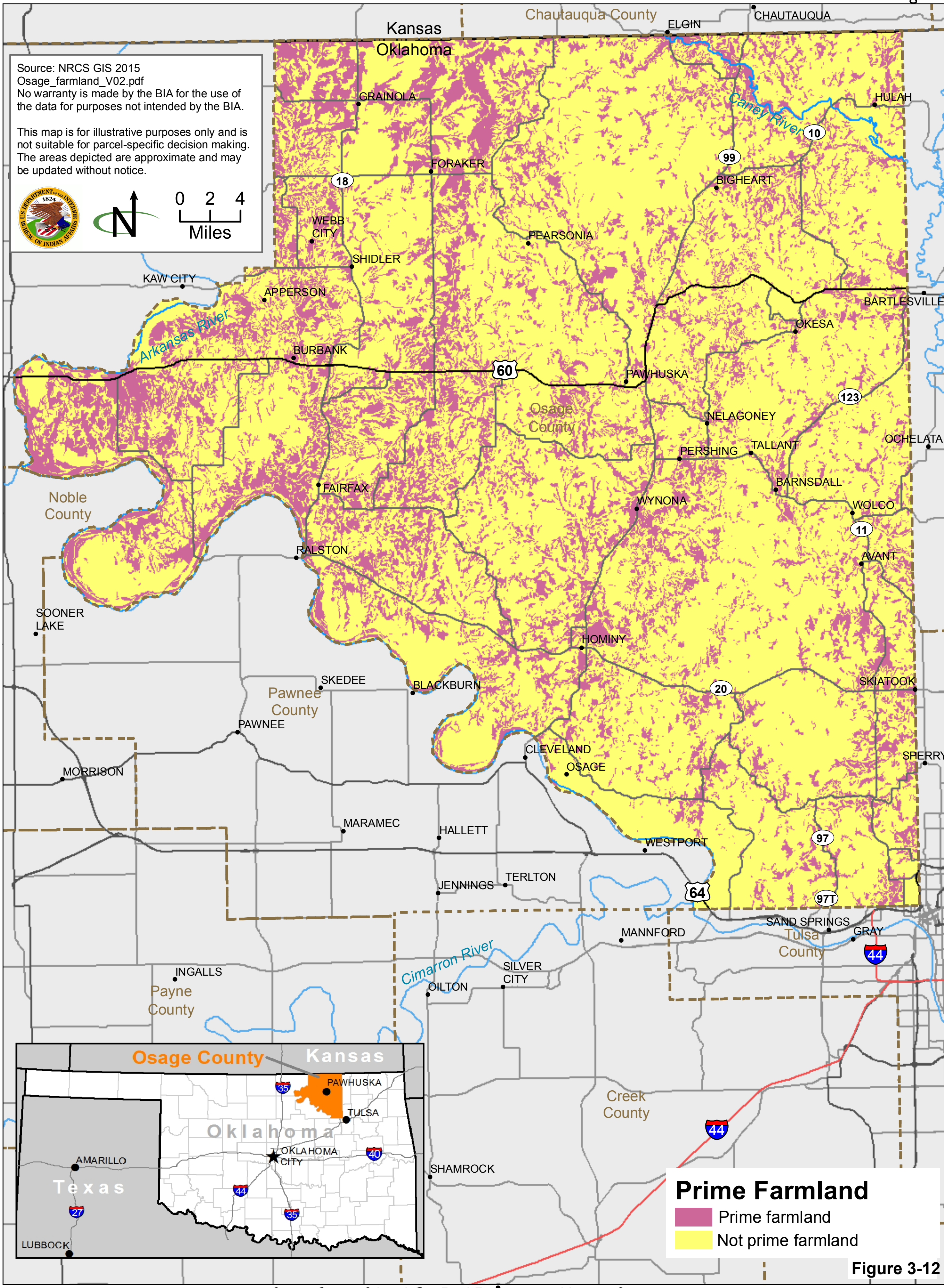

Source: NWI GIS 2017
Osage_wetlands_V08.pdf
No warranty is made by the BIA for the use of the data for purposes not intended by the BIA.
This map is for illustrative purposes only and is not suitable for parcel-specific decision making. The areas depicted are approximate and may be updated without notice.
0 2 4
Miles
Kansas
Oklahoma
Chautauqua County
CHAUTAUQUA
ELGIN
HULAH
Caney River
GRAINOLA
FORAKER
BIGHEART
PEARSONIA
WEBB CITY
SHIDLER
KAW CITY
APPERSON
Arkansas River
BURBANK
PAWHUSKA
BARTLESVILLE
OKESA
Osage County
NELAGONEY
PERSHING
TALLANT
OCHELATA
BARNSDALL
WOLCO
AVANT
Noble County
FAIRFAX
WYNONA
RALSTON
SOONER LAKE
HOMINY
SKEDEE
BLACKBURN
SKIATOOK
Pawnee County
PAWNEE
CLEVELAND
OSAGE
SPERRY
MORRISON
MARAMEC
HALLETT
WESTPORT
JENNINGS
TERLTON
MANNFORD
SAND SPRINGS
GRAY
Tulsa County
Payne County
INGALLS
Cimarron River
OILTON
SILVER CITY
Creek County
SHAMROCK
Osage County
Kansas
Oklahoma
TULSA
OKLAHOMA CITY
AMARILLO
Texas
LUBBOCK
Wetlands
Freshwater Emergent Wetland
Freshwater Forested/Shrub Wetland
Freshwater Pond
Lake
Riverine

Figure 3-11


Source: NRCS GIS 2015
Osage_farmland_V02.pdf
No warranty is made by the BIA for the use of the data for purposes not intended by the BIA.
This map is for illustrative purposes only and is not suitable for parcel-specific decision making. The areas depicted are approximate and may be updated without notice.
0 2 4
Miles
Kansas
Oklahoma
Chautauqua County
ELGIN
CHAUTAUQUA
GRAINOLA
HULAH
Caney River
FORAKER
BIGHEART
WEBB CITY
SHIDLER
PEARSONIA
KAW CITY
APPERSON
BARTLESVILLE
OKESA
Arkansas River
BURBANK
PAWHUSKA
Osage County
NELAGONEY
PERSHING
TALLANT
OCHELATA
BARNSDALL
FAIRFAX
Noble County
WYNONA
WOLCO
RALSTON
AVANT
SOONER LAKE
HOMINY
SKEDEE
Pawnee County
BLACKBURN
SKIATOOK
PAWNEE
CLEVELAND
OSAGE
SPERRY
MORRISON
MARAMEC
HALLETT
WESTPORT
JENNINGS
TERLTON
SAND SPRINGS
GRAY
MANNFORD
Tulsa County
Cimarron River
INGALLS
SILVER CITY
OILTON
Payne County
Osage County
Kansas
PAWHUSKA
TULSA
Oklahoma
OKLAHOMA CITY
AMARILLO
Texas
LUBBOCK
Creek County
SHAMROCK
Prime Farmland
Prime farmland
Not prime farmland
Figure 3-12

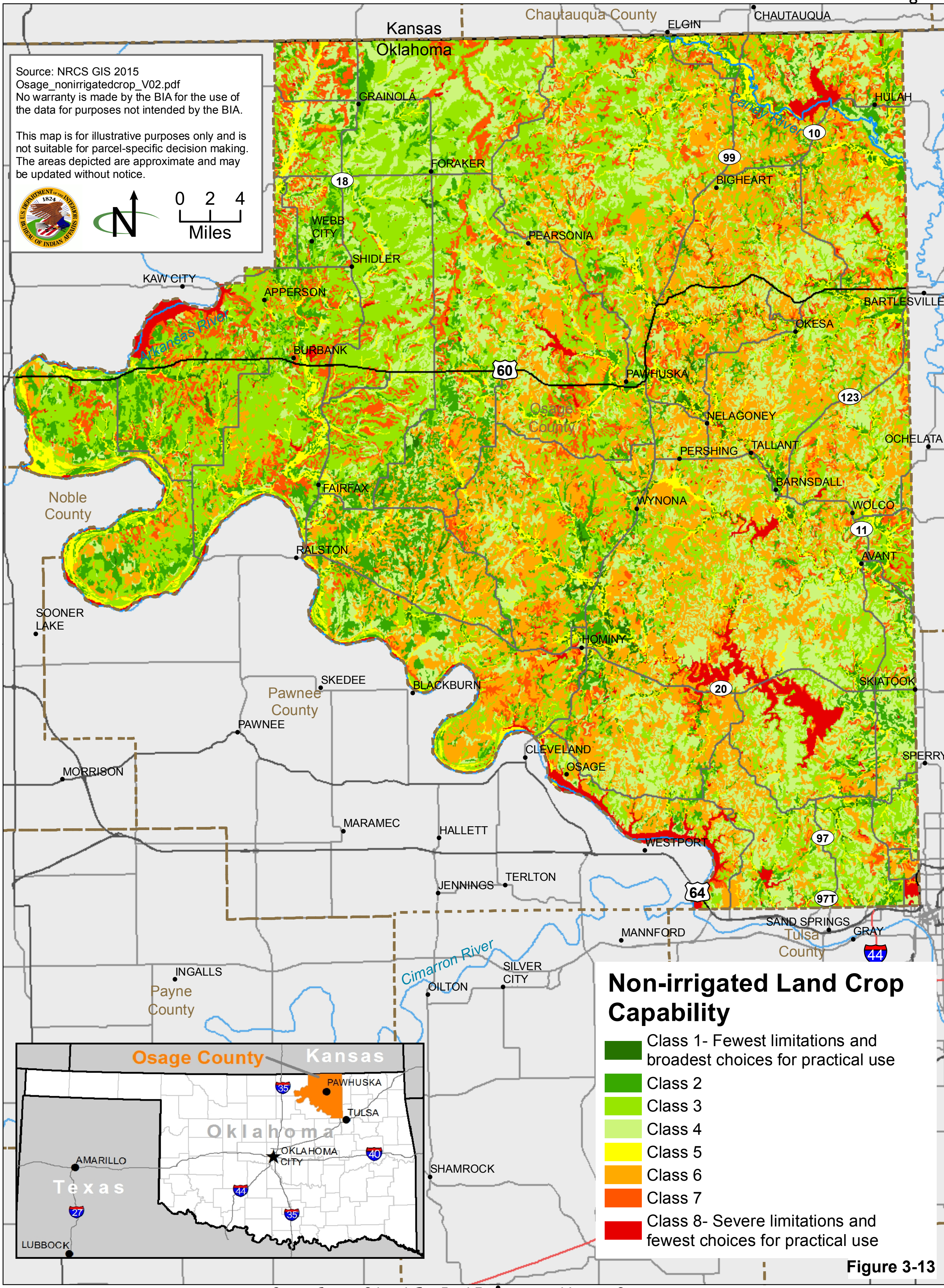

Source: NRCS GIS 2015
Osage_nonirrigatedcrop_V02.pdf
No warranty is made by the BIA for the use of the data for purposes not intended by the BIA.
This map is for illustrative purposes only and is not suitable for parcel-specific decision making. The areas depicted are approximate and may be updated without notice.
0 2 4
Miles
Kansas
Oklahoma
Chautauqua County
ELGIN
CHAUTAUQUA
GRAINOLA
HULAH
Caney River
10
99
BIGHEART
FORAKER
18
WEBB CITY
PEARSONIA
SHIDLER
KAW CITY
APPERSON
BARTLESVILLE
OKESA
Arkansas River
BURBANK
60
PAWHUSKA
123
NELAGONEY
Osage County
OCHELATA
PERSHING
TALLANT
BARNSDALL
Noble County
FAIRFAX
WYNONA
WOLCO
11
RALSTON
AVANT
SOONER LAKE
HOMINY
SKIATOOK
SKEDEE
Pawnee County
BLACKBURN
20
PAWNEE
CLEVELAND
SPERRY
OSAGE
MORRISON
MARAMEC
HALLETT
WESTPORT
97
JENNINGS
TERLTON
64
97T
SAND SPRINGS
GRAY
Tulsa County
MANNFORD
44
Cimarron River
INGALLS
SILVER CITY
Payne County
OILTON
Osage County
Kansas
PAWHUSKA
TULSA
Oklahoma
OKLAHOMA CITY
AMARILLO
Texas
LUBBOCK
35
40
44
27
SHAMROCK
Non-irrigated Land Crop Capability
Class 1- Fewest limitations and broadest choices for practical use
Class 2
Class 3
Class 4
Class 5
Class 6
Class 7
Class 8- Severe limitations and fewest choices for practical use

Figure 3-13

Figure 3-14
Mining Employment 1998–2014

Source: US Census Bureau, as reported in Headwaters Economics 2017

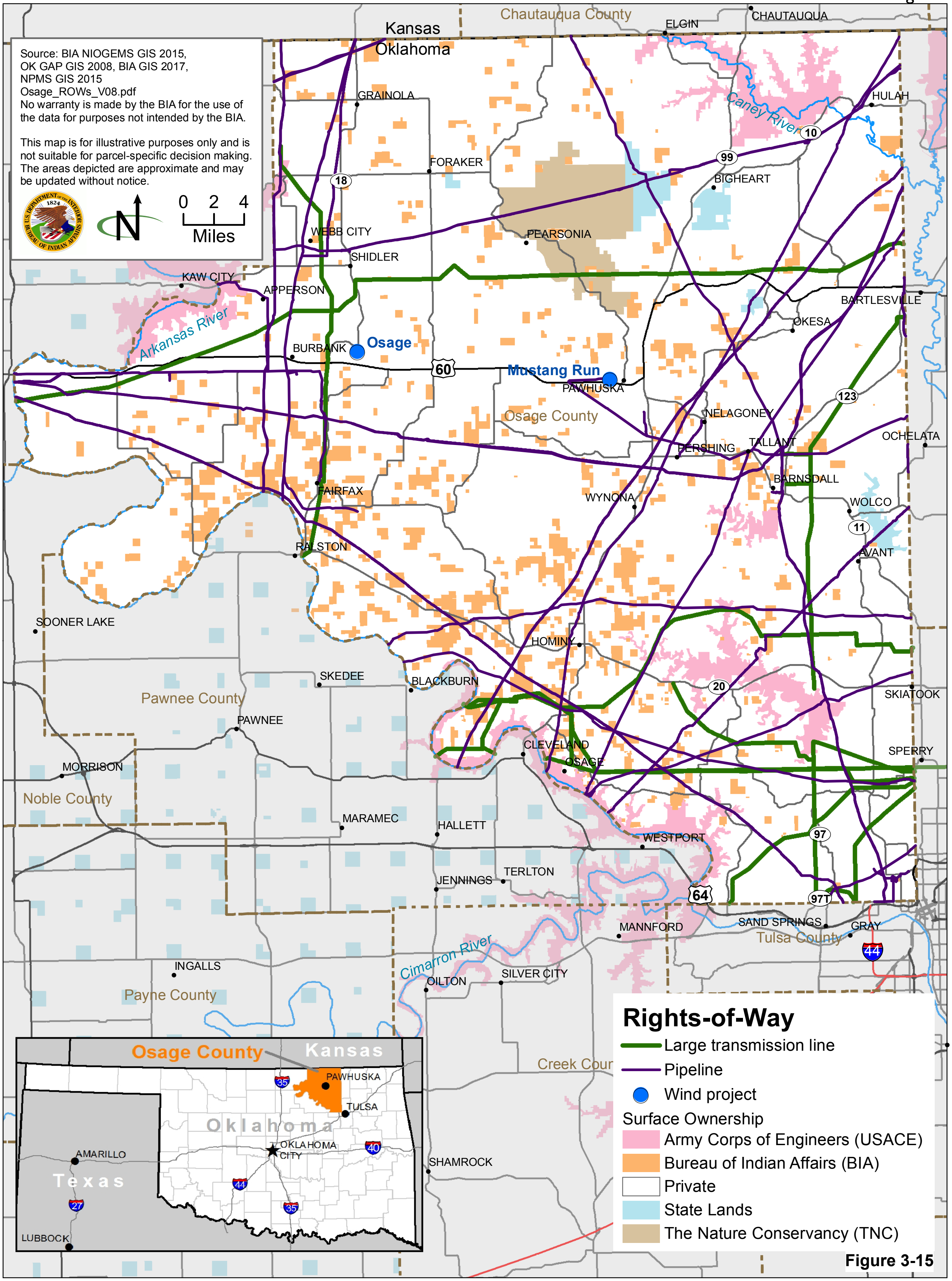

Source: BIA NIOGEMS GIS 2015, OK GAP GIS 2008, BIA GIS 2017, NPMS GIS 2015
Osage_ROWs_V08.pdf
No warranty is made by the BIA for the use of the data for purposes not intended by the BIA.
This map is for illustrative purposes only and is not suitable for parcel-specific decision making. The areas depicted are approximate and may be updated without notice.
0 2 4
Miles
Kansas
Oklahoma
Chautauqua County
Osage County
Pawnee County
Noble County
Payne County
Tulsa County
Creek County
Arkansas River
Caney River
Cimarron River
Osage
Mustang Run
Rights-of-Way
Large transmission line
Pipeline
Wind project
Surface Ownership
Army Corps of Engineers (USACE)
Bureau of Indian Affairs (BIA)
Private
State Lands
The Nature Conservancy (TNC)
Osage County
Kansas
Oklahoma
Texas
PAWHUSKA
TULSA
OKLAHOMA CITY
AMARILLO
LUBBOCK

Figure 3-15

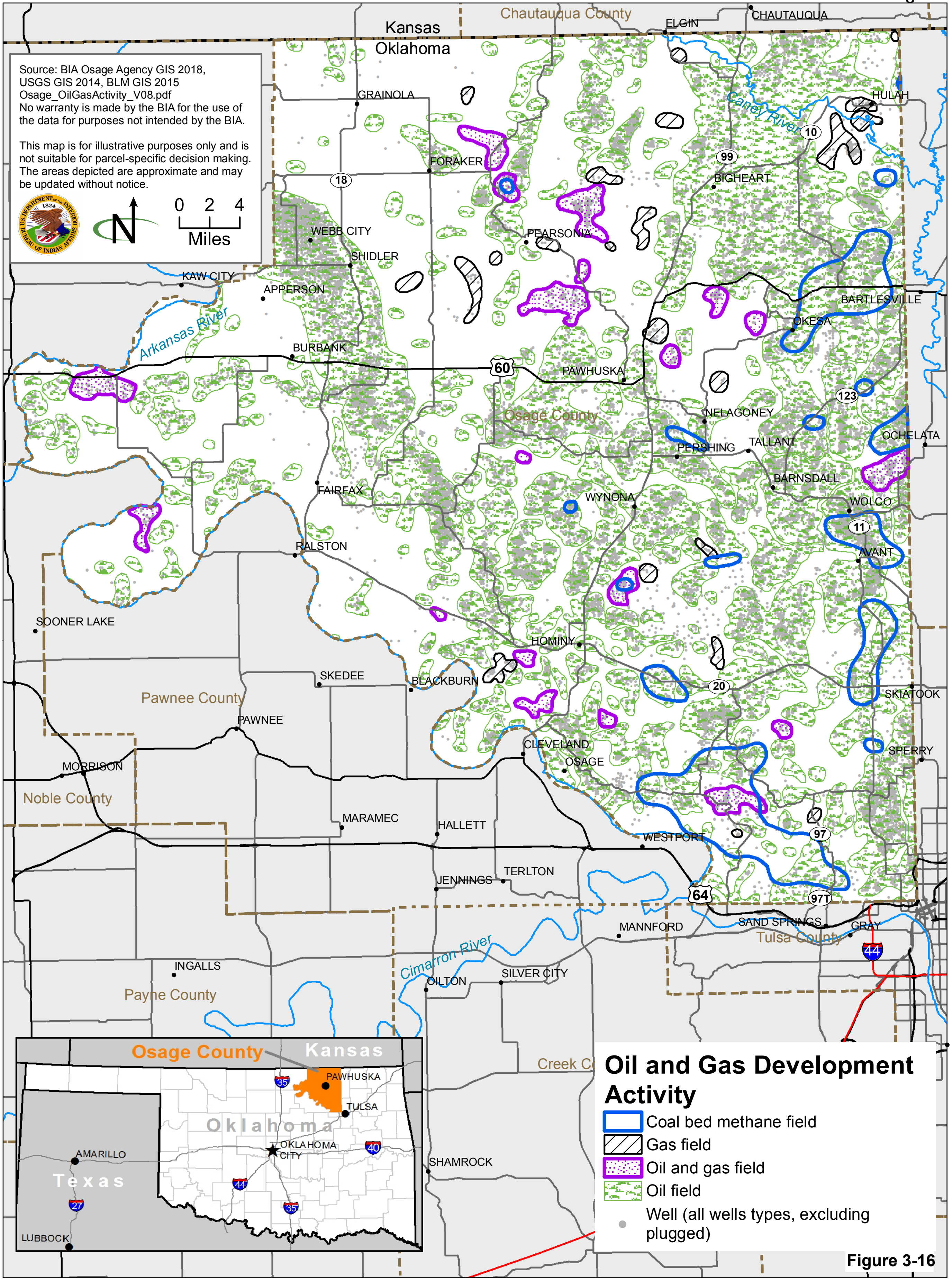

Source: BIA Osage Agency GIS 2018, USGS GIS 2014, BLM GIS 2015
Osage_OilGasActivity_V08.pdf
No warranty is made by the BIA for the use of the data for purposes not intended by the BIA.
This map is for illustrative purposes only and is not suitable for parcel-specific decision making. The areas depicted are approximate and may be updated without notice.
0 2 4
Miles
N
Oil and Gas Development Activity
Coal bed methane field
Gas field
Oil and gas field
Oil field
Well (all wells types, excluding plugged)
Kansas
Oklahoma
Chautauqua County
Osage County
Pawnee County
Noble County
Payne County
Tulsa County
Creek Co
Arkansas River
Caney River
Cimarron River
ELGIN
CHAUTAUQUA
HULAH
GRAINOLA
FORAKER
BIGHEART
PEARSONIA
WEBB CITY
SHIDLER
KAW CITY
APPERSON
BARTLESVILLE
OKESA
BURBANK
PAWHUSKA
NELAGONEY
PERSHING
TALLANT
OCHELATA
BARNSDALL
WOLCO
FAIRFAX
WYNONA
RALSTON
AVANT
SOONER LAKE
HOMINY
SKEDEE
BLACKBURN
SKIATOOK
PAWNEE
CLEVELAND
OSAGE
SPERRY
MORRISON
MARAMEC
HALLETT
WESTPORT
JENNINGS
TERLTON
SAND SPRINGS
GRAY
MANNFORD
INGALLS
OILTON
SILVER CITY
SHAMROCK
10
99
18
60
123
11
20
97
97T
64
44
Osage County
Kansas
PAWHUSKA
TULSA
Oklahoma
OKLAHOMA CITY
AMARILLO
Texas
LUBBOCK
35
40
44
27

Figure 3-16

Appendix F
List of Preparers

Appendix F. List of Preparers

Name	Role/Responsibility
BIA Interdisciplinary Team	
Lisa Atwell	Program Support Assistant, Division of Environmental and Cultural Resource Management, Eastern Oklahoma Region
Richard Beaty	Archaeologist, Osage Agency
Benjamin Daniels	Supervisory Environmental Protection Specialist, Osage Agency (Former)
Jeannine Hale	Regional Environmental Protection Specialist, Division of Environmental and Cultural Resource Management, Eastern Oklahoma Region (Retired)
Mosby Halterman	Project Lead; Regional Environmental Scientist, Division of Environmental and Cultural Resource Management, Eastern Oklahoma Region
Shelby Hanchera	Environmental Protection Specialist, Osage Agency
Deborah Kirk	GIS Specialist, Osage Agency
Sierra Mandelko	Archaeologist, Eastern Oklahoma Region (Former)
Michael Miley	Environmental Protection Specialist, Division of Environmental and Cultural Resource Management, Eastern Oklahoma Region
Robin Phillips	Superintendent, Osage Agency
Richard Winlock	Acting Deputy Superintendent, Osage Agency
Department of the Interior	
Kristen Kokinos	Attorney-Advisor, Office of the Solicitor
Stephen Simpson	Senior Attorney, Office of the Solicitor
EMPSi Interdisciplinary Team	
Jordan Adams	Topography, Geology, Paleontology, and Soils; Agriculture
David Batts	Program Manager
Amy Cordle	Air Quality and Climate
Sean Cottle	Land Use Plans, Utilities, and Timber Harvesting; Recreation and Special Use Areas
Francis Craig	Topography, Geology, Paleontology, and Soils; Public Health and Safety; Mineral Extraction
Annie Daly	Air Quality and Climate; Public Health and Safety
Kevin Doyle	Historical, Cultural, and Archaeological Resources; Agriculture
Zoe Ghali	Socioeconomics and Environmental Justice
Peter Gower	Land Use Plans, Utilities, and Timber Harvesting; Traffic and Transportation
Haley Holladay	Vegetation, Wetlands, and Noxious Weeds
Derek Holmgren	Water Resources; Noise
Jenna Jonker	GIS/eGIS Lead
Kate Krebs	Visual Resources
Molly McCarter	Deputy Project Manager; Visual Resources; Noise; Quality Assurance and Quality Control
Laura Patten	Water Resources
Katie Patterson	Project Manager; Water Resources; Mineral Extraction

Name	Role/Responsibility
Holly Prohaska	Interim Project Manager; QAQC
Kevin Rice	Fish and Wildlife
Andy Spellmeyer	Fish and Wildlife; Special Status Species
Morgan Trieger	Vegetation, Wetlands, and Noxious Weeds
Drew Vankat	Public Health and Safety; Traffic and Transportation; Recreation, and Special Use Areas
Liza Wozniak	Special Status Species
Meredith Zaccherio	Fish and Wildlife; Vegetation, Wetlands, and Noxious Weeds; Special Status Species
Jennifer Thies	NEPA specialist; QAQC
Amanda Tuttle	Record of Decision Lead; QAQC

Appendix G

References

Appendix G. References

Abbott, M. M. 2000. Water Quality of the Quaternary and Ada-Vamoosa Aquifers on the Osage Reservation, Osage County, Oklahoma, 1997: US Geological Survey Water-Resources Investigations Report 99-4231.

Aldridge, C. L., & Boyce, M. S. 2007. Linking Occurrence and Fitness to Persistence: Habitat-Based Approach for Endangered Greater Sage-Grouse. Ecological Applications, 17(2), 508-526.

Alley, William. 2014. Hydraulic fracturing: Meeting the nation's energy needs while protecting groundwater resources. National Groundwater Association Position Paper.

America's Scenic Byways. 2015. Osage Nation Heritage Trail Byway. Internet website: http://scenicbyways.info/byway/74113.html.

American Society of Mammalogists. 2015. State-specific lists of indigenous mammals. Internet website: http://www.mammalsociety.org/mammals-list.

American Speech-Language-Hearing Association. 2018. Loud Noise Dangers. Internet website: http://www.asha.org/content.aspx?id=10737441099.

Annie E. Casey Foundation. 2014. Kids Count. 2014 Data Book: trends in child well-being. Internet website: https://www.aecf.org/2014db.

APLIC (Avian Power Line Interaction Committee). 2012. Reducing Avian Collisions with Power Lines. The state of the Art in 2012. Edison Electric Institute. Internet website: https://www.aplic.org/uploads/files/15518/Reducing_Avian_Collisions_2012watermarkLR.pdf.

AWWA (American Water Works Association). 2013. Water and hydraulic fracturing: A white paper from the American Water Works Association. Internet website: https://pdfs.semanticscholar.org/c1e0/3eb71a8baa400f64ceea7d72fec6c35ea1a9.pdf.

Belnap, J., R. Prasse and K. T. Harper. 2001. Influence of Biological Soil Crusts on Soil Environments and Vascular Plants. Ecological Studies, 2001, Volume 150, Part IV, 281-300, DOI: 10.1007/978-3-642-56475-8_21.

BIA (United States Department of the Interior, Bureau of Indian Affairs). 1979. Environmental Assessment for the Oil and Gas Leasing Program of the Osage Indian Tribe, Osage County, Oklahoma. Muskogee Area Office. Muskogee, Oklahoma. May 1979.

______. 2009. Regional 10-Year Fire Management Plan 2010-2020. Eastern Oklahoma Regional Office, Division of Environmental, Safety, and Cultural Resources Management. Muskogee, Oklahoma.

______. 2012. Indian Affairs National Environmental Policy Act (NEPA) Guidebook. 59 IAM 3-H. Reston, Virginia. August 2012.

______. 2013. Environmental Assessment Report for the Flanagan South Pipeline Project. Prepared by URS. December 24, 2013.

______. 2014. Programmatic Environmental Assessment for Leasing Activities. BIA Osage Agency. Pawhuska, Oklahoma.

______. 2015. Programmatic Environmental Assessment for Approving Workover Operations. BIA Osage Agency. Pawhuska, Oklahoma.

______. 2016. Osage County Oil and Gas Scoping Summary Report. BIA Eastern Oklahoma Region, Osage Agency. September 2016. Internet website: https://www.bia.gov/sites/bia.gov/files/assets/public/pdf/idc2-048210.pdf .

______. 2017a. Standard Best Management Practices (BMP) Drilling Permits and Standard Best Management Practices (BMP) Workover/Plugging Permits. Osage Oil and Gas Environmental Impact Statement. Internet website: https://www.bia.gov/regional-offices/eastern-oklahoma/osage-agency/osage-oil-and-gas-eis.

______. 2017b. BIA Production Report. Oil, Gas and 214 Minerals. Years 2015-2016.

______. 2017c. BIA Osage Agency Spills Tracking Spreadsheet.

BIA GIS. 2017. GIS data created by or for the use of the BIA for the completion of the Osage Oil and Gas EIS. Data used to support the alternatives, affected environment, impact analysis, or other document features. Data updated throughout the project life and available upon request.

BIA NIOGEMS GIS. 2015. GIS data of BIA-administered tribal and allotted lands. Bureau of Indian Affairs, Southern Plains and Eastern Oklahoma Regions.

BIA Osage Agency. 2020. Production records. Data received from BIA April 2020.

BIA Osage Agency GIS. 2018. Osage Agency wellbore plat book and GIS data. Data received from BIA March 2018.

Bingham, R. H., and D. L. Bergman. 1980. Reconnaissance of the Water Resources of the Enid Quadrangle North-central Oklahoma: Oklahoma Geological Survey, Hydrologic Atlas 7.

Birdsell, D. T., H. Rajaram, D. Dempsey, H. S. Viswanathan. 2015. Hydraulic fracturing fluid migration in the subsurface: A review and expanded modeling results. *Water Resources Research*, 51, 7159-7188, doi:10.1002/2015WR017810. Accepted July 2015.

BLM (United States Department of the Interior, Bureau of Land Management). 1984. Manual 8400—Visual Resource Management. Rel. 8-24. Washington, DC. April 5, 1984.

______. 1986. Handbook H-8410-1—Visual Resource Inventory. Rel. 8-28. BLM, Washington, DC. January 17, 1986.

______. 2016a. Air Resources Technical Report for Oil and Gas Development, New Mexico, Oklahoma, Texas, and Kansas. BLM, New Mexico State Office. January 2016.

______. 2016b. Reasonable Foreseeable Development (RFD) for Oil and Gas, Minerals, Geothermal, Wind and Solar Resources in Kansas, Oklahoma and Texas. BLM Oklahoma Field Office. December 5, 2016.

BLM and BIA (United States Department of the Interior, Bureau of Land Management and Bureau of Indian Affairs). 2014. Oklahoma Field Office Resource Management Plan Revision and Environmental Impact Statement Final Scoping Summary Report. BLM Oklahoma Field Office, Tulsa.

______. 2019. Oklahoma, Kansas, and Texas Final Joint EIS/Proposed BLM RMP and BIA Integrated RMP. BLM Oklahoma Field Office, Norman.

BLM and Forest Service (United Stated Department of the Interior, Bureau of Land Management, and United States Department of Agriculture, Forest Service). 2007. Surface operating standards and guidelines for oil and gas exploration and development: The Gold Book. Fourth edition.

BLM GIS. 2015. GIS data of oil and gas potential as provided by the BLM in the Reasonably Foreseeable Development Scenario. Bureau of Land Management, Oklahoma Field Office.

______. 2016. GIS data of Visual Resource Inventory and components. Bureau of Land Management, Oklahoma Field Office.

Brownlow, J.,J.C. Yelderman, Jr., S.C. James. 2016. Spatial Risk of Analysis of Hydraulic Fracturing near Abandoned and Converted Oil and Gas Wells. *Ground Water*. DOI:10:1111/gwat.12471, September 2016.

Bureau of Labor Statistics. 2016. CPI conversion calculator. Internet website: https://www.bls.gov/data/inflation_calculator.htm.

______. 2020. Local Area Unemployment Statistics. Osage County. Internet website: https://data.bls.gov/cgi-bin/dsrv?la.

Cameron Siler. 2017. Chytrid fungus found on amphibians in Oklahoma. Internet website: http://cameronsiler.com/chytrid-fungus-found-on-amphibians-in-oklahoma/.

CEQ (Council on Environmental Quality). 1997. Environmental Justice: Guidance Under the National Environmental Policy Act. Internet website: https://www.epa.gov/environmentaljustice/ceq-environmental-justice-guidance-under-national-environmental-policy-act.

______. 2010. Memorandum for Heads of Federal Departments and Agencies: Establishing, Applying, and Revising Categorical Exclusions under the National Environmental Policy Act. Washington, DC. November 23, 2010. Internet website: https://www.energy.gov/sites/prod/files/nepapub/nepa_documents/RedDont/G-CEQ-CatEx_guidance.pdf.

Ceres. 2014. Hydraulic Fracturing and Water Stress: Water Demand by the Numbers. Internet website: https://www.ceres.org/resources/reports/hydraulic-fracturing-water-stress-water-demand-numbers.

Clement, J. P., A. d'A. Belin, M. J. Bean, T. A. Boling, and J. R. Lyons. 2014. A strategy for improving the mitigation policies and practices of the Department of the Interior. A Report to the Secretary of the Interior from the Energy and Climate Change Task Force. April 2014.

Coleman, J. 2014. "White-nose syndrome the devastating disease of hibernating bats in North America." US Fish and Wildlife Publications. Paper 453.

Cosic, Biljana, and Krish Vijayaraghavan. 2016. GHG Emissions and Climate Change for the BLM-BIA Regional Management Plan/Environmental Impact Statement for Kansas-Oklahoma-Texas. Prepared for the BLM New Mexico State Office, Santa Fe, and the BLM National Operations Center, Denver, Colorado. September 2016.

Cowardin, L. M., V. Carter, F. Golet, and E. LaRoe. 1979. Classification of Wetlands and Deepwater Habitats of the United States. US Department of the Interior, Fish and Wildlife Service, Washington, DC. Jamestown, North Dakota: Northern Prairie Wildlife Research Center Online. Internet website: https://www.fws.gov/wetlands/documents/classwet/index.html (Version 04DEC1998).

D'Lugosz, J. J., R. G. McClaflin, and M. V. Marcher. 1986. Geohydrology of the Vamoosa-Ada Aquifer East-Central Oklahoma: Oklahoma Geological Survey Circular 87.

Daniels, Mike, Brian Haggard, and Andrew Sharpley. Undated. Arkansas Watersheds. University of Arkansas Division of Agriculture, Cooperative Extension Service.

DOI (United States Department of the Interior). 2015. Osage Nation Becomes 20th Tribe to Partner with Interior to Implement the Land Buy-Back Program, Press Release. May 28, 2015 Office of the Secretary, Internet Website: https://www.doi.gov/pressreleases/osage-nation-becomes-20th-tribe-to-partner-with-interior-to-implement-the-land-buy-back-program.

______. 2016. Visual Resource Inventory Report. Bureau of Land Management Oklahoma Field Office and Amarillo Field Office. Bureau of Indian Affairs Southern Plains Region and Eastern Oklahoma Region. April 2016. Tulsa, Oklahoma.

Duck, L. G., and J. B. Fletcher. 1943. The Game Types of Oklahoma. A Report to the Oklahoma Game and Fish Commission. Adapted by the Oklahoma Biological Survey. Internet website: http://obsvweb1.ou.edu/duckflt/tabcont.html.

Earthworks. 2015. Oil and Gas Noise. Internet website: https://earthworks.org/issues/oil_and_gas_noise/.

eBird. 2017. Tallgrass Prairie Preserve, First Sightings, 1994-2017. Internet website: http://ebird.org/ebird/sightings?locInfo.regionType=hotspot&locInfo.regionCode=L275551&locInfo.parentCode=US-OK&continuous=true&listType=first.

Energy Information Administration. 2014. Annual Energy Outlook 2014. pp. A-25 to A-27. Internet website: http://www.eia.gov/forecasts/aeo/pdf/appa.pdf.

______. 2020a. Petroleum & Other Liquids Spot Prices. Internet website: https://www.eia.gov/dnav/pet/pet_pri_spt_s1_m.htm.

______. 2020b. Natural Gas Spot and Futures Prices (NYMEX). Internet website: https://www.eia.gov/dnav/ng/ng_pri_fut_s1_a.htm.

______. 2020c. Oklahoma Field Production of Crude Oil. Internet website: https://www.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=pet&s=mcrfpok1&f=a.

______. 2020d. Oklahoma Natural Gas Marketed Production. Internet website: https://www.eia.gov/dnav/ng/hist/n9050ok2a.htm.

Environmental Laboratory. 1987. 1987 Corps of Engineers Wetlands Delineation Manual. Technical Report Y-87-1, US Army Corps of Engineers Waterways Experiment Station, Vicksburg, Mississippi. January 1987.

EPA (United States Environmental Protection Agency). 1978. Protective Noise Levels. Condensed Version of EPA Levels Document. EPA 550/9-79-100. US Environmental Protection Agency. Office of Noise Abatement and Control. Washington, DC.

______. 2000. EPA Office of Compliance Sector Notebook Project: Profile of the Oil and Gas Extraction Industry. EPA/310-R-99-006. Washington, DC.

______. 2012. Ecoregions in Oklahoma. Internet website: http://www.epa.gov/wed/pages/ecoregions/ok_eco.htm.

______. 2013. 12-Month Finding on a Petition to List the Rattlesnake-Master Borer Moth (*Papaipema eryngii*) as an Endangered or Threatened Species. 78 FR 49422 49440.

______. 2015a. The Process of Hydraulic Fracturing. Internet website: http://www.epa.gov/hydraulicfracturing/process-hydraulic-fracturing.

______. 2015b. About Private Water Wells. Internet website: https://www.epa.gov/privatewells/about-private-water-wells.

______. 2015c. Impaired Waters and Total Maximum Daily Loads. Internet website: http://water.epa.gov/lawsregs/lawsguidance/cwa/tmdl/.

______. 2015d. Watershed, Assessment, Tracking and Environmental Results, Oklahoma 303(d) Listed Waters for Reporting Year 2012. Internet website: http://iaspub.epa.gov/waters10/attains_impaired_waters.impaired_waters_list?p_state=OK&p_cycle=2012.

______. 2015e. Guidance on Considering Environmental Justice During the Development of Regulatory Actions. May 2015. Internet website: https://www.epa.gov/sites/production/files/2015-06/documents/considering-ej-in-rulemaking-guide-final.pdf.

______. 2015f. CERCLA Overview. Internet website: http://www.epa.gov/superfund/policy/cercla.htm.

______. 2015g. Analysis of Hydraulic Fracturing Fluid Data from the FracFocus Chemical Disclosure Registry 1.0. Internet website: https://www.epa.gov/sites/production/files/2015-03/documents/fracfocus_analysis_report_and_appendices_final_032015_508_0.pdf.

______. 2015h. Assessment of the Potential Impacts of Hydraulic Fracturing for Oil and Gas on Drinking Water Resources. Internet website: https://www.epa.gov/sites/production/files/2015-06/documents/hf_es_erd_jun2015.pdf.

______. 2016a. Nonpoint Source Success Story: Delaware Creek. Internet website: https://www.epa.gov/sites/production/files/2016-10/documents/ok_delaware_creek_508.pdf.

______. 2016b. Climate Change Science. Internet website: https://19january2017snapshot.epa.gov/climate-change-science/future-climate-change_.html.

______. 2016c. Glossary of Climate Change Terms. Internet website: https://19january2017snapshot.epa.gov/climatechange/glossary-climate-change-terms_.html.

______. 2016d. What Climate Change Means for Oklahoma. Internet website: https://www.epa.gov/sites/production/files/2016-09/documents/climate-change-ok.pdf. August 2016.

______. 2016e. EPA's Study of Hydraulic Fracturing and Its Potential Impact on Drinking Water Resources. Internet website: https://www.epa.gov/hfstudy/hydraulic-fracturing-water-cycle.

______. 2017a. NAAQS Table. Internet website: https://www.epa.gov/criteria-air-pollutants/naaqs-table.

______. 2017b. Nonattainment Areas for Criteria Pollutants (Green Book). Internet website: https://www.epa.gov/green-book.

______. 2017c. Outdoor Air Quality, Monitor Values Report (Ozone Report in 2013-2015 for Tulsa County, Oklahoma). Internet website: https://www.epa.gov/outdoor-air-quality-data/monitor-values-report.

______. 2017d. Inventory of US Greenhouse Gas Inventory Report, 1990-2015. Internet website: https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks-1990-2015.

______. 2020. National Air Quality: Status and Trends of Key Air Pollutants. Internet website: https://www.epa.gov/air-trends.

EPA GIS. 2015. GIS data used to describe the 303d impaired waters. Environmental Protection Agency. Internet website: http://water.epa.gov/scitech/datait/tools/waters/data/downloads.cfm.

Fairfax Community Hospital. 2017. Information page. Internet website: https://www.fairfaxmed.com/.

FEMA GIS. 2013. GIS data of areas of high risk to flooding. Federal Emergency Management Agency. Data received via disc on October 2013.Forbes, W. T. 1954. Lepidoptera of New York and Neighboring State, Part II. Cornell University Agricultural Experiment Station, Ithaca, New York. (Cited in BIA 2017)

Forest Service (United States Department of Agriculture, Forest Service). 2012. Noxious Weed Risk Assessment, Giant Sequoia National Monument Management Plan. July 2012. 27 pp.

Gallegos, T. J., Brian A. Varela, Seth S. Haines, and Mark A. Engle. 2015. Hydraulic fracturing water use variability in the United States and potential environmental implications. Water Resources Research 51(7):5839–5845. July 2015.

GAO (United States Government Accountability Office). 2004. Natural Gas Flaring and Venting Opportunities to Improve Data and Reduce Emissions.

Getches-Wilkinson Center for Natural Resources, Energy, and the Environment. 2015. Water Quantity. University of Colorado Law School, Intermountain Oil and Gas BMP Project. Internet website: http://www.oilandgasbmps.org/resources/water_quantity.php.

Global Carbon Project. 2014. Carbon Budget 2014: An annual update of the global carbon budget and trends. Internet website: http://www.globalcarbonproject.org/index.htm.

GPNC (Great Plains Nature Center). 2012. American burying beetle *Nicrophorus americanus*. Internet website: https://gpnc.org/fauna/insects/american-burying-beetle/.

Grant, J., R. Parikh, K. Vijayaraghavan, and R. Morris. 2016a. Memorandum: Texas, Oklahoma, and Kansas Oil and Gas and Mining Sector Emissions. Prepared by Ramboll Environ, Novato, California. Developed for the BLM New Mexico State Office, Santa Fe. May 2016.

______. 2016b. Addendum to the Memorandum: Texas, Oklahoma, and Kansas Oil and Gas and Mining Sector Emissions. Developed by Ramboll Environ, Novato, California. Developed for Craig Nicholls, BLM National Operations Center. May 2016.

Hammerson, G.A. 2007. *Phrynosoma cornutum*. The IUCN Red List of Threatened Species 2007: e. T64072A12741535. http://dx.doi.org/10.2305/IUCN.UK.2007.RLTS.T64072A12741535.en.

Harrington, B. 2001. “Red knot (*Calidris canutus*).” In *The birds of North America*. No. 563 (A. Poole, editor). The Academy of Natural Sciences, Washington, DC, and the American Ornithologists’ Union, Philadelphia, Pennsylvania; doi:10.2173/bna.563. (Cited in BIA 2017)

Hays, J., M. McCawley, and S. B. C. Shonkoff. 2017. “Public health implications of environmental noise associated with unconventional oil and gas development.” *Science of The Total Environment* 580: 448–456. February 2017. Internet website: https://www.sciencedirect.com/science/article/pii/S0048969716325724.

Headwaters Economics. 2017. Economic Profile System. Socioeconomic profiles for Oklahoma and Osage County. Produced using the Economic Profile System-Human Dimensions Toolkit. Internet website: http://headwaterseconomics.org/tools/eps-hdt.

______. 2020. Economic Profile System. Socioeconomic profiles for Oklahoma and Osage County. Produced using the Economic Profile System-Human Dimensions Toolkit. Internet website: http://headwaterseconomics.org/tools/eps-hdt.

Hedge, Allen. 2011. Acoustic Environment. DEA3500. Cornell University, Ithaca, New York. January 2011.

Hoagland, B. W. 2000. The Vegetation of Oklahoma: A Classification for Landscape Mapping and Conservation Planning. Oklahoma Natural Heritage Inventory and Department of Geography, University of Oklahoma, Norman. December 2000.

______. 2008. Vegetation of Oklahoma. Educational Publication 9: 2008. Vegetation, Pg. 17.

Hunter, Andrea A., James Munkres, and Barker Fariss. 2013. Supporting Documentation: Osage Nation NAGPRA Claim for Human Remains Removed from the Clarksville Mound Group (23PI6), Pike County, Missouri. Manuscript of file, Osage Nation Historic Preservation Office, Osage Nation, Pawhuska, Oklahoma.

Hylton, S. 2011. Oklahoma tourism department set to close state parks. Tulsa World. March 26, 2011. Internet website: https://www.tulsaworld.com/news/state-and-regional/oklahoma-tourism-department-set-to-close-state-parks/article_b61a86e7-bda0-569c-a3ff-6ecb8ef3e548.html

INCOG and OK DEQ (Indian Nations Council of Governments and Oklahoma Department of Environmental Quality). 2017. Tulsa Area Ozone Advance Annual Update: 2016. Internet website: https://www.epa.gov/sites/production/files/2017-03/documents/tulsa_update.feb_2017.pdf.

Indian Country Today 2016. Osage Nation Takes Ownership of Ted Turner's 43,000-Acre Ranch. August 26, 2016. Indian Country Today, Indian Country Media Network, Verona, NY. Internet website: https://indiancountrytoday.com/archive/osage-nation-takes-ownership-of-ted-turner-s-43-000-acre-ranch-F2vuk5N7nkqIh87Sa3f7Bw.

Information Handling Services, Inc. 2015. Information Handling Services Energy Database. Queried by the BLM in April 2015.

______. 2017. Information Handling Services Energy Database. Queried by the Indian Energy Service Center in March 2017.

IPCC (International Panel on Climate Change). 2013. "Climate change 2013: The physical science basis." Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (T. F. Stocker, D. Qin, G.-K. Plattner, M. Tignor, S. K. Allen, J. Boschung, A. Nauels et al., editors). Cambridge University Press, Cambridge, United Kingdom, and New York, New York.

______. 2014. Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II, and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (R. K. Pachauri and L. A. Meyer, editors). Geneva, Switzerland.

Jackson, R. E., A. W. Gorody B. Mayer, J. W. Roy, M. C. Ryan, and D. R. Van Stempvoort. 2013. Groundwater protection and unconventional gas extraction: The critical need for field-based hydrogeological research. Groundwater 51(4):488-510. July-August 2013.

Jasechko, S. and D. Perrone. Hydraulic Fracturing near domestic groundwater wells. *Proceedings of the National Academy of Sciences of the United States of America.* Approved October 2017.

Johnson, Kenneth S. 2008. Oklahoma Geological Survey. Geologic History of Oklahoma. Education Publication 9:2008. Internet website: http://www.ogs.ou.edu/pubsscanned/EP9_2-8geol.pdf.

Jordan, Louise. 1957. Subsurface Stratigraphic Names of Oklahoma. Oklahoma Geological Survey Guide Book VI. Internet website: http://www.ogs.ou.edu/pubsscanned/guidebooks/GB6.pdf.

Jung, Jaegun, Wei Chun Hsieh, Maria Zatko, John Grant, Tejas Shah, and Krish Vijayaraghavan. 2016. Air Quality Modeling with CAMx for the BLM-BIA Regional Management Plan/Environmental Impact Statement for Kansas-Oklahoma-Texas. Prepared for BLM New Mexico State Office, Santa Fe, New Mexico. December 2016.

Karl, T. R., J. M. Melillo, and T. C. Peterson (editors). 2009. Global Climate Change Impacts in the United States. US Global Change Research Program, Cambridge University Press, New York, New York.

KDWPT (Kansas Department of Wildlife, Parks and Tourism). 2011. American Burying Beetle (*Nicrophorus americanus*). Internet website: https://ksoutdoors.com/Services/Threatened-and-Endangered-Wildlife/Threatened-and-Endangered-Species/Species-Images/American-Burying-Beetle.

______. 2012. Neosho Mucket (*Lampsilis rafinesqueana*). Internet website: https://ksoutdoors.com/Services/Threatened-and-Endangered-Wildlife/All-Threatened-and-Endangered-Species/NEOSHO-MUCKET-MUSSEL.

Keystone State Park. 2017. Internet website: http://www.stateparks.com/keystone_state_park_in_oklahoma.html.

King, G. E. 2012. Hydraulic fracturing 101: What every representative, environmentalist, regulator, reporter, investor, university researcher, neighbor and engineer should know about estimating frac risk and improving frac performance in unconventional oil and gas wells. Presentation at SPE Hydraulic Fracturing Technology Conference, The Woodlands, Texas, February 6-8, 2012. SPE 152596, Society of Petroleum Engineers.

Koplos, J., M. E. Tuccillo, and B. Ranalli. 2014. "Hydraulic fracturing overview: How, where, and its role in oil and gas." *Journal American Water Works Association* 106(11):38–46.

La Flesche, Francis. 1930. "The Osage Tribe: Rite of the Wa-xo'-be." Bulletin No. 45. Bureau of American Ethnology, Smithsonian Institution, Washington, DC.

______. 1939. "The war ceremony and peace ceremony of the Osage Indians." Bulletin No. 101. Bureau of American Ethnology, Smithsonian Institution, Washington, D.C.

Layden, L. 2014. Uncertainty Looms Over Walnut Creek's Somber Final Weekend As A State Park. StateImpact Oklahoma. October 2, 2014. Internet website: https://stateimpact.npr.org/oklahoma/2014/10/02/uncertainty-looms-over-walnut-creeks-somber-final-weekend-as-a-state-park/

Lewis, M. B. 2013. "Roads and the reproductive ecology of *Hesperidanthus suffrutecens*, an endangered shrub." Master's thesis. Utah State University, Logan.

Mashburn, S. L., C. C. Cope, and M. M. Abbott. 2003. Aquifer Characteristics, Water Availability, and Water Quality of the Quaternary Aquifer, Osage County, Northeastern Oklahoma, 2001-2002: US Geological Survey Water-Resources Investigations Report 03-4235.

May, Jon D. 2009. "Osage County." Encyclopedia of Oklahoma History and Encyclopedia of Oklahoma History and Culture. Internet website: www.okhistory.org.

McDermott, John Francis (editor). 1940. Tixier's Travels on the Osage Prairies. Translated from the French by Albert J. Salvan. University of Oklahoma, Norman.

MDC (Missouri Department of Conservation). 2011. MDC Online: Interior Least Tern (*Sternula antillarum athalassos*). Internet website: https://nature.mdc.mo.gov/discover-nature/field-guide/least-tern.

Metz, N. E., T. Roach, and J. A. Williams. 2017. The cost of Induced Seismicity: A Hedonic Analysis. *Economic Letters*. Volume 160, November 2017, Pages 86-9.

Murray, K. E., 2013. "State-scale perspective on water use and production associated with oil and gas operations, Oklahoma." *US Environmental Science & Technology* 47:4918–4925. Internet website: https://www.ncbi.nlm.nih.gov/pubmed/23531128.

NASA (National Aeronautics and Space Administration). 2016. Global Climate Change. Vital Signs of the Planet. Internet website: http://climate.nasa.gov/scientific-consensus.

National Audubon Society. 2013. Developing a Management Model of the Effects of Future Climate Change on Species: A Tool for the Landscape Conservation Cooperatives. Unpublished report prepared for the US Fish and Wildlife Service.

National Climate Assessment. 2014. US Global Change Research Program. National Climate Assessment, Great Plains. Internet website: http://nca2014.globalchange.gov/report/regions/great-plains.

National Oceanic and Atmospheric Administration, National Climatic Data Center. 2015. Data Tools: 1981-2010 Normals. Internet website: http://www.ncdc.noaa.gov/cdo-web/datatools/normals.

National Park Service (US Department of the Interior, National Park Service). 2011. Class I area locations. Internet website: https://www.nps.gov/subjects/air/class1.htm. Last updated on July 26, 2011.

National Research Council. 2002. "Riparian areas: Functions and strategies for management." National Academy of Science. Washington, DC.

National Weather Service, Norman, OK, Weather Forecast Office. 2017. Heavy Snow in Oklahoma – Where, When, and How Often? Internet website: https://www.weather.gov/oun/climate-heavysnow

NatureServe. 2015. Explorer. An Online Encyclopedia of Life. Internet website: http://www.natureserve.org/explorer.

NETL (National Energy Technology Laboratory). 2013. Modern shale gas development in the United States: An update. U.S. Department of Energy. September 2013.

NGWA (National Groundwater Association). 2016. "Hydraulic fracturing: Meeting the nation's energy needs while protecting groundwater resources." Internet website: https://www.ngwa.org/docs/default-source/default-document-library/advocacy/position-papers/hydraulic-fracturing-meeting-the-nations-energy-needs-while-protecting-groundwater-resources.pdf?sfvrsn=6b96777_2.

NHD GIS. 2015. GIS data of hydrographic features, including HUC 8 boundaries. National Hydrography Dataset. Internet website: http://datagateway.nrcs.usda.gov.

Nicot, J-P., and B. R. Scanlon. 2012. "Water use for shale-gas production in Texas." *US Environmental Science & Technology* 46:3580–3586. Internet website: http://www.beg.utexas.edu/staffinfo/Scanlon_pdf/Nicot+Scanlon_ES&T_12_SI.pdf.

Nicot, J-P., R. C. Reedy, R. A. Costley, and Y. Huang. 2012. Oil & gas water use in Texas: Update to the 2011 Mining Water Use Report. Prepared for Texas Oil & Gas Association, Austin, Texas. Bureau of Economic Geology, Austin, Texas. September 2012. Internet website: http://www.twdb.texas.gov/publications/reports/contracted_reports/doc/0904830939_2012Update_MiningWaterUse.pdf.

Niles, L. J., H. P. Sitters, A. D. Dey, P. W. Atkinson, A. J. Baker, K. A. Bennett, R. Carmona, et al. 2008. "Status of the red knot, *Calidris canutus rufa*, in the western hemisphere." *Studies Avian Biol.* 36:1-185. (Cited in BIA 2017)

NPMS GIS. 2015. GIS data of pipelines in Osage County, Oklahoma. National Pipeline Mapping System, Pipeline and Hazardous Materials Safety Administration. Data received August 2015.

NRCS (United States Department of Agriculture, Natural Resources Conservation Service). 2012a. Oklahoma State-listed Noxious Weeds. OK state weed list. Internet website: http://plants.usda.gov/java/noxious?rptType=State&statefips=40.

______. 2012b. Supplement to the Soil Survey of Osage County Web Soil Survey. Internet website: http://websoilsurvey.sc.egov.usda.gov/.

______. 2017. Official Soil Series Descriptions (OSD) Fact Sheet. Internet website: https://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/survey/class/data/?cid=nrcs142p2_053586.

NRCS GIS. 2015. gSSURGO GIS data of slopes, prime farmland, map unit names, and non-irrigated land crop capability. Natural Resources Consevation Service, United States Department of Agriculture. Data received from BLM April 2015.

NWI GIS. 2017. GIS data of wetland and riparian areas. National Wetlands Inventory, United States Fish and Wildlife Service. Internet website: https://www.fws.gov/wetlands/data/data-download.html.

OCC (Oklahoma Corporation Commission). 2014. Title 165, Corporation Commission, Chapter 10, Oil and Gas Conservation. The Oklahoma Register, volume 31, number 24. Published September 2, 2014. Internet website: https://www.occeweb.com/rules/Ch10eff091418 searchable.pdf.

ODM (Oklahoma Department of Mines). 2015. Annual Report 2015. Internet website: http://mines.ok.gov/Websites/mines1/images/Annual%20Reports/AnnualReport2015.pdf.

ODWC (Oklahoma Department of Wildlife Conservation). 2005a. Oklahoma Comprehensive Wildlife Conservation Strategy. Tallgrass Prairie Region. Internet website: https://digitalprairie.ok.gov/ digital/collection/stgovpub/id/127447.

______. 2005b. Final Report: The Freshwater Mussels of Oklahoma. Federal Aid Grant No. T-14-P-1.

______. 2013a. Bats of Oklahoma Field Guide, Oklahoma Department of Wildlife Conservation. Internet website: https://www.wildlifedepartment.com/sites/default/files/Bats%20of%20Oklahoma%20Field %20Guide.pdf.

______. 2013b. 2013 Deer Kill by County, Season, and Sex. Internet website: https://www.wildlifedepartment.com/sites/default/files/bgr1213.pdf.

______. 2016a. Upland urgency: the fight against bobwhite quail decline. Internet website: https://www.wildlifedepartment.com/hunting-old/quail/upland_urgengcy.pdf.

______. 2016b. Wildlife Management Area Profile for Osage. Internet website: https://www.wildlifedepartment.com/wildlife-management-areas/osage.

______. 2017a. Eastern Oklahoma Bat Tests Positive for White-nose Syndrome. Internet website: www.wildlifedepartment.com/outdoor-news/eastern-oklahoma-bat-tests-positive-white-nose-syndrome.

______. 2017b. Whooping crane species account. Internet website: https://www.wildlifedepartment.com/ wildlife/nongamespecies/whooping-crane.

______. 2017c. Eagles in Oklahoma. Internet website: https://www.wildlifedepartment.com/wildlife/wildlife-diversity/wildside/tips-making-your-winter-eagle-watching-trips-successful.

OGRPCST GIS. 2015. Oklahoma Greater Prairie Chicken spatial planning tool. Oklahoma Department of Wildlife Conservation. Internet website: http://www.wildlifedepartment.com/ grpcspatial_planning/grpcdevelopmentplanninggis.htm.

OGS (Oklahoma Geological Survey). 2015. Statement on Oklahoma Seismicity. Internet website: http://www.ogs.ou.edu/Documents/OGS_Statement-Earthquakes-21-April-2015.pdf.

______. 2020. Earthquake Catalog Download Tool. Internet website: http://www.ou.edu/ogs/research/earthquakes/catalogs.

OGS GIS. 2016. Comprehensive Fault Database and Interpretive Fault Map of Oklahoma, by Stephen Marsh and Austin Holland. OF2-2016. Internet website: http://www.ou.edu/content/ogs/data/fault.html.

______. 2017. Spatial data of earthquakes from 1882 through June 2017. Internet website: http://www.ou.edu/content/ogs/research/earthquakes/catalogs.html.

OHSP (Osage Hills State Park). 2017. Osage Hills State Park. Internet website: http://www.stateparks.com/osage_hills.html.

OK Biological Survey GIS. 1943. The Game Types of Oklahoma, map created in 1943 and digitized in 1995. Internet website: http://obsvweb1.ou.edu/duckflt/bigrmap.htm.

OK Department of Commerce. 2012. 2012 Demographic State of the State Report, Oklahoma State and County Population Projections through 2075. Steve Barker, MBA, Senior Research Analyst/Program Manager. Policy, Research, and Economic Analysis Division.

OK DEQ (Oklahoma Department of Environmental Quality). 2017. Point Source Emissions Inventory Data (2013-2015). Internet website: http://www.deq.state.ok.us/aqdnew/emissions/inventory_data.htm.

______. 2018. Water Quality in Oklahoma: 2018 Integrated Report. Appendix C - 2018 Oklahoma 303(d) List of Impaired Waters. Internet website: https://www.deq.ok.gov/wp-content/uploads/water-division/2018-Appendix-C-Final.pdf

OK DEQ GIS. 2017. GIS data of public water supply wells and wellhead protection areas. Data provided by BIA.

OK GAP GIS. 2008. USGS Gap Analysis Project (GAP) data symbolized for owner type as a proxy for surface administration. Internet website: https://gapanalysis.usgs.gov/padus/data/download/.

OkIPC (Oklahoma Invasive Plant Council). 2014. Oklahoma Nonnative Invasive Plant Species. Developed by the Oklahoma Native Plant Society, Oklahoma Biological Survey, and Oklahoma State University Natural Resource Ecology and Management. Internet website: https://www.okinvasives.org/.

Oklahoma Atlas Institute. 2015. Physiography, Fenneman Physiography Classification. Department of Cartography and Geography, East Central University. Ada, Oklahoma. Internet website: http://www.mymaps.com/okatlas/terrain/provinces.htm.

Oklahoma Climatological Survey. 2013. The Climate of Osage County: Oklahoma Climatological Survey. Internet website: http://climate.ok.gov/county_climate/Products/County_Climatologies/county_climate_osage.pdf.

ODOT (Oklahoma Department of Transportation). 2013. Annual Average Daily Traffic – Oklahoma Highway System. Strategic Asset and Performance Management Division.

______. 2015. Long Range Transportation Plan. August 2015. Internet website: http://www.oklongrangeplan.org/.

______. 2017. Cimarron Public Transit System. Internet website: http://www.okladot.state.ok.us/transit/s5311/cimarron.htm.

Oklahoma Historical Society. 2009. Osage Plains. Internet website: http://www.okhistory.org/publications/enc/entry.php?entry=OS007.

Oklahoma Indian Affairs Commission. 2011. 2011 Oklahoma Indian Nations. Internet website: https://web.archive.org/web/20120512040555/http://www.ok.gov/oiac/documents/2011.FINAL.WEB.pdf.

Oklahoma Office of the Secretary of Energy and Environment. 2017. Internet website: http://earthquakes.ok.gov/what-we-know/.

ONENRD (Osage Nation Environmental and Natural Resources Department). 2006. Integrated Resource Management Plan. Bureau of Indian Affairs Quarterly Report October – December 2005. January 2006.

Osage County. 2011. 2030 Osage County Comprehensive Plan. Internet website: https://digitalprairie.ok.gov/digital/collection/stgovpub/id/205655/. June 2011.

______. 2015. County 2015-2016 Estimate of Needs and Financial Statement for the Fiscal Year 2014-2015. County Commissioners of the County of Osage, State of Oklahoma. October 30, 2015.

Osage Nation. 2007. 25-Year Vision and Strategic Plan Summary Report. Oklahoma. September 2007.

______. 2012. The Osage Nation. Internet website: https://www.osagenation-nsn.gov/.

______. 2015. Auditor's Report and Financial Statements for 2015. September 30, 2015. Internet website: https://www.osagenation-nsn.gov/who-we-are/treasury.

______. 2016. Audited Financial Statements and Supplementary Information for 2016. September 30, 2016. Internet website: https://www.osagenation-nsn.gov/who-we-are/treasury.

______. 2017a. Osage Nation Emergency Management - OILFIELD DANGERS. Internet website: https://www.osagenation-nsn.gov/news-events/news/osage-nation-emergency-management-oilfield-dangers.

______. 2017b. Housing Department. Internet website: https://www.osagenation-nsn.gov/what-we-do/housing.

______. 2017c. Financial Assistance. Internet website: https://www.osagenation-nsn.gov/what-we-do/financial-assistance.

______. 2017d. Long Range Transportation Plan 2017–2036. Internet website: https://s3.amazonaws.com/osagenation-nsn.gov/files/departments/Roads/2017_Roads_Osage-LRTP-Final.pdf.

______. 2017e. Osage Headright Payments (Annual). Internet website: https://s3.amazonaws.com/osagenation-nsn.gov/files/departments/Minerals/2017-0504_3OMC_Headright-Payment-History-Per-Headright.pdf. Last updated February 2017.

______. 2017f. Law Enforcement. Internet website: https://www.osagenation-nsn.gov/what-we-do/law-enforcement-department.

______. 2018. Roads Department. Internet website: https://www.osagenation-nsn.gov/what-we-do/roads-department.

______. 2020. Osage Headright History 1880 - 2032 Actual Prices. Osage Minerals Council. Internet website: https://s3.amazonaws.com/osagenation-nsn.gov/files/departments/Minerals/1880-2019_OMC_Eoy-Osage-Headright-History.pdf

Osage Nation Congress. 2017. Bill Number ONCA 17-30. Osage Nation Wildlife Conservation Act. April 24, 2017. Internet website: https://www.osagenation-nsn.gov/who-we-are/congress-legislative-branch/legislation.

Osage Sheriff. 2015. Osage County Sheriff's Office. Internet website: https://ocso.net/osage-county-sheriff.php.

OSDA (Oklahoma State Department of Agriculture). 2000. Oklahoma Noxious Weed Laws and Rules. Effective May 11, 2000. Internet website: http://oces.okstate.edu/caddo/agriculture/Oklahoma%20Noxious%20Weed%20Law.pdf.

OSHA. 2017. Safety and Health Topics- Hydrogen Sulfide. Internet website: www.osha.gov/SLTC/hydrogensulfide/hazards.html.

OSU (Oklahoma State University). 1998. E-952 Riparian Area Management Handbook. Oklahoma Cooperative Extension Service, Division of Agricultural Sciences and Natural Resources, Oklahoma State University.

______. 2012. EPP-7318 Integrated Management of Invasive Thistles in Oklahoma. Internet website: http://pods.dasnr.okstate.edu/docushare/dsweb/Get/Document-10975/CR-7192web2019.pdf.

OTRD (Oklahoma Tourism and Recreation Department). 2015. State Parks. Internet website: http://www.travelok.com/State_Parks.

OWQS GIS (Oklahoma Water Quality Standards). 2017. GIS data of Oklahoma Water Quality Standards. Data provided by BIA.

OWRB (Oklahoma Water Resources Board). 2016. Water Use Permitting. Internet website: http://www.owrb.ok.gov/supply/watuse/permitting.php.

OWRB GIS. 2015. GIS data for rivers and streams, and domestic water wells. Oklahoma Water Resources Board. Internet website: http://www.owrb.ok.gov/maps/pmg/owrbdata_SW.html.

Pardieck, K.L., D.J. Ziolkowski Jr., M.-A.R. Hudson, and K. Campbell. 2016. North American Breeding Bird Survey Dataset 1966 - 2015, version 2015.1. U.S. Geological Survey, Patuxent Wildlife Research Center. Internet website: www.pwrc.usgs.gov/BBS/RawData/.

Payne, Toni, Stevens, S., and W. Caire. 2015. Annotated checklist of the mammals of the Tallgrass Prairie Preserve, Osage County, Oklahoma." In Proceedings of the Oklahoma Academy of Science, vol. 81, pp. 41-51. 2015.

PHMSA (Pipeline and Hazardous Materials Safety Administration). 2017. U.S. Department of Transportation. Internet website: https://www.phmsa.dot.gov.

Pitman, J. C., Hagen, C. A., Robel, R. J., Loughin, T. M., & Applegate, R. D. 2005. Location and success of lesser prairie-chicken nests in relation to vegetation and human disturbance. *Journal of Wildlife Management*, *69*(3), 1259-1269.

Pruett, J. 2009. Invasive Species Audit for Oklahoma. The Nature Conservancy. July 8, 2009.

PWC (PricewaterhouseCoopers). 2011. The Economic Impacts of the Oil and Natural Gas Industry on the US Economy in 2009: Employment, Labor Income and Value Added. May 2011.

Region Track. 2017. Regional Economic Forecasting and Analysis. Economic Timeline of Drilling an Oil and Gas Well in Oklahoma. Internet website https://www.regiontrack.com/www/wp-content/uploads/OK-Oil-Gas-Well-Drilling-Timeline-RegionTrack-2018.pdf.

Richter, C. F. 1958. Elementary Seismology. W. H. Freeman and Company, San Francisco. Internet website: http://resilience.abag.ca.gov/shaking/mmi/. Pp. 135-149, 650-653.

Riedle, J. D., P. A. Shipman, S. F. Fox, D. M. Leslie Jr. 2005. Status and distribution of the alligator snapping turtle, *Macrochelys temminckii* in Oklahoma. The Southwestern Naturalist. 50:1 79-84.

Rosgen, D. L. 1996. "A geomorphological approach to restoration of incised rivers." Proceedings of the Conference on Management of Landscapes Disturbed by Channel Incision, 1997.

Rubinstein, Justin L., and Alireza Babaie Mahani. 2015. Myths and Facts on Wastewater Injection, Hydraulic Fracturing, Enhanced Oil Recovery, and Induced Seismicity. Seismological Research letters, Volume 86, Number 4, DOI: 10.1785/0220150067. Internet website: https://scits.stanford.edu/sites/g/files/sbiybj13751/f/isfc_2_rubenstein_pap_srl-2015067.pdf. August 2015.

Sampson, F. and F. Knopf. 1994. Prairie conservation in North America. BioScience 44(6). June 1994.

Scanlon, B. R., R. C. Reedy, and J.-P. Nicot. 2014a. Comparison of water use for hydraulic fracturing for unconventional oil and gas versus conventional oil. Environmental Science & Technology 48(20):12386–12393. October 2014.

______. 2014b. Will water scarcity in semiarid regions limit hydraulic fracturing of shale plays? Environmental Research Letters 9(2014):124011.

Schlumberger. 2015. Oilfield Glossary. Internet website: http://www.glossary.oilfield.slb.com/.

Sheley, R., M. Manoukian, and G. Marks. 1996. Preventing Noxious Weed Invasion. Rangelands 18(3).

Shiver, M. A. 2002. "Reproduction and propagation of the Neosho mucket, *Lampsilis rafinesqueana*." Master's thesis. Southwest Missouri State University. (Cited in BIA 2017)

Shop Oklahoma. 2012. "Native American Culture." Internet website: http://www.shopoklahoma.com/native.htm.

Smith, M. D., and A. K. Knapp. 2001. Physiological and Morphological Traits of Exotic, Invasive Exotic, and Native Plant Species in Tallgrass Prairie. Int. J. Plant Sci. 162(4):785-792.

Snead, Mark, and Suzette Barta. 2008. The Economic Impact of Oil and Gas Production and Drilling on the Oklahoma Economy; Oklahoma State University. October 2008.

Spaulding, George F. (editor). 1968. On the Western Tour with Washington Irving; The Journal and Letters of Count de Pourtalès. Translated by Seymour Feiler. University of Oklahoma, Norman.

SRI (Statistical Research, Inc.). 2016. Class I Cultural Resources Survey of BLM and BIA Lands in Nebraska, Kansas, Oklahoma, and Texas. Edited by Christine Ward, with contributions by A. M. Hernandez, P. O. Leckman, T. M. Mills, M. L. Murrell, D. T. Unruh, C. Ward, and R. Wells. Confidential electronic supporting data. Prepared for the BLM Oklahoma Field Office, Tulsa, and (EMPSi) Environmental Management and Planning Solutions, Inc., Boulder, Colorado.

State of Oklahoma. 2015. Oklahoma Public School Directory. Internet website: https://data.ok.gov/dataset/oklahoma-public-school-district-directory/resource/e4983b43-6868-4482-af58-7204c5df5bc7#{view-grid:{columnsWidth:[{column:!District++Name,width:269},{column:!Mailing++Address,width:378}]}}. Last updated February 15, 2015.

Stephens, Daniel B., and Associates, Inc. 2016. Hydrological Assessment Report. Prepared in support of Oklahoma, Kansas, and Texas Joint Environmental Impact Statement. Albuquerque, New Mexico. January 26, 2016.

Stewart, J. G., F. P. Gelwick, W. J. Matthews, C. M. Taylor. 1991. An annotated checklist of the fishes of the tallgrass prairie preserve in Osage County, Oklahoma. Okla. Acad. Sci. 79:13-17.

Storer, Fred, T. Keener, and L. Burleson. Hydration Engineering PLLC. 2016. Oil and Gas Land Use in Osage County, Oklahoma. September 10, 2016. Internet website: https://ec637f48-b460-4378-9729-cab9e0feb1fc.filesusr.com/ugd/028647_02ad3201cd13488a8b38440c3706c382.pdf.

Taylor, J. M., T. S., Seilheimer, and W. L. Fisher. 2014. "Downstream fish assemblage response to river impoundments varies with degree of hydrologic alteration." *Hydrobiologia* 728:23–39.

The Oklahoman. 2016. "Oklahoma, federal regulators amend disposal well action in area around Pawnee quake," by Paul Monies. September 12, 2016. Internet website: http://newsok.com/article/5517814.

The Paleontology Portal. 2015. Interactive database. Internet website: http://www.paleoportal.org/index.php?globalnav=time_space&sectionnav=map.

Thorman, C. H., and M. H. Hibpshman. 1979. Status of Mineral Resource Information for the Osage Indian Reservation, Oklahoma. Administrative Report BIA-47.

TNC (The Nature Conservancy), Robert G. Hamilton. 2013. Letter to the Osage Negotiated Rulemaking Committee regarding concerns about minerals production in the Tallgrass Prairie Preserve. January 25, 2013. Internet website: http://www.bia.gov/cs/groups/xregeasternok/documents/text/idc-041324.pdf.

TNC (The Nature Conservancy). 2015. Oklahoma Tallgrass Prairie Preserve. Internet website: http://www.nature.org/ourinitiatives/regions/northamerica/unitedstates/oklahoma/placesweprotect/tallgrass-prairie-preserve.xml.

Tradewind Energy. 2016. Osage Wind Project. Internet website: http://tradewindenergy.com/project/osage/.

Travel OK. 2015. Osage Nation Heritage Trail. Internet website: http://www.travelok.com/listings/view.profile/id.14855.

Tucker, Sara J. 1942. Indian Villages of the Illinois County. Scientific Papers Vol. 2, Part I Atlas. Illinois State Museum, Springfield, Illinois.

Tuttle, D. R. 2013. "More on the Chaparral / Burbank CO_2 Project." *The Journal Record*. June 29, 2013. Internet website: https://m.osages-you-need-to-know.com/upload/2013-6-29%20More%20on%20the%20Chaparral%20CO2%20Project.pdf.

United Community Action Program, Inc. 2015. Annual Report: Activities and Results 2015. Internet website: http://www.ucapinc.org/uploads/Agency_Annual_Report_2015.pdf.

USACE (United States Army Corps of Engineers). 1996. Lakeshore Management Plan, Hulah Lake, Oklahoma and Kansas. Tulsa District. Tulsa, Oklahoma. January 19, 1996.

______. 2015. Welcome to Hulah Lake. Internet website: http://www.swt.usace.army.mil/Locations/TulsaDistrictLakes/Oklahoma/HulahLake.aspx.

______. 2017. Regulatory Program Overview. Internet website: http://www.swt.usace.army.mil/Missions/Regulatory.aspx.

US Census Bureau. 2010. American Fact Finder, Community Facts, 2010 Demographic Profile. Internet website: https://data.census.gov/cedsci/table?q=2010%20demographic%20profile%20Osage%20county&g=0500000US40113&tid=ACSDP5Y2010.DP05&y=2010&vintage=2010&layer=VT_2010_050_00_PY_D1&cid=DP05_0001E .

______. 2015. 2015 Poverty Thresholds. Internet website: https://www.census.gov/data/tables/time-series/demo/income-poverty/historical-poverty-thresholds.html.

______. 2016. QuickFacts Tulsa County, Oklahoma. Internet website: https://www.census.gov/quickfacts/table/BZA210214/40143.

US Census GIS. 2017. GIS data of cities and towns in Osage County, Oklahoma. Data provided by the BIA.

USDA (US Department of Agriculture). 2012a. 2012 Census of Agriculture, County Profile: Osage County, Oklahoma. National Agricultural Statistics Service. Internet website: https://www.agcensus.usda.gov/Publications/2012/Online_Resources/County_Profiles/Oklahoma/cp40113.pdf.

______. 2012b. 2012 Census of Agriculture, Oklahoma Volume 1, Chapter 2: County Level Data. Internet website: https://www.agcensus.usda.gov/Publications/2012/Full_Report/Volume_1,_Chapter_2_County_Level/Oklahoma/.

USFWS (United States Department of the Interior, Fish and Wildlife Service). 1990. Recovery Plan for the Interior Population of the Least Tern (Sterna antillarum). Grand Island, Nebraska.

______. 1991. American burying beetle (*Nicrophorus americanus*) recovery plan. Newton Corner, Massachusetts. Internet website: http://ecos.fws.gov/docs/recovery_plans/1991/910927.pdf.

______. 2000. “Wildlife mortality risk in oil field waste pits.” US Fish and Wildlife Service Region 6 Contaminants Information Bulletin, December 2000.

______. 2008. Birds of Conservation Concern 2008. United States Department of the Interior, Fish and Wildlife Service, Division of Migratory Bird Management, Arlington, Virginia.

______. 2010. Species Profile: Sprague’s Pipit (*Anthus spragueii*). Internet website: http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=B0GD.

______. 2011. Species Profile: Least Tern. Oklahoma Ecological Service Field Office. Internet website: http://www.fws.gov/southwest/es/Oklahoma/Documents/TE_Species/Species%20Profiles/Least%20Tern.pdf.

______. 2012a. US Counties in which the American burying beetle, entire is known to or is believed to occur. Internet website: https://ecos.fws.gov/ecp0/profile/speciesProfile?sId=66.

______. 2012b. American Burying Beetle: Additional Information. Internet website: http://www.fws.gov/southwest/es/Oklahoma/ABB_Add_Info.htm.

______. 2012c. Species profile for Whooping Crane (*Grus americana*). Internet website: https://www.fws.gov/southwest/es/oklahoma/Documents/TE_Species/Species%20Profiles/Whooping%20Crane.pdf.

______. 2012d. Species profile for Piping Plover (*Charadrius melodus*). Internet website: https://www.fws.gov/southwest/es/oklahoma/Documents/TE_Species/Species%20Profiles/Piping%20Plover.pdf.

______. 2013. Endangered and Threatened Wildlife and Plants; 12-Month finding on a petition to list the rattlesnake-master borer moth (*Papaipema eryngii*) as an endangered or threatened species. Federal Register volume 78, no. 157. Internet website: https://www.gpo.gov/fdsys/pkg/FR-2013-08-14/pdf/2013-19632.pdf.

______. 2014a. Oil and Gas Industry Conservation Plan Associated with Issuance of Endangered Species Action Section 10(a)(1)(B) Permits for the American Burying Beetle in Oklahoma. Oklahoma Ecological Services Field Office. Tulsa, Oklahoma. May 21, 2014.

______. 2014b. Oklahoma Ecological Services Field Office Migratory Bird and Eagle Impact Avoidance Measures for Actions Associated with Oil and Gas Projects. Internet website: https://www.fws.gov/southwest/es/oklahoma/documents/abb/abb_icp/migbird%20and%20eagle%20avoidance%20measures%20april2014.pdf.

______. 2014c. All About the Piping Plovers. Internet website: http://www.fws.gov/plover/facts.html.

______. 2017. Northern long-eared bat range map. Internet website: https://www.fws.gov/Midwest/endangered.

USFWS GIS. 2016. American Burying Beetle Conservation Priority and potential range GIS data. Internet website: https://www.fws.gov/southwest/es/oklahoma/ABB_Add_Info.htm.

USGS (United States Geological Survey). 2002. Surface-Water Characteristics and Quality on the Osage Reservation, Osage County, Oklahoma, 1999. Reston, Virginia.

______. 2003a. A Digital Geologic Map Database of Oklahoma: USGS Open File Report 03-247.

______. 2003b. Environmental Impacts of Petroleum Production: Initial Results from the Osage-Skiatook Petroleum Environmental Research Sites, Osage County, Oklahoma. USGS Open File Report 03-4260.

______. 2005. Environmental Impacts of Petroleum Production: Initial Results from the Osage-Skiatook Petroleum Environmental Research Sites, Osage County, Oklahoma. Water-Resources Investigations Report 03-4260. Internet website: https://pubs.usgs.gov/wri/wri03-4260/pdf/WRIR03-4260.pdf.

______. 2010. Volcano Hazards Program, Volcano Gases and Their Effects. Internet website: http://volcanoes.usgs.gov/hazards/gas/index.php.

______. 2013, Hydrogeology, distribution, and volume of saline groundwater in the southern midcontinent and adjacent areas of the United States: U.S. Geological Survey Scientific Investigations Report 2013–5017, 58.

______. 2014. Description of Landscape Features, Summary of Existing Hydrologic Data, and Identification of Data Gaps for the Osage Nation, Northeastern Oklahoma 1890-2012. Scientific Investigations Report 2014-5134.

______. 2015a. Mineral Resources On-Line Spatial Data. Internet website: http://mrdata.usgs.gov/geology/state/state.php?state=OK.

______. 2015b. Environmental Impacts Associated with Disposal of Saline Water Produced During Petroleum Production. Internet website: https://toxics.usgs.gov/photo_gallery/osage.html (image: https://toxics.usgs.gov/photo_gallery/photos/osage/site_b_salt_scar_l.jpg).

______. 2015c. Introduction to Hydraulic Fracturing. Internet website: https://www2.usgs.gov/hydraulic_fracturing/.

______. 2015d. Hydrologic Unit Maps. Internet website: http://water.usgs.gov/GIS/huc.html.

______. 2016. Wastewater Disposal Likely Induced February 2016 Magnitude 5.1 Oklahoma Earthquake. OCTOBER 24, 2016. Internet website: https://earthquake.usgs.gov/earthquakes/eventpage/us10006jxs/executive.

______. 2018. Estimated use of water in the United States in 2015: U.S. Geological Survey Circular 1441. Internet website: https://doi.org/10.3133/cir1441.

USGS GIS. 2014. Published report- Description of Landscape Features, Summary of Existing Hydrologic Data, and Identification of Data Gaps for the Osage Nation, Northeastern Oklahoma 1890-2012. GIS data of principal aquifers, oil, gas and CBM fields, and surface geology. Data received from USGS Jerrod Smith April 2015.

US News and World Report. 2014. Best Hospitals Survey. Internet website: http://health.usnews.com/best-hospitals/area/ok.

Weingarten, M., J. Ge, J. W. Godt, B. A. Bekins, and J. L. Rubinstein. 2015. "High-rate injection associated with increase in U.S. mid-continent seismicity." *Science* 348(6241):1336-1340. June 2015. Internet website: https://www.colorado.edu/program/hydrosciences/2018/08/13/high-rate-injection-associated-increase-us-mid-continent-seismicity.

WRI (World Resources Institute). 2016. World Resources Institute Climate Analysis Indicators Tool (CAIT). Internet website: http://cait.wri.org.

______. 2017. CAIT Climate Data Explorer, Historic Emissions, Oklahoma (1990-2012). Internet website: http://cait.wri.org/profile/OK.

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Appendix H
Glossary

Appendix H. Glossary

Ad valorem taxes: Tax based on the assessed value of an item, such as real estate or personal property. The most common ad valorem taxes are property taxes levied on real estate.

Anoxia: Low oxygen levels.

Aquatic environment: Waters of the United States, including wetlands, that serve as habitat for interrelated and interacting communities and populations of plants and animals (40 CFR 230.3[b]).

Arbuckle formation: A deep sedimentary rock formation directly above continental basement rock; it was seen as ideal for injection due to its location far deeper than drinking water aquifers and its ability to accept large amounts of wastewater.

CO_2e: Carbon dioxide equivalent is the number of metric tons of CO_2 emissions with the same global warming potential as one metric ton of another greenhouse gas, It is calculated using Equation A-1 in 40 CFR 98.

Crinoidal limestone: Limestone with a high fossil content of the marine animals that make up the class Crinoida of the echinoderms.

Cuesta: A hill or ridge with a gentle slope on one side and a steep slope on the other.

Deciview: The unit of measurement of haze, or haze index.

Enhanced oil recovery: The implementation of various techniques for increasing the amount of crude oil that can be extracted from an oil field. Enhanced oil recovery is also called tertiary recovery (as opposed to primary and secondary recovery). There are three primary techniques for enhanced oil recovery – thermal recovery, gas injection, and chemical injection.

Eutrophic: Deprived of oxygen.

Flowback: A mix of water, mud, dissolved solids and petroleum returned from a well following hydraulic fracturing.

Headright: A prospective right to share in the periodic distributions of royalties derived from the Osage Mineral Estate, after certain authorized deductions have been made (Opinions of the Solicitor General of the Department of the Interior, M-8370 [August 15, 1922]).

Historic properties: Any prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion in, the National Register of Historic Places maintained by the Secretary of the Interior. This term includes artifacts, records, and remains that are related to and located within such properties. The term includes properties of traditional religious and cultural importance to an Indian Tribe or Native Hawaiian organization and that meet the National Register criteria.

Hydrostatic pressure: The pressure exerted by a fluid due to the force of gravity. Hydrostatic pressure increases in proportion to depth measured from the surface because of the increasing weight of fluid exerting downward force from above.

Muskeg: A North American swamp or bog, consisting of a mixture of water and dead vegetation, frequently covered by a layer of sphagnum or other mosses.

National Register of Historic Places: The official list of the nation's historic places considered worthy of preservation, maintained by the Secretary of the Interior, which is part of a national program to coordinate and support public and private efforts to identify, evaluate, and protect America's historic and archaeological resources.

Oil and gas field: A geographical area under which an oil or gas reservoir lies.

Oil and gas play: A set of known or postulated oil and or gas accumulations sharing similar geologic, geographic, and temporal properties, such as source rock, migration pathways, timing, trapping mechanism, and hydrocarbon type.

Pronotum: The plate covering all or part of the thorax of some insects.

Proppant: A solid material, typically sand, added to fracturing fluid to hold open the fractures created during hydraulic fracturing.

Radionuclide: An unstable form of a chemical element that radioactively decays, resulting in the emission of nuclear radiation.

Salt scarring: Bare soil with a reduced ability to support vegetation as a result of increased salinity, due to the release of brine or high salt concentrated water onto the landscape, generally from historic oil and gas exploration and production.

Section: According to the Public Land Survey System's method of subdividing and describing lands, a section is an area of one square mile (640 acres).

Section 106: A cultural resource compliance process under the National Historic Preservation Act, and implemented at 36 CR 800, that outlines the steps for identifying and evaluating historic properties, for assessing the effects of federal undertakings on historic properties, and for consulting to avoid, reduce, or minimize adverse effects.

Sensitive Waters: Waters and watersheds, which are harboring endangered and threatened species and their critical habitat

Sundry Notice: Written request to perform work not covered by another type of permit, or to change operations in a previously approved permit.

Take: As used in the Endangered Species Act of 1973, is to "pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest, or disturb" a listed species.

Transfer payment: Transfer payments are defined as those payments to persons for which no current services are performed; these are payments to individuals and to nonprofit institutions by federal, state, and local governments and by businesses.

Umbo: The highest point of a bivalve shell.

Workover: Additional work on an oil and gas lease post initial construction, such as removal or replacement of the production equipment.

Wellbore: The drilled hole of a well.

Well spud: Beginning the physical process of drilling a well.

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Appendix I

Index

Appendix I. Index

Appendix J
Comment Summary and Response Report

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Appendix J. Comment Summary and Response Report

J.1 Introduction

This report describes the public comment and response process to finalize the Osage Oil and Gas Environmental Impact Statement (EIS) for the United States Department of the Interior (DOI), Bureau of Indian Affairs (BIA) Osage Agency.

The appendix is divided into three main parts, as follows:

- **Section 1** defines terms useful in understanding this document and summarizes public involvement related to release of the Osage Oil and Gas EIS.
- **Section 2** describes how public comments were acquired, categorized, addressed, and documented.
- **Section 3** presents substantive comments organized by specific comment issue category that relate to an aspect of the National Environmental Policy Act of 1969 (NEPA), the BIA planning process, or specific resources and resource uses. Each topic or subtopic contains excerpted substantive comments from individual letters, emails, or written submissions and the BIA's response to the summary statement.

J.1.1 Definitions

The terms listed and defined in this section are provided to help commenters find their substantive comments and understand the responses.

Comment

A comment is a distinct statement or question about a particular topic, such as the following:

- Purpose of and need for action
- The BIA's use of facts, methods, or analyses in the Osage Oil and Gas EIS
- Matters outside the scope of the Osage Oil and Gas EIS

Public Input and Comment Tracking (PICT) Database

This is the BIA's comment tracking system. The PICT database stores the full texts of all correspondence and allows each comment to be coded by topic and issue. The BIA entered all unique submissions and applicable commenter information into the PICT database and then analyzed all substantive comments and classified them in the PICT database system.

Commenter

A commenter is any potentially interested or affected party. A commenter could be a private citizen; state, local, or Tribal government; environmental group; water user or irrigation district; civic and community organization; business; or other entity.

Comment Issue Category

This is the resource topic or issue that a substantive comment addresses. It may concern the NEPA process, including alternatives; the affected environment section of the Osage Oil and Gas EIS; or a specific resource category, such as water quality.

Comment Response

The BIA prepares a response for each comment. The response states relevant policy or guidance related to the concern, notes document locations where issues of concern are addressed, explains agency rationale for decisions, and notes how the Osage Oil and Gas EIS was updated, as appropriate.

Submission

This is any written version of comments submitted by a commenter in a letter or email. A submission may contain any number of comments.

Substantive Comment

A substantive comment is one that is relevant to the scope of the Osage Oil and Gas EIS, environmental analysis, or NEPA process that merits a response. Comments that state the commenter's support for or opposition to an alternative are not substantive comments. Additional details related to the definition of substantive comments are in Section 2, Comment Analysis, of this report.

J.1.2 Draft Osage Oil and Gas EIS Availability and Public Outreach

A notice of availability announcing the release of the Draft Osage Oil and Gas EIS was published in the *Federal Register* on November 22, 2019, initiating the formal 45-day public comment period; however, the fact that the comment period fell over the holiday season and the BIA received multiple requests for extension, the BIA extended the comment period to February 21, 2020. The BIA has continued to accept comments beyond this date, but they are not included in this report.

The BIA maintains a project mailing list. All contacts on the mailing list received an email newsletter announcing the availability of the Draft Osage Oil and Gas EIS. The email also announced the public review period and notified the public of a public meeting on December 12 at the Wah-Zha-Zhi Cultural Center in Pawhuska, Oklahoma. An additional email was sent to the mailing list to note the comment period extension from the original end date of January 6, 2020, to the new date of February 21, 2020. All project-related documents were available via the project website: https://www.bia.gov/regional-offices/eastern-oklahoma/osage-agency/osage-oil-and-gas-eis.

During the comment period, the BIA held a public meeting in Pawhuska, Oklahoma. At the meeting, the agency accepted oral comments, and provided attendees with a brief overview of the plan and helpful information about making effective comments. A total of 35 people attended the meeting.

Refer to **Chapter 5** of this Final Osage Oil and Gas EIS for additional information on public coordination.

J.2 Comment Processes

J.2.1 Comment Collection

The BIA recognizes that commenters invested considerable time and effort to submit comments on the Draft Osage Oil and Gas EIS. It developed a systematic process for cataloging comments, as described in detail below, to ensure that all substantive comments were tracked and considered.

Unique Submissions

The BIA evaluated all submissions that it received during the public comment period and documented them in this report. A total of 82 unique written submissions were received in addition to 9 spoken submissions at the public meeting. Some commenters sent their submissions via the US Postal Service, but these were duplicative of submissions sent via other means. In the event that duplicate submissions were received via multiple means, only one of the submissions was counted.

The public comment form available at the public meeting and sent out to the mailing list provided instructions for requesting confidentiality and for withholding individual names or addresses from public review or from disclosure under the Freedom of Information Act.

To ensure that public comments were properly registered and that none were overlooked, the BIA used a multiphase management and tracking system. Handwritten submissions were logged and given a unique identification number and then were entered manually into the PICT database.

The BIA considered submissions to be associated with an organization, nonprofit, industry, or government when they were on official letterhead of that group or when signed by representatives in an official capacity using their title. People who noted an affiliation with a group, such as a member of an organization, were counted as individuals. All unique submissions, including relevant affiliation and commenter contact information, were entered into the BIA's PICT database, organized by a unique identifying number.

J.2.2 Comment Analysis

Once all comment submissions were received and catalogued through the process described above, the BIA reviewed each submission to understand the commenter's overall intent and perspective. All substantive comments were numbered and assigned a comment code appropriate to their content.

During this analysis, the BIA relied on the Council on Environmental Quality's (CEQ) regulations to determine what constituted a substantive comment. A substantive comment does one or more of the following:

- Questions, with a reasonable basis, the accuracy of the information or analysis in the Draft Osage Oil and Gas EIS
- Questions, with a reasonable basis, the adequacy of the information or analysis in the Draft Osage Oil and Gas EIS
- Presents reasonable alternatives other than those presented in the Draft Osage Oil and Gas EIS that meet the purpose of and need for the proposed action and addresses significant issues
- Questions, with a reasonable basis, the merits of an alternative or alternatives
- Causes changes in or revisions to the preferred alternative
- Questions, with a reasonable basis, the adequacy of the planning process itself

Additionally, the BIA NEPA Handbook (59 IAM 3-H) identifies the following types of substantive comments:

- Comments on the adequacy of the analysis—Comments that express a professional disagreement with the conclusions of the analysis or assert that the analysis is inadequate are substantive but may or may not lead to changes in the Final EIS. Interpretations of analyses should be based on professional expertise. Where there is disagreement within a professional discipline, a careful review of the various interpretations is warranted. In some cases, public comments may necessitate a reevaluation of analytical conclusions. If, after reevaluation, the BIA Authorized Officer responsible for preparing the EIS does not think that a change is warranted, the response should provide the rationale for that conclusion.
- Comments that identify new impacts, alternatives, or mitigation measures—Public comments on a draft EIS that identify impacts, alternatives, or mitigation measures that were not addressed in the draft are substantive. This type of comment requires the BIA Authorized Officer to determine whether it warrants further consideration. If it does, the BIA Authorized Officer must determine whether the new impacts, new alternatives, or new mitigation measures should be analyzed in the Final EIS, a supplement to the EIS, or a completely revised and recirculated draft EIS.
- Disagreements with significance determinations—Comments that directly or indirectly question, with a reasonable basis, determinations regarding the significance or severity of impacts are substantive. A reevaluation of these determinations may be warranted and may lead to changes in the EIS. If, after reevaluation, the BIA Authorized Officer does not think that a change is warranted, the response should provide the rationale for that conclusion.

Comments that failed to meet the above description were considered nonsubstantive; for example, many commenters expressed personal opinions or preferences. Also considered nonsubstantive are those comments that had little relevance to the adequacy or accuracy of the Draft Osage Oil and Gas EIS and were commentary on resource management or impacts, without any real connection to the document. Others were considered out of scope because they dealt with existing law, rule, regulation, or policy.

In some cases, commenters may have provided comments on other land use plans outside the planning area. These nonsubstantive comments did not provide specific information to assist the BIA in making changes to the alternatives or impact analysis in the Osage Oil and Gas EIS; therefore, these comments were not addressed further.

Opinions, feelings, and preferences for one element or one alternative over another and comments of a personal or philosophical nature were all read, analyzed, and considered; however, because such comments are not substantive, the BIA did not include them in this report or respond to them.

Note that, while the BIA reviewed and considered all comments, they were not counted as "votes." The NEPA public comment period is not an election, nor does it result in a representative sampling of the population; therefore, public comments are not appropriate to be used as a democratic decision-making tool or as a scientific sampling mechanism.

Of the 91 unique submissions received, 39 contained substantive comments. A total of 113 unique substantive comments were contained in all comment submissions. Copies of all submissions received on the Draft Osage Oil and Gas EIS are available on the project website at https://www.bia.gov/regional-offices/eastern-oklahoma/osage-agency/osage-oil-and-gas-eis.

For each submission, the BIA identified and sorted substantive comments into comment categories. These categories were queried and tallied to provide information on comment types, as summarized in **Table J-1**. Comment categories generally follow the sections presented in the Draft Joint EIS/BLM RMP and BIA Integrated RMP, though some relate to the planning process. Resource sections that did not receive comments are not included in the table below. Coded comments were divided into subcategories related to the purpose and need, alternatives, best available information/baseline data, impacts analysis, and cumulative impacts.

Table J-1
Substantive Comments by Issue Category

Comment Issue Category Description	Number of Total Comments
Affected Environment	
Cultural Resources	1
Mineral Extraction	2
Noise	1
Public Health and Safety	3
Socioeconomics and Environmental Justice	1
Special Status Species	3
Topography, Geology, Paleontology, and Soils	2
Trust Assets and Osage Nation Interests	1
Visual Resources	2
Water Resources	5
Consultation and Coordination	3
Document Edits	3
Environmental Consequences	
General	3
Agriculture	1
Cultural Resources	2
Fish, Wildlife, and Migratory Birds	1
Mineral Extraction	1
Socioeconomics and Environmental Justice	2
Special Status Species	14
Topography, Geology, Paleontology, and Soils	7
Trust Assets and Osage Nation Interests	2
Vegetation, Wetlands, and Noxious Weeds	1
Water Resources	4
Extension Requests	5
General EIS comments	15
Purpose and Need	3
Range of Alternatives	25

Comments that related to the impacts of management of one resource or another were coded under the affected resource, following the structure of the impacts analysis in the Osage Oil and Gas EIS; for example, comments on the impacts of oil and gas development on water resources were coded under water resources.

Many submissions included more than one comment, so the submissions yielded approximately 113 individual comments in all submissions.

J.3 COMMENT CATEGORIES, SUMMARIES, AND RESPONSES

For each identified comment issue category, the BIA reviewed substantive comments and provided a response. Comment responses cited one or more of the following:

- Relevant laws, standards, or criteria that defined the BIA's approach
- Information from the Draft Osage Oil and Gas EIS as it relates to the comment
- Whether the comment resulted in changes to the document
- Rationale for why changes were warranted or not

Comments citing editorial changes to the document, such as spelling and grammatical changes, were coded, reviewed, and incorporated as appropriate into the Final Osage Oil and Gas EIS.

In the table below, responses are provided for each substantive comment. Individual substantive comments are followed by responses in each section. Each substantive comment retains the unique identifier code for the submission, as well as the commenter last name and first initial, received date and commenter affiliation, if applicable, in the file name.

J.3.1 Substantive Comments and Responses

The following are responses to the substantive comments received.[1] Comments or responses that were too long to fit in a single cell were extended down across additional cell(s).

[1] Note: PICT software sometimes mis-transcribes or corrects comments with grammatical errors, but original letters were reviewed for context.

Comment ID	Received Date	Comment	Comment Code	File Name	Response
1425	2/21/2020	TRENDS CULTURAL RESOURCES "Compliance activities have steadily increased the rate of site discoveries due to continued mineral and energy development and the use of block surveys to efficiently inventory the cultural resources. Although sites are generally avoided, additional information valuable to archaeological and historical research could be gained by compiling and synthesizing data from these studies." What does the writer mean when he/she speaks of "compliance activities have steadily increased"? This is not baseline analysis but a general description. How many acres have been surveyed due to oil and gas activities? Other activities? Total Acres? What benefits to the BIA/OMC have been realized due to these surveys? The last sentence has no bearing on the Cultural baseline of the DEIS. Again, this is an opinion and not based on any cited facts. "Continued oil and gas development near sites increases the potential for impacts on cultural resources from unintentional or inadvertent damage, unauthorized collection, vandalism, and erosion. Damage, intentional or otherwise, to historic properties is irreversible and may result in a loss of the site's significance, integrity, or both. These losses may adversely affect the site's eligibility for listing on the National Register of Historic Properties." This paragraph contradicts the preceding paragraph. A cultural resources survey and report is required for any new well drill. This includes intense research and pedestrian surveys. This is an opinion and not a baseline analysis. There is no factual basis for the conclusion as written in the paragraph. Any factual assertions should include citations to the studies or documentation that lead to the conclusion made in the first sentence? In its current form, this statement is extremely biased. "… Tight timelines, lack of staffing, and difficulties with mitigation enforcement can lead to cultural resources not being identified or affected." This is, again, an opinion with no factual basis. What tight timelines and from whom? The Cultural resources survey report must go through a comment period per the NHPA. The reports are carefully reviewed by the THPO, BIA archeologist and state archeologist. In fact, the current landscape is such that the review of the archeology reports is a cause for delays in getting APD's approved due to the review process.	Affected Environment - Cultural Resources	WallerE_20200221_OsageMineralsCouncil	Accurate data on the total acreage and number of surveys conducted in the County are not available. It is not feasible to separate these data by type of activity, but they provide a picture of the total number of surveys for all authorized activities. The potential for disturbance of cultural resources is a commonly accepted effect of oil and gas development due to increased human presence and activity in the area. Cultural surveys mitigate but do not eliminate this effect. The sentence on tight timelines and lack of staffing has been deleted from Section 3.9.2 of the FEIS.
1454	2/21/2020	The EIS fails to include the disastrous effects the draconian policies of the BIA in Osage County have had on new oil production and the drop in daily oil production since the meritless suit was filed in 2014 for surface land owners against the BIA and Osage County producers. Since 2014, the "non-CO2 daily oil production in Osage County has fallen from 14,266 BOPD to 8,279 BOPD", a 42% decline in production". Even when including the CO2 oil production, which has been a bright spot in this storm, total daily oil production has dropped to just over 10,000 BOPD., an approximate 28.5% decline in overall production.	Affected Environment - Mineral Extraction	RyanJ_20200221	The BIA did not implement any regulatory changes in 2015, nor has it implemented regulatory changes since that time. The regulations governing leasing of the Osage Mineral Estate - 25 C.F.R. part 226 - were last revised in 1974. Oil and gas production data for the Osage Mineral Estate indicates that production is primarily, and heavily, correlated with market conditions, a trend that is common throughout the industry both inside and outside Indian country. The BIA is required to ensure that oil and gas development operations in Osage County comply with the ESA and related USFWS guidance. USFWS changed the ABB guidance for Osage County in 2014, significantly increasing the burdens of ESA compliance for the BIA and lessees alike. Other independent factors have also influenced the amount of oil and gas development inside and outside Indian country (see Section 3.16.2, Section 3.16.3, and Appendix A). Section 3.16.2 of the FEIS has been revised to incorporate production data for a longer period of time and to provide additional context about how such data compares to statewide and global trends.
1463	2/21/2020	Primary Issue which has impacted drilling is not price, but is related to Regulatory Burden and compliance, particularly compliance to the ESA – ABB. This correlates to the removal of 1.2 Acre Threshold by the FWS, and by coincidence the collapse in price. Price is coming back, but drilling is not.	Affected Environment - Mineral Extraction	KnappeR_20200221_Warrior Exploration and Production	ESA compliance procedures are discussed in Section 3.6, Special Status Species, in the DEIS. The implications of the EIS alternatives on the ESA compliance process associated with this EIS as well as site-specific development activities are summarized in Table 2-1, Alternatives Summary, in the DEIS.
1428	2/21/2020	NOISE Again, the writer makes a conclusion in several paragraphs. The last paragraph under Existing Sensitive Receptors makes a conclusion that "Surface owners next to oil and gas developments may be particularly sensitive to noises from this industry." First, the writer does not define "next to". Does "next to" mean 500 feet? 1,000 feet? 100 feet? Second, what data backs this conclusion up? These are opinions with no data. This again is an impacts analysis, and this should be explained in Section 4. Also, one could also deduce that surface owners near oil and gas developments are less sensitive to the noise due to that fact that they are desensitized to that particular noise. Finally, in Section 3.13.3, the writer says (and this is all throughout the DEIS) that "the number of oil land gas wells in the planning area is expected to increase over the next 20 years; therefore, noise associated with this industry is also expected to increase." The writer does not contemplate that although the number of wells drilled will increase, that does not take into account the number of wells that may be plugged and abandoned. Therefore, the number of producing wells over the next 20 years could remain the same as they are today. Therefore, the conclusion that noise with this industry is expected to increase is inaccurate. Furthermore, what does "increase" mean? Does the writer mean that there will be an increase in decibel levels? An increase in noise in a wider range of area? Or both?	Affected Environment - Noise	WallerE_20200221_OsageMineralsCouncil	The statement about surface owners next to oil and gas developments in Section 3.13.2 of the DEIS is continuing the introduction of existing sensitive receptors as part of the description of the affected environment. The distance at which noise effects are felt depends on a variety of factors, such as topography, vegetation, and the decibel level at the well site. A citation has been added to this sentence in Section 3.13.2 of the FEIS to provide further information on this effect. Published studies do not support the assertion that surface owners near developments are desensitized to the noise. Appendix A of the DEIS acknowledges that wells may be plugged and abandoned but explains why it is not possible to quantify this effect and factor it into overall development projections. The BIA acknowledges that recent trends in Osage County have shown plugging permits outpacing drilling permits and has added language to Section 3.1 of the FEIS to explain that the NEPA analysis still assumes the total number of wells will increase going forward in order to provide maximal NEPA coverage in describing possible effects of these activities.
1426	2/21/2020	PUBLIC HEALTH AND SAFETY 3.11.2 CURRENT CONDITIONS "Produced water from oil and gas operations typically contains elevated levels of sodium and other chemicals. In the event of a spill or improper disposal of produced water near a drinking water intake, there is a possibility that chemical concentrations in drinking water could exceed federal safe drinking water standards." 26 This is not a baseline analysis. The baseline analysis would be to determine how many wells, if any are near a "drinking water intake"? What is a "drinking water intake"? Risks and possibilities should be in the affects analysis, not in the baseline analysis.	Affected Environment - Public Health and Safety	WallerE_20200221_OsageMineralsCouncil	The FEIS has been revised to consolidate discussion of the potential environmental impacts of future oil and gas development activities in Chapter 4, Environmental Consequences.
1471	2/21/2020	"The number of spills will generally correlate with the level of oil and gas development in the county." The DEIS provides no citation to data to support this conclusion, and thus, reflects an opinon rather than fact that should be relied upon for a DEIS.	Affected Environment - Public Health and Safety	WallerE_20200221_OsageMineralsCouncil	This is a reasonable assumption, as the more development that occurs in an area, the more opportunity for a spill. No change required.
1472	2/21/2020	Comment "3.11.3 TRENDS PG 392 "Oil and gas development will continue to introduce risks to public health and safety in Osage County. The risk level depends on such factors as the amount of development and nature and type of mitigation measures implemented." This is a reckless statement not supported by facts stated in the DEIS."	Affected Environment - Public Health and Safety	WallerE_20200221_OsageMineralsCouncil	Section 3.11.2 of the DEIS describes the risks posed to public health and safety from oil and gas development. The cited statement is reasonable in noting that there are public health and safety risks introduced by oil and gas development and, at this programmatic analysis level, a variety of factors affect the level of risk and the probability of actual public health and safety impacts from a specific development.
1465	2/21/2020	Figure 3-13 o "A downward trend has been observed since 2013 in Osage County, likely due to market conditions." • Comments: o Biggest impact in Osage county has been since 2015, which is the last year included. Updated information would show a significant impact in mining employment which is really based on the regulatory environment associated with the BIA and USFWS and its significant impact on Osage Co.	Affected Environment - Socioeconomics and Environmental Justice	KnappeR_20200221_Warrior Exploration and Production	The BIA did not implement any regulatory changes in 2015, nor has it implemented regulatory changes since that time. The regulations governing leasing of the Osage Mineral Estate - 25 C.F.R. part 226 - were last revised in 1974. Oil and gas production data for the Osage Mineral Estate indicates that production is primarily, and heavily, correlated with market conditions, a trend that is common throughout the industry both inside and outside Indian country. The BIA is required to ensure that oil and gas development operations in Osage County comply with the ESA and related USFWS guidance. USFWS changed the ABB guidance for Osage County in 2014, significantly increasing the burdens of ESA compliance for the BIA and lessees alike. The employment and income information has been updated to include more recent years in Section 3.10.1 of the FEIS.
1391	1/31/2020	· Where does the beetle do well in Osage County? Answer: The Tallgrass Preserve. And, why not so well elsewhere? The FWS talks about habitat fragmentation, lights, and urban encroachment. That explains why beetles are not found in Tulsa. Maybe the beetle's problem in Osage County is wild horses and cattle. The BLM paid The Nature Conservancy $200,000 (a dollar an acre) to do something to benefit the beetle because wild horses (7.5 acres per horse) destroy beetle habitat. A stocker cattle operation puts lots of cattle (2 acres per cow) on the grass for 90 days in which time the cattle eat all the grass and walk on every square foot of the pasture to the detriment of the creatures the beetle needs to bury. This starts in April and lasts past the time where the beetles leave their nests. If there were any beetles there is a good chance they will be stepped on by a cow. BTW, the Tallgrass winters 1,618 bison on 39,650 acres, 24 acres per bison.	Affected Environment - Special Status Species	TrentJ_20200131	Section 4.6.7 of the DEIS acknowledges the effects of other types of activities on the ABB in combination with oil and gas development.

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1424	2/21/2020	3-48 "The ABB is present in the planning area and would be affected by oil and gas development. Most of Osage County is within the range of this species, and the northeastern part of the county is considered a Conservation Priority Area for ABB (USFWS 2014a; see Figure 3-10, American Burying Beetle [in Appendix E])." This should be changed to may be affected by oil and gas development. 3.6.2 CURRENT CONDITIONS "Bald Eagle (Haliaeetus leucocephalus), Bird of Conservation Concern The USFWS has identified the bald eagle as a Bird of Conservation Concern, meaning that it is a species that represents the agency's highest conservation priorities. In addition, the species is of cultural significance to the Osage Nation, as the feathers are highly valued. The eagle has a distinctive white head and tail, bright yellow bill, and dark plumage; it occurs in Osage County throughout the year. It can be found along the Arkansas River, including Kaw and Keystone Lakes (ODWC 2017c). The species prefers areas near water for hunting fish or waterfowl. It also nests in tall trees or cliffs near water. Clutch size is one to three eggs. Defended territories are relatively small, from 27 to 279 acres, but feeding home ranges around active nests are larger, from 1,729 to 5,337 acres. Wintering eagles tend to avoid areas with high levels of nearby human activity and development (NatureServe 2015); as such, the species may be affected by oil and gas development." Birds of Conservation Concern – published by the USFWS Division of Migratory Bird Management, refers to the list of migratory and non-migratory birds of the U.S. and its territories that are of conservation concern. The 1988 amendment to the Fish and Wildlife Conservation Act requires the identification of "species, subspecies, and populations of migratory non-game birds that, without further additional conservation actions, are likely to become candidates for listing under the Endangered Species Act of 1973." Bald Eagles were removed from the endangered species list in August 2007 because their populations recovered sufficiently. Bald and Golden eagles are protected under the Migratory Bird Treaty Act (MBTA) and the Bald and Golden Eagle Act (Eagle Act). 3.6.3 TRENDS "For the ABB, threats described above are expected to continue to reduce its populations and to fragment habitat in Osage County. Oil and gas companies are expected to continue to construct, operate, and reclaim well pads, pipelines, and accompanying facilities, including access roads, electric distribution lines and substations, and off-site impoundments. Oil and gas development in some portions of Osage County are likely to result in take of ABBs or impacts on their habitat. Activities occurring during the ABB active season could reduce the species' foraging and reproduction efficiency for the duration of the active season. This would affect prey species and reproduction and their habitat in project areas. This likely would reduce the available food sources, decrease reproduction potential, and decrease ABB use of the area. Any permanent facilities, such as access roads, would remove ABB breeding, feeding, and sheltering habitat." Ecosystems supporting ABB populations are diverse and include primary forest, scrub forest, forest edge, grassland prairie, riparian areas, mountain slopes, and maritime scrub	Affected Environment - Special Status Species	WallerE_20200221_OsageMineralsCouncil	3-48: This sentence in Section 3.6.2 of the FEIS has been updated to state that the ABB is likely to be adversely affected by oil and gas development, in line with the language used in the Biological Assessment (see Appendix B). 3.6.2: FWS states on the website dedicated to Birds of Conservation Concern (BCC) that the list considers "ESA candidate, proposed, and recently delisted species." As the listing has not been updated since 2008, and bald eagles were on the BCC at that time, it is still technically correct to list them as a BCC. 3.6.3: The comment does not contradict the statement referenced in the DEIS. No change is needed. 3.7.3: The Act of June 28, 1906, § 3, 34 Stat. 539, as amended ("1906 Act"), vests the Secretary with broad authority over leasing of the Osage Mineral Estate. Specifically, the 1906 Act provides that the Osage Nation may lease the Osage Mineral Estate for oil and gas mining "…subject to the approval of the Secretary of the Interior, and under such rules and regulations as he may prescribe." The U.S. Congress did not limit, or otherwise qualify, the Secretary's sole authority to establish and implement the "rules and regulations" governing the Osage Mineral Estate. At present, the regulations governing the Osage Mineral Estate are set forth in 25 C.F.R. part 226 and the Superintendent of the Osage Agency is delegated the authority to interpret and supplement those regulations, as well as issue additional mandatory guidance, via orders and notices. Under Section 7 of the Endangered Species Act of 1973, it is the responsibility of Federal Agencies planning actions that might may affectd threatened and endangered species to consult with the USFWS and identify potential mitigation and conservation measures. 3.8.3: Appendix A, Reasonably Foreseeable Development Scenario, presents projected activity in the planning area based on the best available data, as cited in the appendix. The projected gross disturbance acreage has been corrected in Section 3.8.3 of the FEIS to match that in the current RFD (9,522 acres).
1455	2/21/2020	The Fish and Wildlife Service proposal to change the status of the American Burying Beetle from endangered to threatened will drastically change the scope of the EIS. This should immediately lessen the financial burdens now in place for producers to drill new wells and encourage new production in Osage County. This fact should be included even if this is not accomplished by time the EIS is published.	Affected Environment - Special Status Species	RyanJ_20200221	The American Burying Beetle subsection in Section 3.6.2 of the DEIS acknowledges the ongoing USFWS consideration of potential delisting of the ABB and the potential change in application of COAs that could result.
1418	2/21/2020	TOPOGRAPHY, GEOLOGY, PALEONTOLOGY, AND SOILS "Paleontological resources are any fossilized remains or traces of organisms that are preserved in or on the earth's crust. They include invertebrate, plant, trace, or vertebrate fossils, which constitute a fragile and nonrenewable record of the history of life. The BLM may, on request, provide expertise to other federal agencies, such as the BIA, in managing paleontological resources and research." This violates the 1906 Act, as amended. The BLM has no involvement whatsoever with the Osage mineral estate, and it is highly inappropriate to use a DEIS to try to effectuate this type of change. Furthermore, it is not clear that BLM offices have paleontologists. In the event there are paleontological issues associated with the Osage mineral estate, the BIA and the Osage Minerals Council should confer and concur about the experts that would be used to address these issues.	Affected Environment - Topography, Geology, Paleontology, and Soils	WallerE_20200221_OsageMineralsCouncil	Pursuant to the Act of June 28, 1906, § 2, 34 Stat. 539, as amended ("1906 Act"), the United States holds certain surface lands in Osage County in trust or restricted status for the benefit of the Indian landowner. The BIA is required to manage fossils found on, or embedded in, such lands as trust resources belonging to the Indian landowner. Black Hills Inst. of Geological Research v. S. Dakota Sch. of Mines and Tech., 12 F.3d 737, 742–43 (8th Cir. 1993). The 1906 Act vests the Secretary of the Interior with broad authority over the management of trust and restricted lands. Nothing in the 1906 Act prohibits the Secretary of the Interior from consulting with, or requesting technical advice from, any bureau, agency, or office within the Department or any other Federal government entity having knowledge or expertise regarding a matter relating to Indian lands. Consultation and collaboration between different bureaus, agencies, and offices within the Department is routine and leverages knowledge and resources for the benefit of all parties. The BLM has a well-established paleontology program under which it manages, preserves, and protects paleontological resources on public lands in accordance with the National Environmental Policy Act of 1969 (NEPA), Paleontological Resources Preservation Act of 2009 (PRPA), and Federal Land Policy Management Act of 1976 (FLPMA). The BLM's experience in its management of this nationwide program provides valuable insight and experience that may be of assistance to the BIA and Indian landowners in certain cases. The EIS does not state, or otherwise attempt, to transfer jurisdiction for management of the Osage Mineral Estate from the BIA to BLM. As stated in Section 1.2 of the EIS, "the BIA is the sole federal agency with authority over managing the subsurface mineral estate in Osage county." Moreover, in Section 2.5.3, in response to public comments proposing an alternative whereby jurisdiction over the Osage Mineral Estate would be transferred to the BLM, the EIS states that "the BIA cannot delegate its management of the Osage Mineral Estate to the BLM without the BLM's consent. In addition, because the statutes under which the BLM operates explicitly exclude the Osage Nation from the BLM's jurisdiction, legislative amendments may also be required to achieve such an action. The enactment or amendment of legislation and implementation of delegations of authority are outside the scope of this EIS…" The FEIS has been revised to clarify that the BIA will request technical advice and assistance with respect to paleontological resources on a case-by-case basis, as necessary.
1419	2/21/2020	Soils "Soils in the planning area have been affected by oil and gas leasing for the past 100 years. Impacts are as follows (USGS 2003b): • Surface disturbance and soil compaction related to the construction of oil and gas operations and ancillary facilities • Salt scarring and soil salinization; elevated sodium concentrations in soil kill vegetation and break down cohesion of soil particles, both of which enhance soil erosion • Tree kills • Brine and oil contamination from improper disposal or accidental release of large volumes of saline water produced in association with oil and gas production Before federal laws and regulations were instituted in the 1970s, produced waters were often discharged into streams, creeks, and unlined evaporation ponds, causing salt scars and surface water and groundwater pollution (USGS 2003b). These waters are highly saline (total dissolved solids may exceed 350,000 milligrams per liter) and may contain toxic metals, organic and inorganic components, and radium-226/228 and other naturally occurring radioactive isotopes. Currently, contaminated water generally comes from accidental hydrocarbon and produced water releases and from incorrectly sealed abandoned wells (USGS 2003b). Areas with salt scarring or oil contamination are unable to support vegetation, leaving the soils susceptible to erosion. To gauge the potential success of restoration, the soil salt content, nutrients, organic matter, petroleum hydrocarbons, and bacterial activity at individual sites would need to be measured." These are very broad statements. It is unclear to what degree (number of acres) soils have been affected by oil and gas production. The focus of this section is fundamentally flawed as it only considers issues related to oil and gas, making no mention of farming, agriculture, ranching, or wild horse care, and the baseline analysis of these industries on soils. No other land uses are considered in this section (See Section 3.8.2), effectively undermining the purpose of any study on environmental impacts on the soil. Furthermore, the USGS 2003b that the DEIS relies upon for the proposition that "contaminated water generally comes from accidental hydrocarbon and produced water releases and from incorrectly sealed abandoned wells" is 17 years old and makes no direct connection to contamination issues related to the Osage mineral estate. Instead of overly broad statements, the DEIS should confirm, at a minimum, that it is relying upon the most recent science available, and include the impacts of all industries on the soil—ranching (wild horses) included—along with information about whether there has been a decrease in soil contamination due to brine and oil contamination, and whether there are any plans to gauge the potential success of restoration, soil salt content, nutrients, etc.	Affected Environment - Topography, Geology, Paleontology, and Soils	WallerE_20200221_OsageMineralsCouncil	Section 4.2.7 of the DEIS provides cumulative impact analysis that acknowledges the effects other non-oil and gas activities have had on soils in the planning area. The analysis of direct and indirect impacts from oil and gas development on soils in Sections 4.2.2 through 4.2.6 is appropriately limited to the action being considered in this EIS--BIA management of oil and gas leasing and development. In addition, the USGS 2003b source that is being referenced represents the most recently available information specific to Osage County and is considered the best available data given its relevance to the planning area. The Osage Nation and BIA were included as stakeholders in the study effort. The sentence has been clarified in Section 3.2.2 of the FEIS to be more explicit about the study relied on.

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1387	1/31/2020	Your Alternatives 3 and 4 intend the reduction of the Osage mineral estate which was established by the Osage Allotment Act of 1906 and its amendments. I don't think you can do that, and I assure you I will support litigation to restore the mineral estate if Alternative 3 or 4 are implemented. Also, you must not realize that the no drilling areas include existing leases where the lessee has a right to drill additional wells. I expect lessees will seek compensation for there losses.	Affected Environment - Trust Assets and Osage Nation Interests	TrentJ_20200131	Alternatives 3 and 4 do not diminish, nor are they intended to diminish, the Osage Nation's ownership of the Osage Mineral Estate or the total acreage thereof. Similarly, Alternatives 3 and 4 have no impact on the right of lessees to develop leases of the Osage Mineral Estate executed prior to issuance of the Record of Decision ("ROD") for the EIS ("existing leases"). The alternatives in the EIS represent a reasonable range of management decisions the Bureau of Indian Affairs can make regarding development of the Osage Mineral Estate. The Act of June 28, 1906, § 3, 34 Stat. 538, as amended ("1906 Act"), vests the Secretary of Interior with broad authority over leasing of the Osage Mineral Estate. Specifically, the 1906 Act provides that the Osage Nation may lease the Osage Mineral Estate for oil and gas mining "...subject to the approval of the Secretary of the Interior, and under such rules and regulations as he may prescribe." In 1929, the U.S. Congress amended the 1906 Act, adding a provision governing the number of acres of the Osage Mineral Estate that must be offered for lease annually. The Act of March 2, 1929, § 1, 45 Stat. 1478 ("1929 Act") directs the Secretary of the Interior and Osage Nation to offer for lease..."any unleased portion of [the Osage Mineral Estate] in such quantities and at such times as may be deemed in the best interest of the Osage [Nation], Provided, That not less than twenty-five thousand acres shall be offered for lease for oil and gas mining purposes during any one year." Alternatives 3 and 4 are consistent with this statutory mandate. The EIS does not alter or amend a lessee's right, title, or interest in an existing lease. Under all alternatives, lessees holding record title to existing leases remain authorized and obligated to develop the Osage Mineral Estate in accordance with the terms and conditions of the lease and the regulations in 25 C.F.R. part 226. Alternatives 3 and 4 provide for the use of directional drilling to extract oil and gas from designated "sensitive areas," to allow for continued development while minimizing surface disturbance. The Bureau of Indian Affairs acknowledges, however, that directional drilling is not feasible in all cases. If the Bureau of Indian Affairs selects an alternative that restricts drilling in designated "sensitive areas," the ROD will include a procedure whereby the Superintendent may approve variances from such restrictions where all, or some portion, of an existing lease is located within a sensitive area and directional drilling is not feasible. In Sections 2.3.4 and 2.3.5 of the FEIS, Alternatives 3 and 4 have been revised to more clearly identify the allowance for directional drilling and explain the variance procedure that would be implemented for existing leases located within designated sensitive areas.
1390	1/31/2020	You talked about visual resources and said nothing about the Osage Wind Farm a visual blight which I can see for miles	Affected Environment - Visual Resources	Trent_20200131	Section 4.12.7 of the DEIS provides cumulative impact analysis that acknowledges the effects other non-oil and gas activities, including wind farms, have had on visual resources in the planning area. The analysis of direct and indirect impacts from oil and gas development on visual resources in Sections 4.12.2 through 4.12.6 is appropriately limited to the action being considered in this EIS--BIA management of oil and gas leasing and development.
1427	2/21/2020	VISUAL RESOURCES 3.12.2 CURRENT CONDITIONS "The most prominent human-made modifications to the visual landscape are the roads. Several major roadways bisect the county. Cities and towns in the county are characteristic of rural areas. Pump jacks and tank batteries are also frequently visible throughout the landscape." The DEIS explains that pump jacks and tank batteries are part of the landscape. However, in Section 3.12.3, the writer says that oil and gas activity will increase visual changes. To what extent? How? Again, this is a conclusion with little facts and should be in Section 4. Furthermore, in section 3.12.2 "the oil and gas industry…is one of the most important economic industries in the county." Is oil and gas part of the landscape or not? The writer presents a biased and conflicting view.	Affected Environment - Visual Resources	WallerE_20200221_OsageMineralsCouncil	An increase in pump jack and tank battery installation would lead to an increase in visual changes to the landscape since these are new facilities that are not presently visible on the landscape. The fact that these types of facilities already exist does not mean that the addition of more facilities would not represent a change.
1420	2/21/2020	Water Use for Oil and Gas Extraction: "The surface release of contaminated water or substances capable of contaminating water can affect the quality of surface water and groundwater; accordingly, such releases can affect potential uses of this water, such as for domestic consumption. The quantity of water used for well drilling, completion, and production varies by the type of well and drilling technique. Vertical well completion, or conventional drilling, uses an estimated 100,000 to 500,000 gallons per well, with an assumed average of 250,000 gallons per well completion. Coal bed methane wells require significantly less water than other shale gas and tight oil wells (Murray 2013): from 50,000 to 350,000 gallons, with an average of 150,000 gallons per well completion." The first sentence does not fit the remainder of the paragraph. The writer seems to show bias against oil and gas development by repeating this theme. This is repeated several times in this section. It is also a conclusion, not a baseline. Conclusions and impacts analysis belong in Section 4 of the DEIS. "Vertical well completion, or conventional drilling" is confusing. There is a distinction between drilling a well and completing a well. The writer seems to combine these. The writers water usage source seems to be broad with no specifics to actual average water usage in Osage County. Water usage is based on formation, depth, length of lateral etc. Again, this section fails to mention agriculture practices or grazing practices and their baseline analysis on water consumption and possible contamination. Finally, this assumes that wells in Osage County are all drilled with water. A common method of drilling wells in Osage County is the use of air drilling. This method uses a fraction of the water requirements of conventional rotary drilling. The writer does not address air drilling and its percentage of usage comparatively.	Affected Environment - Water Resources	WallerE_20200221_OsageMineralsCouncil	The first sentence is stating that releases of contaminated water can impact water quality; it is not a conclusion. This paragraph and the preceding one have been reorganized in Section 3.3.2 of the FEIS to clarify the information. Data on water usage in Osage County are not available, therefore the description relies on ranges of water use from other reliable sources as cited in the paragraph. Section 4.3.7 of the DEIS provides cumulative impact analysis that acknowledges the effects other non-oil and gas activities have had on water resources in the planning area. The analysis of direct and indirect impacts from oil and gas development on water resources in Sections 4.3.2 through 4.3.6 is appropriately limited to the action being considered in this EIS--BIA management of oil and gas leasing and development. Language has been added to Section 3.3.2 of the FEIS acknowledging the differences in water use for wells drilled using air drilling.
1421	2/21/2020	"In 2016, 116 spills resulted in saltwater being released; 20 of these spills resulted in more than 100 barrels worth of saltwater being released (BLM 2017)." This information is from the BLM, but the BLM has no involvement in oil and gas production within the Osage Reservation. How is this information applicable to the Osage Reservation? Or, is it applying information that has no applicability to the Osage Reservation? If the DEIS is going to rely upon information from an agency that has no involvement with the Osage mineral estate, then it needs to identify the specific locations within "planning area[s]" on the Osage Reservation that have been impacted by these spills. Furthermore, the quantitative analysis falls short here. The analysis fails to include relevant information, such as: • The number of acres and to what extent the 20 spills had an environmental impact to the vegetation and soils 100 bbls; • The impact of the other 96 spills and whether they affected vegetation, soils etc., as well as the extent of the impact. This information needs to be fleshed out so that proper impacts analysis can be completed in Section 4. These are again, blanket statements that are biased against oil and gas development.	Affected Environment - Water Resources	WallerE_20200221_OsageMineralsCouncil	The reference has been corrected to be BIA 2017. It is spill record data from the BIA Osage Agency. The data available do not include the number of acres affected by spills, therefore it is not possible to describe this information in the EIS.

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1422	2/21/2020	Lands in the planning area have been affected by salt scarring, tree kills, soil salinization, and brine and oil contamination. These conditions are due to the leakage of produced water and associated hydrocarbons from brine pits and accidental releases from active and inactive pipes and tank batteries (USGS 2005)." Again, this has been repeated with no quantitative analysis or facts. How many acres have been affected compared to the number of acres in the planning area? There needs to be more of a quantitative baseline analysis instead of blanket negative statements. How can the Affects analysis be done if there is no baseline analysis? "The US Geological Survey analyzed groundwater quality in the planning area in 2014 (USGS 2014). The entire planning area is underlain by brines containing concentrations of sodium and chloride and total dissolved solids of greater than 1,500mg/L (D'Lugosz et al. 1986); therefore, all freshwater aquifers in the planning area are subject to contamination by brines from natural seepage or oil and gas development activity (USGS 2014)." (Pg 3-21 / 3-22) Environmental baseline should be committed to the facts. Regarding the last sentence of this paragraph, what is the level of concern for oil and gas development activity to contribute to contamination of the groundwater. Has there been a study of level of contribution between natural seepage and oil and gas development? If not, it seems that this paragraph should be limited to D'Lugozs 1986 literature. This "entire planning area is underlain by brines" is false. USGS 2015-26 electro-magnetic aerial survey of Osage County disclosed many areas of low salinity, not brine, subsurface ground water. "Local effects may cause the substantial variations in dissolved chloride concentration in groundwater in the planning area (USGS 2014). These effects can be caused by brines seeping into shallow groundwater or by leaks and spills from oil and natural gas extraction near the land surface. No general geographic patterns of dissolved chloride concentration are apparent in groundwater samples collected in the planning area (USGS 2013)." (pg 3-22) This paragraph is an opinion with no real baseline quantitative analysis. Was there an independent study completed to validate analysis? Where is the agriculture and grazing baseline analysis regarding groundwater?	Affected Environment - Water Resources	WallerE_20200221_OsageMineralsCouncil	Data on the exact number of acres affected by salt scarring, tree kills, soil salinization, and brine and oil contamination are not available; however, the statement is supported by the reference cited. The assertion from D'Lugosz et al. 1986 referenced in Section 3.3.2 of the DEIS is not contradicted by the USGS study, which measured groundwater. The brine can be below low salinity groundwater. The statements in the paragraph describing dissolved chloride concentration in Section 3.3.2 of the DEIS are supported by the references cited in the paragraph, which refer to USGS studies. Section 4.3.7 of the DEIS provides cumulative impact analysis that acknowledges the effects other non-oil and gas activities have had on water resources in the planning area. The analysis of direct and indirect impacts from oil and gas development on water resources in Sections 4.3.2 through 4.3.6 is appropriately limited to the action being considered in this EIS--BIA management of oil and gas leasing and development.
1422	2/21/2020	"As shown in Table 3-9, oil and natural gas activities are considered a probable source in 3 out of the 18 impaired waterbodies in the planning area: Hominy Creek, Bigheart Creek, and Harlow Creek. No total maximum daily load has been established for the pollutants that could be related to oil and natural gas activities on these waterbodies (EPA 2015d)." pg 3-23 What information is there to back up the statement "oil and natural gas activities are considered a probable source in 3 out of the 18 impaired waterbodies…"? The writer presents a biased view based on an EPA study. "Chloride concentrations measured in surface water in 1999 at sites distributed throughout the planning area were generally greatest in the southern and eastern sections. This is also where the most oil and gas wells had been drilled. Chloride levels are particularly high in the Little Hominy Creek watershed in the Bird Creek basin (USGS 2014)." Pg3-24 The statement "This is also where the most oil and gas wells had been drilled" reflects a bias that leads the reader to deduce that oil and gas wells are the sole factor of heavier chloride concentrations. "As oil and gas development and populations increase, the demand for water will likely increase. Injecting produced water is also expected to increase, with the continuation of hydraulic fracturing and conventional oil and gas development in the planning area." Pg 3- 25 The continuation of drilling new oil and gas wells does not necessarily translate into an increase in produced water injection. It could very well be that the produced water injection rate stays the same even with the increase in drilling wells. The reason why would be due to depletion of the producing wells. The blanket statement that it is "expected to increase" is based on what? By how much?	Affected Environment - Water Resources	WallerE_20200221_OsageMineralsCouncil	The statement about oil and gas being considered a probable source in 3 out of the 18 impaired waterbodies is from the referenced EPA source. The statement comparing chloride concentrations and oil and gas development is supported by the reference cited. The statement about injecting produced water being expected to increase with increased oil and gas development is reasonable based on the history of oil and gas development in the planning area described in Section 3.3.2 of the DEIS. Wells generally produce the most water early in the well life and the decrease in produced water from the abandonment of late cycle wells is not likely to be enough to offset the increase from new wells brought online. The BIA acknowledges that recent trends in Osage County have shown plugging permits outpacing drilling permits and has added language to Section 3.1 of the FEIS to explain that the NEPA analysis still assumes the total number of wells will increase going forward in order to provide maximal NEPA coverage in describing possible effects of these activities. It is not possible to project a specific increase in injection using available data.
1462	12/31/2019	EPA recommends the Final EIS incorporate information regarding the process for obtaining Clean Water Act (CWA) 401 certification. The purpose of these certification reviews is to determine whether a proposed discharge to surface waters under a federal permit (e.g., CWA Section 402 or Section 404) will comply with water quality standards. The Oklahoma Department of Environmental Quality (ODEQ) administers the CWA Section 401 water quality certification program in Oklahoma for projects on state lands. However, on tribal land when a tribe has not received treatment in the same manner as a state for the CWA Section 401 program, EPA retains responsibility for CWA 401 certification reviews. For the 2017 nationwide permits (NWP) under CWA Section 404; EPA Region 6 did not certify the use of the 2017 NWP's for use in the Tulsa District. Rather, in accordance with Corps regulations at 33 CFR 330.4(c), anyone wanting to perform an activity subject to the NWPs (or under an individual CWA 404 permit) on tribal land is required to obtain an activity specific water quality certification, or waiver, from EPA before proceeding under the NWP. We also note that a project requiring coverage under ODEQ's construction general permit, may also require coverage under EPA's construction general permit for the portion on tribal land.	Affected Environment - Water Resources	BlancoA_20191231_EPA	Information on the process for obtaining a CWA Section 401 permit has been added to Section 3.3.2 of the FEIS.
1386	1/31/2020	Where is the US EPA in all this? The big issues are managed by the EPA not by the BIA, spill plans (Clean Water Act) and injection wells (Safe Drinking Water Act).	Consultation and Coordination	TrentJ_20200131	The U.S. Environmental Protection Agency (EPA) is a cooperating agency for the Osage County Oil and Gas EIS (EIS) (see, Executive Summary, Section ES.4.2, Cooperating Agency Coordination; Chapter 5, Section 5.3.2, Cooperating Agency involvement). As a cooperating agency, the EPA participated in all aspects of the planning process for the Draft EIS including, but not limited to, the development of alternatives. The EIS does not supersede, amend, or otherwise alleviate the need to comply with, applicable federal law, nor does it impact any Federal Government agency's jurisdiction over operations and resources within Osage County. Under all Alternatives, lessees must comply with the requirements of federal law including, but not limited to, the Clean Air Act of 1972 (CWA) and Safe Drinking Water Act of 1974 (SDWA) (see, Executive Summary, Section ES.6, Alternatives; Chapter 2, Section 2.3.1, Management Common to All Alternatives).
1396	2/21/2020	while the BIA has invited the OMC to be a "cooperating agency" under the provisions of 40 C.F.R. § 1501.6, the OMC has not been treated as such, and the comments we offer could have been resolved had the OMC been a full partner in the preparation of this DEIS. The OMC has special expertise, and in some cases jurisdiction by law, and it is clear that the White House Council on Environmental Quality intended that a cooperating agency be involved in every aspect of the NEPA process from scoping to the Record of Decision. A cooperating agency should not be one in name only, nor should a cooperating agency be relegated to merely commenting on a DEIS once the preparation is complete.	Consultation and Coordination	WallerE_20200221_OsageMineralsCouncil	The Osage Minerals Council (OMC) has been actively involved in preparation of the Osage County Oil and Gas EIS (EIS) as a cooperating agency. On July 7, 2016, the OMC and BIA executed a Memorandum of Understanding (MOU) establishing a cooperating agency relationship for preparation of the EIS. The OMC has participated as a cooperating agency since that date in accordance with the terms of the MOU. Between July 2016 and April 2018, the OMC and its legal counsel attended seven cooperators' meetings held in Pawhuska, Oklahoma. The OMC and its legal counsel also participated in two teleconferences with cooperating agencies and communicated with the project lead informally on a routine basis. During those meetings and calls, the BIA, OMC, and other cooperating agencies worked collaboratively to develop the alternatives, BMPs, and COAs (the OMC's legal counsel provided proposed alternatives in writing for discussion); consider the potential impacts of proposed alternatives, COAs, and BMPs; analyze the affected environment; examine the results of public scoping; compile and review data, maps, and graphs; discuss the FWS Biological Opinion for Osage County; and schedule public meetings, among other things. The BIA provided the OMC with the working copy of the Draft EIS for review and comment in October 2017. The OMC and its legal counsel provided both written and verbal comments thereon. The BIA also provided the newly elected OMC with a copy of the Draft EIS in July 2018. The BIA values the OMC's contributions as a cooperating agency and looks forward to continued collaboration on the EIS. If the OMC no longer wishes to be a cooperating agency for the EIS, in accordance with Section VII(C) of the MOU, the Chairman must submit a request to terminate the MOU to the Regional Director, Eastern Oklahoma Region, BIA in writing.

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1448	2/21/2020	Shortcomings Related to Osage Minerals Council Status as Cooperating Agency The current draft of the DEIS provides a number of provisions that conflict with the 1906 Act and subsequent amendments to the 1906 Act. These conflicts could have been resolved had the Osage Minerals Council been treated as a cooperating agency in more than name alone, as represented by the BIA Notice of Availability published on November 22, 2019. ^24 On July 7, 2016, Everett Waller, Chairman of the Osage Minerals Council, signed the Memorandum of Understanding Between Department of the Interior, Bureau of Indian Affairs, Eastern Oklahoma Region, and Osage Minerals Council as a Cooperating Agency/Entity (MOU). Eddie Streater, Regional Director for the BIA's Eastern Oklahoma Region had signed the MOU on June 30, 2016. The MOU presented a number of requirements that have yet to be fulfilled, and thus, the Osage Minerals Council should not be deemed a cooperating agency that participated in the development of the DEIS. Among other things, the MOU permits the OMC, as cooperating agency: to participate in activities including, but not limited to, those identified in Attachment A. These activities include: identifying 24 84 Fed. Reg. 64556. 44 data needs, identifying alternatives, identifying effects of alternatives, suggesting design features, and providing written comments on working drafts of the EIS and supporting documents. ^25 Additionally, the MOU provides: The OMC will review the draft EIS and offer comments and edits for BIA's consideration for incorporation into the draft EIS before it is released for public review. Upon the EIS becoming final, the OMC will have the opportunity to approve the final EIS by resolution before the record of decision is published. ^26 Since entering the MOU, the OMC has not been privy to any working drafts of the DEIS or other supporting documents, nor was OMC permitted to review the DEIS prior to its released for public review. The OMC initially agreed to be a cooperating agency, as the BIA seemingly acknowledged the benefit of including the OMC in the EIS development process, due to the OMC's "jurisdiction by law and special expertise applicable to the EIS effort."^27 This special expertise has not, however, been utilized, and as a result, the DEIS is rife with problematic provisions.	Consultation and Coordination	WallerE_20200221_OsageMineralsCouncil	The Osage Minerals Council (OMC) has been actively involved in preparation of the Osage County Oil and Gas EIS (EIS) as a cooperating agency. On July 7, 2016, the OMC and BIA executed a Memorandum of Understanding (MOU) establishing a cooperating agency relationship for preparation of the EIS. The OMC has participated as a cooperating agency since that date in accordance with the terms of the MOU. Between July 2016 and April 2018, the OMC and its legal counsel attended seven cooperators' meetings held in Pawhuska, Oklahoma. The OMC and its legal counsel also participated in two teleconferences with cooperating agencies and communicated with the project lead informally on a routine basis. During those meetings and calls, the BIA, OMC, and other cooperating agencies worked collaboratively to develop the alternatives, BMPs, and COAs (the OMC's legal counsel provided proposed alternatives in writing for discussion); consider the potential impacts of proposed alternatives, COAs, and BMPs; analyze the affected environment; examine the results of public scoping; compile and review data, maps, and graphs; discuss the FWS Biological Opinion for Osage County; and schedule public meetings, among other things. The BIA provided the OMC with the working copy of the Draft EIS for review and comment in October 2017. The OMC and its legal counsel provided both written and verbal comments thereon. The BIA also provided the newly elected OMC with a copy of the Draft EIS in July 2018. The BIA values the OMC's contributions as a cooperating agency and looks forward to continued collaboration on the EIS. If the OMC no longer wishes to be a cooperating agency for the EIS, in accordance with Section VII(C) of the MOU, the Chairman must submit a request to terminate the MOU to the Regional Director, Eastern Oklahoma Region, BIA in writing.
1379	1/16/2020	Mistakes, errors, secondary sources, etc. Page ES-2, Paragraph ES.2: A reference is made to the 2014 and 2015 Programmatic EAs. These have been deleted from the Agency's website and should be restored until the EIS process is completed. Page ES-2, Paragraph ES.3: EAs are not the responsibility of the operator. Page 2-23, COA 28: The BIA lacks the authority to regulate noise and visual impacts. Page 3-7, Paragraph 3.2.2: The Indian Nations Council of Governments, 2030 Osage County Comprehensive Plan is a poor secondary source for earthquakes, a reliable source is http://www.ou.edu/ogs/research/earthquakes/catalogs . Page 3-19: "Additional volumes of produced saline groundwater are likely reinjected in other producing fields in the planning area, but data are not available from those fields." This information is relevant and should be readily available, the BIA should contact the US EPA or the Osage Nation for information on Class II injection wells. Page 3-47, Paragraph 3.6.2: The highest elevation in Osage County, approximately 1,300 feet is in the far northwest not near Wynona. Page 3-75, Paragraph 3.10.1, Housing: Pawhuska and Hominy are cities. Recognized villages of the Osage Nation are Grayhorse Indian Village, the Pawhuska Indian Village, and the Hominy Indian Village. Page 3-89, Paragraph 3.10.1, Environmental Justice: The EIS would benefit from stating that Census tract 9400.2 is the extreme southeast corner of Osage County, 3,800 feet from Tulsa City Hall, and 9400.6 encompasses the city of Pawhuska and the Pawhuska Indian Village. Page 3-92, Paragraph 3.11.3, Trends: "Oil and gas development will continue to introduce risks to public health and safety in Osage County. The risk level depends on such factors as the amount of development and nature and type of mitigation measures implemented." This and similar gratuitous statements insinuate a level of risk that does not exist.	Document Edits	DeLongJ_20200116_OsageProducersAssociation	ES.2 - The Leasing and Workover PEAs are available on the BIA Osage Agency website at https://www.bia.gov/regional-offices/eastern-oklahoma/osage-agency ES.3 - The commenter is correct that the ultimate responsibility for NEPA review lies with the Federal Agency. The CEQ Regulations, however, provide for preparation of NEPA reviews by contractors or applicants (e.g., producers) with independent evaluation by the Federal agency. 40 C.F.R. 1506.5. This is a recognition that preparation by an outside party may be faster than relying on the agency to prepare the review as it has resources and budget to do so. The BIA's NEPA Handbook has reflected its policy of requesting preparation by applicants since at least 2005. The Osage Agency adopted such a policy in 2014. COA 28 - The Secretary of the Interior has broad discretion regarding management of the Osage Mineral Estate. The Act of June 28, 1906, § 3, 34 Stat. 539, as amended ("1906 Act"), provides that the Osage Nation may lease the Osage Mineral Estate for oil and gas mining "…subject to the approval of the Secretary of the Interior, and under such rules and regulations as he may prescribe." The 1906 Act does not specify, or otherwise place limitations on, the nature of the rules and regulations to be implemented thereunder. Accordingly, it is within the Secretary's authority to issues rules and regulations relating to noise and visual impacts associated with development of the Osage Mineral Estate. At present, § 226.19(a) of the regulations governing the Osage Mineral Estate prohibits lessees from permitting avoidable nuisance to be committed upon the lease. The Secretary also reserves the right to issue additional rules, orders, and notices to lessees relating to the prevention of nuisance. 3.2.2 - The information on number of earthquakes statewide and with epicenters in Osage County has been updated based on OGS information. Page 3-19 - The referenced text in Section 3.3.2 of the DEIS is discussing injection of produced water for hydraulic fracturing, which is not subject to permitting under the EPA's Underground Injection Control program. 3.6.2 - This statement has been updated to refer to the highest point in Osage County being in the far northwestern part of the county. 3.10.1, Housing - This paragraph has been clarified to refer to the Indian Villages being reserved. 3.10.1, Environmental Justice - The requested information has been added for additional context. 3.11.3 - Section 3.11.2 of the DEIS describes the risks posed to public health and safety from oil and gas development. The cited statement is reasonable in noting that there are public health and safety risks introduced by oil and gas development and, at this programmatic analysis level, a variety of factors affect the level of risk and the probability of actual public health and safety impacts from a specific development.
1379 (cont.)	1/16/2020	Page 3-92, Paragraph 3.12, Visual Resources: The Osage Windfarm is an affront to visual resources and should be called out. Page 3-94, Visual Resources: The referenced "byway" is U.S. 60. Although it does provide unique views and vistas {the best in Oklahoma}, there are no buffalo to be seen and no "estates of Oklahoma's historic oil barons", which would have been obvious had the Preparers traveled across Osage County on U.S. 60. Page 3-94, Visual Resources: Lighting from oil and gas related construction is not significant, less than high school football. The largest operator in Osage County uses "air rigs" and does not operate at night. When rotary rigs are used night, operation is about 5 days per well. Osage wells are not at all like multi well horizontal operations that operate for weeks. Page 3-95, Paragraph 3.12.3 Trends: The "modification" of the landscape due to oil and gas development is minuscule compared to, for example, the reconstruction of US 60 between Pawhuska and Bartlesville. "Predicted nationwide price increases" are not discussed in Section 3.16 or elsewhere in the DEIS. Page 3-106, Paragraph 3.16.2 Current Conditions: To spud a well is to start the drilling process. Page 3-106: It is best not to confuse flowback with produced water. Flowback occurs following hydraulic fracturing and in quality and quantity is similar to the water and chemicals that were introduced as fracking fluids. Produced water is formation water brought to the surface along with oil and gas and may occur through the life of the well and increase over time. Page 3-107: Produced water is not stored in pits in Osage County. It is not recycled except as a water flood to enhance oil recovery. Produced water in Osage County is disposed of through Class II disposal wells regulated by the US EPA. Page 3-113: Keystone State Park is on the south side of the Arkansas River, it is not in Osage County. Page 4-1, Paragraph 4.1 Introduction: The DEIS does not demonstrate the "team's knowledge of the planning area and its resources". Page 4-8, Table 4-1: The Spearhead and Flanagan South Pipeline "run through" approximately 50 miles of Osage County not 11.3 miles. Page 4-9: Table 4-1: The Table failed to include the Chaparral {now Perdure Petroleum} C02 flood project.	Document Edits	DeLongJ_20200116_OsageProducersAssociation	3.12 - Section 4.12.7 of the DEIS provides cumulative impact analysis that acknowledges the effects other non-oil and gas activities, including wind farms, have on visual resources in the planning area. The analysis of direct and indirect impacts from oil and gas development on visual resources in Sections 4.12.2 through 4.12.6 is appropriately limited to the action being considered in this EIS--BIA management of oil and gas leasing and development. Page 3-94, Visual Resources, Byway language - This language has been clarified in Section 3.12.2 of the FEIS. Page 3-94, Visual Resources, Lighting language - Section 3.12.2 of the DEIS states that "Lighting from oil and gas-related construction also reduces nighttime darkness." The commenter's statement does not contradict this language, and no change is needed to the EIS. 3.12.3 - Language has been added to this section reiterating acknowledgement of other modifications to the visual landscape, such as road construction in the county. Section 3.16.3 of the DEIS discusses projected nationwide oil and natural gas price increases. 3.16.2, Spud language - This language has been revised in the EIS to clarify that spudding only is referring to the beginning of the drilling process. 3.16.2, Produced water language - "produced water" has been deleted from this sentence to reduce confusion. Page 3-107 - This language has been clarified in Section 3.16.2 of the FEIS. Page 3-113 - The commenter's statement does not contradict the statement in Section 3.17.2 about Keystone State Park being located along the southern boundary of Osage County on the south side of the Arkansas River. Added further clarification that this is outside Osage County. Page 4-8 - Table 4-1 in the FEIS has been updated to correct the mileage for the pipelines running through Osage County. Page 4-9 - Information on this project has been added to Table 4-1 in the FEIS.

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1379 (cont.)	1/16/2020	Page 4-12, Paragraph 4.2.2 Impacts Common to All Alternatives: The DEIS has failed to account for the substantial volume of produced water returned via Class II disposal wells {Information available from the US EPA or the Osage Nation}. The incremental volume introduced by future wells is, by comparison, modest. Substantial quantities of produced water have been reinjected in Osage County for decades without causing seismicity. Page 4-20, Groundwater: Dedicated wastewater treatment plants and municipal wastewater treatment plants are not used for disposal of produced water in Osage County. Unlined earthen pits are not used to contain produced water in Osage County. Page 4-21, Impacts from Disposing of Produced Water: Produced water has not been stored in unlined pits for decades. Produced water is never "fresh". Page 4-23, Indirect Impacts on Water Resources Due to Wastewater Disposal Associated with Hydraulic FraCturing: Produced water is not "disposed of in pits" lined or unlined. Page 4-25, Paragraph 4.3.4 Alternative 2: Land application of oil and wastewater are not practiced in Osage County. Page 4-28, Paragraph 4.3.7 Cumulative Impacts: The Preparers are advised to read the entire paragraph from Page ES-9 of Assessment of the Potential Impacts of Hydraulic Fracturing for Oil and Gas on Drinking Water Resources Executive Summary, External Review Draft, EPA/600/R-15/047a, June 2015. The statement, "FracFocus 1.0 disclosures indicate that annual water use for oil and gas development was 10 percent, or greater, of total annual water use in 6.5 percent of the counties reporting", is not relevant to Osage County. Appendix A Page 12, Paragraph G. Infrastructure: Figure 14 is the standard DOT PHMSA map, most of the pipelines shown are not connectable to Osage production. Appendix A Page 16, Paragraph VII. Surface Disturbance Due to Oil and Gas Activity: We agree, that is difficult, but not extremely difficult, to estimate the current surface disturbance of O&G. It has been done, see: https://ec637f48-b460-4378-9729-cabgeOfeblfc.filesusr.com/ugd/028647 02ad3201cd13488a8b38440c3706c382.pdf.	Document Edits	DeLongJ_20200116_OsageProducersAssociation	Page 4-12 - Data on historical amounts of water injected into disposal wells are not relevant to the analysis, as the referenced scientific citations in Section 3.2.2 of the DEIS describe the linkage between water injection into disposal wells and induced seismicity in central and north-central Oklahoma. Page 4-20 - The referenced language has been deleted from Section 4.2.2 of the FEIS, as COA 12 has been removed from all alternatives. The measures in COA 12 are already required by the regulations in 25 CFR Part 226. Page 4-21 - The referenced language has been revised in Section 4.2.2 of the FEIS, as COA 12 has been removed from all alternatives. The measures in COA 12 are already required by the regulations in 25 CFR Part 226. These revisions also clarify that effects have occured from historical storage of produced water in pits. Compliance with the regulations has mitigated these effects. Page 4-23 - This discussion has been deleted from Section 4.3.2 of the FEIS, as COA 12 has been removed from all alternatives. The measures in COA 12 are already required by the regulations in 25 CFR Part 226. Page 4-25 - Land application of wastewater is not practiced and is strongly discouraged, but is not directly prohibited in Osage County, therefore it is analyzed here as a possible occurence. Page 4-28 - The sentence on FracFocus disclosures has been deleted from Section 4.3.7 of the FEIS. Appendix A Page 12, Paragraph G - The referenced text from the Reasonably Foreseeable Developent Scenario does not imply that these pipelines can be connected to Osage production. On the contrary, it goes on to discuss the barriers to natural gas transport in the planning area. The preceding paragraph acknowledges that "virtually all oil purchased in Osage County is transported by truck to nearby Oklahoma and Kansas refineries or to pipeline facilities located within the County." Appendix A Page 16, Paragraph VII - The link provided by the commenter was broken and could not be accessed.
1381	1/19/2020	many (about 30) of the internet links listed in References are no longer functional and access to the referenced information should be restored. However, much of that information is not relevant to the purpose of the EIS and could be deleted from the EIS along with the reference. For example, "Fairfax Community Hospital. 2017. Information page. Internet website: http://www.fairfaxcommunityhospital.com/ ", is the source for "Fairfax Community Hospital provides emergency, laboratory, and inpatient care and has 15 beds (Fairfax Community Hospital 2017)". The information is not relevant, and the domain name is now for sale. The Hydration Engineering paper, Storer, Fred, T. Keener, and L. Burleson. Hydration Engineering PLLC. 2016. Oil and Gas Land Use in Osage County, Oklahoma. September 10, 2016, lacks a source. It is available at https://www.hydrationengineering.com/osage-county , item 7.	Document Edits	StorerF_20200119_HydrationEngineering	The links to all files in the References appendix of the FEIS have been verified.
1376	2/6/2020	The environmental consequences are discussed as if the COAs pertaining to each alternative are certain. However, the DEIS makes clear that COAs for any permit (regardless of the alternative) are actually uncertain: "The EIS does not list the exact set of COAs that would be applied to each permit under an alternative. Under all alternatives, the BIA may waive COAs or apply additional COAs based on site-specific determinations." DEIS, p. 2-8. This lack of certainty as to the COAs, and the failure to consider that lack of certainty in the impacts, renders the rest of the EIS deficient and inaccurate.	Environmental Consequences	FuhrM_20200206NatureConservancy	Because this is a programmatic NEPA document that does not analyze a specific proposal, it is not possible to identify the exact set of COAs that would apply to development activities. Section 2.3.1 of the DEIS details how COAs are part of the EIS alternatives and may vary for specific developments. The environmental consequences analysis in Chapter 4 assumes application of certain COAs listed under each alternative. This assumption has been reiterated in Section 4.1 the FEIS. Additional site-specific analysis of COAs proposed for application to a permit may be completed as part of NEPA compliance associated with individual drilling permits and certain types of workovers.
1377	2/6/2020	Infrastructure relative to oil and gas activities (including pipelines, roads, facilities, etc.) are only nominally mentioned yet are some of the biggest contributors to environmental degradation.	Environmental Consequences	FuhrM_20200206_NatureConservancy	Impacts of surface-disturbing activities, including construction of roads, pipelines, and other related infrastructure, are discussed in various resource sections throughout Chapter 4 of the DEIS. These related infrastructure activities are specifically mentioned and included in the analysis. For example, in Sections 4.2.2, 4.3.2, 4.4.2, 4.5.2, 4.6.2, and many other sections of Chapter 4, the description of impacts common to all alternatives focuses on how surface disturbing activities affect the resource and include infrastructure such as roads and pipelines in that description.
1378	1/16/2020	The Draft EIS is, inappropriately, a list of perceived risks and the measures that might be applied to counter the risks. The Draft EIS fails to make a detailed statement by the responsible official of the environmental impact ofthe proposed action as required by Section 102 of the National Environmental Policy Act (NEPA). The proposed action is the continued management of the Osage mineral estate for the benefit of the shareholders (defined by the 1906 Osage Allotment Act). The best evidence of environmental impact is the consequences of actions of the Osage Agency since the Agency rediscovered NEPA in 2014. Those consequences can be gleamed from the fifty plus Environmental Assessments prepared by the Agency and/or by the, not too difficult, task of just going to the well sites and looking. Examination of the consequences might well result in recognition of problems, errors made, or the need for additional regulations.	Environmental Consequences	DeLongJ_20200116_OsageProducersAssociation	As stated in Section 1.3 of the DEIS, the federal actions analyzed in the EIS are the approval of leases, drilling permits, and workover permits. These approvals result in environmental effects associated with the activities authorized by them. It is therefore appropriate to analyze the effects of the activities being authorized by the BIA.
1382	2/20/2020	There is also a need to consider social sustainability that goes hand-in-hand with economic stability in Osage county. Ranching and oil and gas production are primary drivers of the economy in Osage county and most all of the populous of the county is directly or indirectly benefitting from one of these industries. It only seems logical to work on protecting both of these cultures by devising improved and enforceable best management practices (BMPs) that will ensure cleaner and more sustainable oil and gas production as well as preserve property values and the productivity of these lands as agricultural enterprises.	Environmental Consequences - Agriculture	WallisB_20200220_OsageBuckCreek	The DEIS analyzes current conditions and effects on agriculture in Sections 3.8 and 4.8, and agriculture is described as a key employment sector in Osage County in Section 3.10.1. The alternatives presented in Chapter 2 seek to promote oil and gas development while avoiding or minimizing potential adverse impacts on surface owners, wildlife, and natural and cultural resources from noise, traffic, excavation, dust, and other disturbances associated with construction and operations under oil and gas leases, as stated in Section 2.3 of the DEIS.
1413	2/21/2020	"Under all alternatives, incidental loss of or damage could occur to cultural resources, including those of significance to the Osage Nation and interested Tribes. Required compliance with the provisions of the NHPA, specifically Section 106 (36 CFR Part 800), would minimize and mitigate impacts. The BIA would consult with the THPO, interested Tribes, and other interested parties." Any protections related to cultural protection must be provided within the context of the 1906 Act, as amended. The NHPA does not exist in a vacuum, void of Osage-specific federal laws. To the extent these alternatives do not specifically address how they comply with the 1906 Act, as amended, or otherwise why they can operate outside of the 1906 Act, as amended, they are not in the best interest of the Osage. Additionally, the DEIS uses the word "could" which is a much better term and should be considered in other sections. Even so, the DEIS again assumes damage or loss of cultural resources has occurred by oil and gas development with no evidence or examples to show this.	Environmental Consequences - Cultural Resources	WallerE_20200221_OsageMineralsCouncil	Section 106 of the National Historic Preservation Act (NHPA), 54 USC 306108, requires that Federal agencies "take into account the effect of any undertaking on any historic property" before making a decision on the undertaking. The consideration of the effects is to be in consultation with the State Historic Preservation Officer or, for tribal land, the Tribal Historic Preservation Officer. 36 C.F.R. 800.1 and 800.2. An "undertaking" is "a project, activity, or program funded in whole or in part under the direct or indirect jurisdiction of a Federal agency, including: (1) those carried out by or on behalf of the Federal agency; (2) those carried out with Federal financial assistance; [and] (3) those requiring a Federal permit, license, or approval." 54 USC 300320. Thus, before taking the action, the Secretary must consider the effect on historic properties of any action that the Secretary takes, funds, or approves in Osage County. That consideration is done in consultation with the Oklahoma State Historic Preservation Officer, the Oklahoma Archaeological Survey, and the Osage Nation Tribal Historic Preservation Officer. Like the NEPA process, the Section 106 process does not "trump" or replace any other Federal law; rather, it supplements other laws to ensure that consideration of the effects on important tribal cultural and religious sites, as well as other historic properties, are taken into account in the decision making process. It is a commonly accepted fact that surface disturbing activities such as oil and gas development carry with them the risk of destruction of cultural resources. The DEIS acknowledges this in Sections 3.9 and 4.9 and also describes how following the procedures laid out in the NHPA significantly reduces the risk of these effects.
1443	2/21/2020	CULTURAL RESOURCES It seems all alternatives would be equal in the affects analysis with respect to cultural resources and the potential impacts. This is due to the fact that Section 106 under the NHPA would have to be complied with. COA's would not have any impact on complying with Section 106. The preservation of cultural resources in Osage County can be primarily attributed to the oil and gas industry and the requirement to comply with the NHPA. The writer fails to analyze and describe to the public how many acres in Osage County have been surveyed for cultural resources and what industry those surveys were related to. The writer fails to definitely conclude that these surveys related to oil and gas development have had a positive outcome for the preservation of cultural resources	Environmental Consequences - Cultural Resources	WallerE_20200221_OsageMineralsCouncil	Section 3.9.2 of the DEIS describes how "compliance activities have steadily increased the rate of site discoveries due to continued mineral and energy development and the use of block surveys to efficiently inventory the cultural resources." While data on the total acreage surveyed in the County are not available, information on the total number of cultural surveys that have been conducted in the County associated with activities authorized by the BIA has been added to Section 3.9.2 of the FEIS. It is not feasible to separate these data by type of activity, but they provide a picture of the total number of surveys for all authorized activities.

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1383	2/20/2020	In addition to the many mammals and aquatic species that we all enjoy the tallgrass prairie also supports a large population of grassland obligate bird species, both resident birds and migratory birds, as well as endangered species such as the American Burying Beetle. The tallgrass prairie acts as a travel corridor and has been identified as an area of importance for migratory birds as they move from their wintering grounds to their breeding grounds. Many of these migratory species also breed and nest here. However, with every pad site, road, power line, and pipeline that is associated with increased oil and gas exploration the available habitat for breeding, nesting, raising chicks, and wintering birds is decreased. The Greater Prairie Chicken is a species of concern that totally relies on the tallgrass prairie for its home range. Research conducted in Osage county from 2014- 2016 (Londe et al. 2019) has shown that Greater Prairie Chickens have a strong propensity to avoid structures such as power lines, pump jacks, tank batteries, and roads and that increased oil and gas operations actually fragment the landscape and provide barriers that these birds avoid which only increases the rate at which their useable habitat is shrinking. Western Osage county represents that last of the unfragmented tallgrass prairie in the state of Oklahoma and therefore is home to what is likely the southernmost population of greater prairie chickens left in the world. As a species of concern for federal and state agencies as well as private landowners it would be a shame to blindly continue to fragment their habitat with increased oil and gas exploration and infrastructure.	Environmental Consequences - Fish, Wildlife, and Migratory Birds	WallisB_20200220_OsageBuckCreek	Sections 3.5.2 and 3.5.3 of the DEIS describe the importance of the tallgrass prairie to migratory birds and, specifically, the greater prairie-chicken. Effects on these species from oil and gas development are described in Section 4.5 of the DEIS.
1446	2/21/2020	MINERAL EXTRACTION 4.16.4 ALTERNATIVE 2 "With the removal of some COAs, the BIA would need to submit a revised BA and reinitiate formal consultation on a new BO. Until a new BO is issued, lessees would be solely responsible for documenting compliance under ESA Section 10. Oil and gas operations could not proceed until a 45-day wait period has elapsed, 4. Environmental Consequences (Mineral Extraction) 4- 102 Osage County Oil and Gas Draft Environmental Impact Statement November 2019 unless there is no suitable habitat and the BIA is willing to make a "no affect" determination for the ABB. This could delay oil and gas development in the planning area, compared with Alternative 1 (No Action)." The writer needs to explain this in more detail. It is unclear as to why a revised BA would be needed with a new BO.	Environmental Consequences - Mineral Extraction	WallerE_20200221_OsageMineralsCouncil	As described in Section 2.3.3 of the DEIS and demonstrated in Appendix B, which contains the Biological Assessment (BA) and Biological Opinion (BO), the analysis in the BA is based in part on protections provided by the COAs currently being applied. Because Alternative 2 would no longer apply some of these COAs, the analysis in the BA would likely need to be revised to reflect the changes in protection, and a new BO would be needed.
1444	2/21/2020	SOCIOECONOMICS AND ENVIRONMENTAL JUSTICE 4.10.2 IMPACTS COMMON TO ALL ALTERNATIVES "While proposed COAs may affect operations, they are not expected to result in development becoming economically unfeasible. Application of the COAs is therefore not anticipated to have a significant impact on the level of oil and gas development in the county under any of the four alternatives analyzed. Further, the BIA Osage Agency Superintendent may approve a modification or waiver of a COA, so long as such modification or waiver does not violate applicable laws and regulations." "Application of the COAs is therefore not anticipated to have a significant impact on the level of oil and gas development in the county under any of the four alternatives analyzed." This flies in the face of the writer's entire analysis in this DEIS. If this is true, then why have a distinction between the 4 alternatives and their respective COAs?	Environmental Consequences - Socioeconomics and Environmental Justice	WallerE_20200221_OsageMineralsCouncil	There is no requirement in the CEQ NEPA regulations that alternatives result in variations in one type of impacts or another. The COAs provide different levels of environmental protection and restrictions on development activities, and their application would result in varying impacts on resources and resource uses, as described in Chapter 4 of the DEIS. They do not necessarily need to result in different levels of oil and gas production. Differences in the methods used for development and production may result in varying effects on other resources and resource uses.
1445	2/21/2020	"Construction associated with oil and gas development has the potential to result in short term impacts on local residents' quality of life due to increased potential for erosion, dust, traffic, and noise. Long-term impacts on local air, water quantity and quality, and visual setting also may occur. The level of impacts would be affected by the location of development, mitigation measures employed, and drilling technology. Impacts are detailed in Sections 4.3, Water Resources; 4.4, Air Quality and Climate; 4.11, Public Health and Safety; and 4.13, Noise. In addition, disposal of produced water in underground injection wells has been linked with increased seismicity in Osage County. Under all alternatives, new wells are projected to increase, which is anticipated to increase the amount of wastewater requiring disposal (see Section 4.2). Property value has the potential to be affected by induced seismicity in high-risk areas (for example, see Metz et al 2017). Hydraulic fracturing may represent unique impacts on local communities' quality of life through impacts on water quantity and quality (see Section 4.3). As discussed in the Osage RFD (Appendix A), the majority of new wells during the life of this EIS are anticipated to be conventional wells, drilled and completed without the use of hydraulic fracturing. Oil and gas development may conflict with other land uses, including agriculture, timber, and wind development. The degree to which conflict may occur depends on the degree of surface disturbance and would vary by alternative. Conflicts with other land uses could reduce the economic contributions from these resources. Under all alternatives, oil and gas development may affect nonmarket values in the planning area. Nonmarket values are the benefits derived by society from the uses or experiences that are not dispensed through markets and do not require payment. This can include the preservation of scenic views, plant and animal 4. Environmental Consequences (Socioeconomics and Environmental Justice) November 2019 Osage County Oil and Gas Draft Environmental Impact Statement 4-71 habitat, clean air and water, and important cultural sites for use and enjoyment by future generations. As detailed in other resource sections, oil and gas development could alter viewscapes and affect wildlife habitat, air, and water. This may result in changes to the associated nonmarket values and social setting." These paragraphs do not belong in this section. Why is the writer including discussion of produced water, hydraulic fracturing etc. in the Socioeconomics portion of the DEIS? Those issues have been discussed. There is a positive socioeconomic impact for all alternatives that the writer fails to point out distinctly. That is the money generated by royalties to the headright owners. The writer downplays this by adding the above paragraphs.	Environmental Consequences - Socioeconomics and Environmental Justice	WallerE_20200221_OsageMineralsCouncil	The paragraphs referenced by the commenter describe non-monetary social effects of the alternatives. This information is appropriately included in the socioeconomic analysis section (Section 4.10 of the DEIS). This section also includes extensive quantitative analysis of economic effects of the alternatives, including monetary benefits of oil and gas development in the county. Effects on royalties distributed to headright holders are further discussed in Section 4.18 of the DEIS.
1412	2/21/2020	ES.8.3 SPECIAL STATUS SPECIES "Under all alternatives, special status species would continue to be affected by habitat loss and fragmentation and disruption from noise and traffic. Under all alternatives, requirements to comply with the ESA and USFWS guidelines would mitigate or reduce impacts. Alternatives 3 and 4 would reduce the risk of habitat loss and species takes compared with Alternative 1 (No Action), since they would prevent new drilling near some lakes and rivers, and apply COAs designed to minimize surface disturbance, which would incidentally protect species habitat." Furthermore, the writer presents no evidence of habitat loss and fragmentation and disruption from noise and traffic.	Environmental Consequences - Special Status Species	WallerE_20200221_OsageMineralsCouncil	Section 3.6.2 of the DEIS describes effects on special status species from habitat fragmentation, disturbance, and other factors, with citations to relevant sources.
1423	2/21/2020	SPECIAL STATUS SPECIES The DEIS provides a baseline for each Endangered Species and also provides an effects analysis within the environmental baseline. The effects analysis should be completed in Section 4. The DEIS effects analysis does not meet the standards outlined in 50 CFR part 402 or the 1998 USFWS MNFS Endangered Species Consultation Handbook. Effects analysis for endangered species are required to have either of the following determinations: "No effect," "Not likely to adversely affect," Likely to adversely affect." Candidates species determinations should be: "No affect," "Not likely to jeopardize proposed species or adversely modify proposed critical habitat," "Likely to jeopardize proposed species or adversely modify critical habitat."	Environmental Consequences - Special Status Species	WallerE_20200221_OsageMineralsCouncil	The description of the affected environment in Section 3.6 of the DEIS discusses current conditions and effects of past development in contributing to current conditions. The analysis of environmental consequences in Section 4.6 of the DEIS describes effects on special status species and, while an EIS is not subject to the requirements of the USFWS Endangered Species Consultation Handbook, effects in Section 4.6 are characterized using similar terminology of "likely to be affected," "not likely to be affected," etc. The analysis in the Biological Assessment (included as Appendix B of the DEIS) reflects the official consultation under Section 7 of the Endangered Species Act of 1973. This analysis uses the official effects determination terminology and complies with the USFWS Endangered Species Consultation Handbook.

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1434	2/21/2020	IMPACTS COMMON TO ALL ALTERNATIVES “Under all alternatives, existing leases would remain valid. Lessees would be required to comply with all applicable laws and regulations, such as the ESA, and to prevent environmental degradation. Section 7 of the ESA (16 USC 1531 et seq.) requires federal agencies, in consultation with the USFWS, to ensure that their actions are not likely to jeopardize the continued existence of any listed species or to result in adverse effects on designated critical habitat of such species.” This states that all leases would remain valid under all alternatives. However, if areas are designated as sensitive with no surface occupancy stipulations this may make certain leases unable to be developed.	Environmental Consequences - Special Status Species	WallerE_20200221_OsageMineralsCouncil	Alternatives 3 and 4 do not impact the right of lessees to develop leases of the Osage Mineral Estate executed prior to issuance of the Record of Decision ("ROD") for the EIS ("existing leases"). The EIS does not alter or amend a lessee's right, title, or interest in an existing lease. Under all alternatives, lessees holding record title to existing leases remain authorized and obligated to develop the Osage Mineral Estate in accordance with the terms and conditions of the lease and the regulations in 25 C.F.R. part 226. Alternatives 3 and 4 provide for the use of directional drilling to extract oil and gas from designated “sensitive areas,” to allow for continued development while minimizing surface disturbance. The Bureau of Indian Affairs acknowledges, however, that directional drilling is not feasible in all cases. If the Bureau of Indian Affairs selects an alternative that restricts drilling in designated “sensitive areas,” the ROD will include a procedure whereby the Superintendent may approve variances from such restrictions where all, or some portion, of an existing lease is located within a sensitive area and directional drilling is not feasible. In the FEIS, Alternatives 3 and 4 have been revised to more clearly identify the allowance for directional drilling and explain the variance procedure that would be implemented for existing leases located within designated sensitive areas.
1435	2/21/2020	“Construction and operation of this infrastructure would result in direct habitat loss, degradation, and fragmentation; displacement; potential death of individuals; and nest abandonment.” In lieu of “would,” it is better written as “could” or “may.” It is possible for infrastructure to be collocated with existing infrastructure to reduce direct habitat loss, degradation and fragmentation. Furthermore, the species listed in 3.6.2 address the following with the below affect determinations: American burying beetle – should be “may affect” Whooping Crane – “unlikely to be affected” Red Knot – “unlikely to be affected” Interior Least Tern – “may be affected” Piping Plover – “unlikely to be affected” Northern Long-Eared Bat – “unlikely to be affected” Neosho Mucket Mussel – “the likelihood of a threat from oil and gas development in Osage County is low” Based on these determinations it is not conclusive that all oil and gas development will result in habitat loss, degradation and fragmentation; displacement; potential death of individuals; and nest abandonment. “Specific activities expected to result in take of the ABB are human, vehicle, and equipment movement and surface disturbance from construction and installation of well pads, pipelines, access roads, transmission lines, and substations and operation and maintenance. This is due to the beetle’s small size and the difficulty of avoiding them when working in habitat areas (USFWS 2014a). For the same reason, human, vehicle, and equipment movement and ground disturbance from construction and installation of well pads, pipelines, and access roads, as well as operation and maintenance, are also expected to result in take of ABB. Oil and gas development would remove vegetation or alter soil moisture. It also may degrade habitat, reduce habitat connectivity, and cause the loss of breeding, foraging, and sheltering habitat. Additionally, these activities may increase the potential for introducing nonnative, invasive species (USFWS 2014a).” The use of the term “reduce habitat connectivity” is unsubstantiated. The ABB is a habitat generalist and prefers edge habitats. There is no evidence that the ABB requires	Environmental Consequences - Special Status Species	WallerE_20200221_OsageMineralsCouncil	Section 4.6.2 of the FEIS has been revised to change the referenced language to include "could" instead of "would" and to remove "habitat connectivity" from the list of effects. The official effects determinations for individual species are contained in the Biological Opinion issued by the USFWS (see Appendix B of the EIS).
1436	2/21/2020	ALTERNATIVE I - NO ACTION American Burying Beetle “For ABB compliance, the BIA prepared a BA, and the USFWS would issue a BO describing the total amount of acreage in the county where incidental take of ABB can occur. Minimization and mitigation measures from the Oil and Gas Industry Conservation Plan Associated with Issuance of ESA Section 10(a)(1)(B) Permits for the ABB in Oklahoma (USFWS 2014a) are proposed in the BA and would be concurred with and accepted in the BO or alternative minimization and mitigation measures would be proposed by the USFWS. Requiring lessees to follow USFWS-established protocol regarding areas where the ABB is known or expected to exist would reduce impacts on the ABB from surface-disturbing activities associated with workovers, cover drilling, or plugging. This would improve the likelihood of survival and reproduction of the species (USFWS 2014a).” The Oil and Gas Industry Conservation Plan Associated with Issuance of ESA Section 10(a)(1)(B) Permits for the ABB in Oklahoma (USFWS 2014a) is already in place with minimization and mitigation measures in place. Will participants in this plan be required to purchase mitigation credits and follow all mitigation measures in the plan? Furthermore, enrollment in the plan can take at least 60 days with an additional 45 days for approval of individual projects that have a positive survey or assume take. There is no mention of whether this process will be streamlined for Osage County.	Environmental Consequences - Special Status Species	WallerE_20200221_OsageMineralsCouncil	None of the alternatives considered in the EIS would require operators to enroll in the Oil and Gas Industry Conservation Plan or to apply any mitigation measures other than those identified specifically as COAs in Table 2-3 in the DEIS (see COA 19).
1437	2/21/2020	Alternative 1 Migratory Birds “In addition to the requirement to follow USFWS Impact Avoidance (USFWS 2014b) guidance, described in Section 4.7.2, other COAs would protect migratory birds by requiring screening or netting open-top tanks and pits. These measures would help protect prairie-nesting birds from disturbance and death; however, birds would continue to be disturbed by habitat fragmentation and degradation. The whooping crane may face increased energy expenditures from loss of migratory stopover habitat.” In section 3.6.2 it was stated that the Whooping Crane was “unlikely to be affected” but in this section there appears to be new affects analysis for the Whooping Crane. Osage County should have the standard Bureau of Land Management Conditions of Approval implemented. NTL-96-01	Environmental Consequences - Special Status Species	WallerE_20200221_OsageMineralsCouncil	The sentence in Section 3.6.2 stating that the whooping crane is unlikely to be affected has been deleted from the FEIS. As stated in Section 5.2 of Appendix B (Biological Assessment) in the DEIS, the whooping crane may be affected but is unlikely to be adversely affected. The types of minimal effects described in Section 4.7.2 of the DEIS are in line with this determination. BLM Notices to Lessees do not apply in Osage County.
1438	2/21/2020	ALTERNATIVE 2 American Burying Beetle “American Burying Beetle Like Alternative 1 (No Action), under Alternative 2, lessees would be required to protect the federally endangered ABB; however, without key BMPs and COAs, the BIA would likely need to revise the BA and reinitiate formal consultation under ESA Section 7 for ABB compliance. Until the USFWS issues the new BO, lessees would be solely responsible for documenting compliance under ESA Section 10. Because ESA compliance would still be required under this alternative, impacts on the ABB would be the same as those described under Alternative 1 (No Action).” It is unclear why the BA would need to be revised for Alternative 2.	Environmental Consequences - Special Status Species	WallerE_20200221_OsageMineralsCouncil	As described in Section 2.3.3 of the DEIS and demonstrated in Appendix B, which contains the Biological Assessment (BA) and Biological Opinion (BO), the analysis in the BA is based in part on protections provided by the COAs currently being applied. Because Alternative 2 would no longer apply some of these COAs, the analysis in the BA would likely need to be revised to reflect the changes in protection, and a new BO would be needed.
1439	2/21/2020	ALTERNATIVE 3 “In high-density sections, the BIA would apply the COAs described in Alternative 1 (No Action); thus, protections in high-density sections would be the same as under Alternative 1 (No Action) and greater than those in Alternative 2; however, additional COAs applied under Alternative 3 in low-density sections would make these sections more protective of special status species than Alternatives 1 (No Action) and 2. Alternative 3 would add more COAs in specific areas, based on information about where sensitive resources need to be protected. The BIA may choose to apply additional COAs to protect resources based on site-specific determinations. The BIA would also no longer approve permits for ground disturbing activities in certain sensitive areas, totaling approximately 17 percent of the county. These sensitive areas are important habitats for special status species in the planning area. Species in these areas would be protected from the impacts of new oil and gas development activities.” Past areas of high-density oil and gas development does not predict future areas of oil and gas develop due to the discovery of new fields and formation. Therefore, Alternative 3 may deter new development of oil and gas in other areas of Osage County. Furthermore, designating sensitive areas may result in take from current lessees if they are not allowed to drill. Osage Nation maybe required to refund bonuses for areas that can no longer be developed. If Alternative 3 is adopted the BIA should consider utilizing drilling islands that are pre-approved areas within the sensitive areas that can be used for drilling.	Environmental Consequences - Special Status Species	WallerE_20200221_OsageMineralsCouncil	Alternative 3 will not impact the right of lessees to develop leases of the Osage Mineral Estate executed prior to issuance of the Record of Decision ("ROD") for the EIS ("existing leases"). The EIS does not alter or amend a lessee's right, title, or interest in an existing lease. Under all alternatives, lessees holding record title to existing leases remain authorized and obligated to develop the Osage Mineral Estate in accordance with the terms and conditions of the lease and the regulations in 25 C.F.R. part 226. Alternative 3 provides for the use of directional drilling to extract oil and gas from designated “sensitive areas,” to allow for continued development while minimizing surface disturbance. The Bureau of Indian Affairs acknowledges, however, that directional drilling is not feasible in all cases. If the Bureau of Indian Affairs selects an alternative that restricts drilling in designated “sensitive areas,” the ROD will include a procedure whereby the Superintendent may approve variances from such restrictions where all, or some portion, of an existing lease is located within a sensitive area and directional drilling is not feasible. In the FEIS, Alternative 3 has been revised to more clearly identify the allowance for directional drilling and explain the variance procedure that would be implemented for existing leases located within designated sensitive areas.

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1440	2/21/2020	ALTERNATIVE 4 "The BIA would also no longer approve permits for ground disturbing activities in certain areas, totaling approximately 36 percent of the county. Species in these areas would be protected from the impacts of new oil and gas development activities." Removing 36 percent of the county from oil and gas development violates the 1906 Act, as amended, and could drastically affect tribal income and negatively affect Environmental Justice. This could also result in a taking of private property from current lessees of the 36 percent area. American Burying Beetle "Under Alternative 4, the ABB would be provided a high level of protections in the same way as in low-density sections under Alternative 3. For example, the 4. Environmental Consequences (Special Status Species) November 2019 Osage County Oil and Gas Draft Environmental Impact Statement 4-49 BIA would apply a buffer around culturally sensitive areas, such as historic sites, sacred sites, and grave sites. These buffers would preserve vegetation and habitat for the ABB and other special status species found in these areas by reducing surface disturbance. As a result, impacts of oil and gas development on the ABB would be reduced, compared with Alternative 1 (No Action). Under Alternative 4, new oil and gas-related ground-disturbing activities would not be permitted in 484,700 acres of potential ABB range, including 141,500 acres (29 percent) of conservation priority area (BIA GIS 2017)." It is unclear how this provision will change if the ABB is delisted. There could be a scenario where the ABB is delisted but still afforded "high level of protections" in Osage County. These protections may not be required under the ESA.	Environmental Consequences - Special Status Species	WallerE_20200221_OsageMineralsCouncil	Alternative 4 does not diminish, nor is it they intended to diminish, the Osage Nation's ownership of the Osage Mineral Estate or the total acreage thereof. Similarly, Alternative 4 has no impact on the right of lessees to develop leases of the Osage Mineral Estate executed prior to issuance of the Record of Decision ("ROD") for the EIS ("existing leases"). The alternatives in the EIS represent a reasonable range of management decisions the Bureau of Indian Affairs can make regarding development of the Osage Mineral Estate. The Act of June 28, 1906, § 3, 34 Stat. 538, as amended ("1906 Act"), vests the Secretary of Interior with broad authority over leasing of the Osage Mineral Estate. Specifically, the 1906 Act provides that the Osage Nation may lease the Osage Mineral Estate for oil and gas mining "...subject to the approval of the Secretary of the Interior, and under such rules and regulations as he may prescribe." In 1929, the U.S. Congress amended the 1906 Act, adding a provision governing the number of acres of the Osage Mineral Estate that must be offered for lease annually. The Act of March 2, 1929, § 1, 45 Stat. 1478 ("1929 Act") directs the Secretary of the Interior and Osage Nation to offer for lease..."any unleased portion of [the Osage Mineral Estate] in such quantities and at such times as may be deemed in the best interest of the Osage [Nation], Provided, That not less than twenty-five thousand acres shall be offered for lease for oil and gas mining purposes during any one year." Alternative 4 is consistent with this statutory mandate. The EIS does not alter or amend a lessee's right, title, or interest in an existing lease. Under all alternatives, lessees holding record title to existing leases remain authorized and obligated to develop the Osage Mineral Estate in accordance with the terms and conditions of the lease and the regulations in 25 C.F.R. part 226. Alternatives 3 and 4 provide for the use of directional drilling to extract oil and gas from designated "sensitive areas," to allow for continued development while minimizing surface disturbance. The Bureau of Indian Affairs acknowledges, however, that directional drilling is not feasible in all cases. If the Bureau of Indian Affairs selects an alternative that restricts drilling in designated "sensitive areas," the ROD will include a procedure whereby the Superintendent may approve variances from such restrictions where all, or some portion, of an existing lease is located within a sensitive area and directional drilling is not feasible. In the FEIS, Alternative 4 has been revised to more clearly identify the allowance for directional drilling and explain the variance procedure that would be implemented for existing leases located within designated sensitive areas. As noted in Section 3.6.2 of the DEIS, if the ABB is removed from the endangered species list, the BIA will update the COAs, as appropriate.
1441	2/21/2020	CUMULATIVE IMPACTS This cumulative impact analysis does not appear to be specific to any of the Alternatives. This appears to be cumulative impacts based on worst case scenario. "Oil and gas leasing and development, in combination with converting tallgrass prairie habitat to agricultural use, is likely to continue to affect ABB and special status bird species that use prairie habitat for nesting, foraging, and protection from predators. As discussed, the ABB's small size makes them difficult to avoid. The proliferation of oil and gas projects across ABB habitat means an indeterminate but potentially vast number of individuals will be taken during project construction." This paragraph is conclusionary with no data to back any of the statements. It is unclear what information the author is using to make the following statement: "indeterminate but potentially vast number of individuals will be taken during project construction." The DEIS tends to be vague and conclusionary without background data. This will make the DEIS very difficult to tier any future site-specific Environmental Assessments to and therefore will most likely not speed up the permitting process. "Under all alternatives, the rattlesnake master borer moth also would cumulatively lose an indeterminate but potentially large number of individuals from loss of its host plant and sole food source, the rattlesnake master plant. Losses would occur during construction of oil and gas and infrastructure projects across the region." The Rattlesnake Master Borer Moth is currently not a listed species on the ESA. Once it is listed it will be afforded protections by USFWS that would put forth mitigation protocols. "Alternatives Analysis Under Alternative 1 (No Action), Alternative 2, and Alternative 3 (high-density sections), trends toward habitat loss, fragmentation, and degradation from agricultural conversion and development for special status species described in Section 3.7.3 are likely to continue. The cumulative impacts of oil and gas development, agricultural and livestock grazing, and other infrastructure projects would be greatest under Alternatives 2 and 3 (high-density sections). For the ABB, trends of death and injury and habitat loss and fragmentation would continue. Implementing measures from the Oil and Gas Industry Conservation Plan Associated with Issuance of ESA Section 10(a)(1)(B) Permits for the ABB in Oklahoma (USFWS 2014a) may reduce, but not eliminate, the affects of oil and gas development on ABB and species that share ABB habitat." Lessees are only required to follow the provisions in the Oil and Gas Industry Conservation Plan if they are enrolled in the plan. If they are not enrolled in the plan they must comply with ESA.	Environmental Consequences - Special Status Species	WallerE_20200221_OsageMineralsCouncil	Section 4.6.7 of the DEIS discusses cumulative effects in general terms and then distinguishes between the different alternatives and how their contributions to cumulative effects may differ (see subsection on Alternatives Analysis). Section 4.6.2 of the DEIS discusses the ways in which ABB are affected by oil and gas development, including relevant citations. Section 4.6.7 of the FEIS has been revised to provide better context for the possible cumulative effects on ABB from oil and gas and non-oil and gas development projects across the planning area based on the analysis in the Biological Opinion (see Appendix B of the EIS). The fact that the rattlesnake master borer moth is not currently listed as a threatened or endangered species does not preclude it from being analyzed as a species affected by the alternatives considered in this EIS. The statement referenced by the commenter from Section 4.6.7 regarding the mitigating effects of implementing measures the Oil and Gas Industry Conservation Plan does not make any assertion that all lessees would be implementing those measures. It only states that the implementation of those measures, wherever they were implemented, may reduce effects of development on ABB habitat.
1464	2/21/2020	American Burying Beetle o "Activities associated with oil and gas development are likely to result in take of ABBs and to have adverse effects on their habitat." • Comments: o At 2 Acres per well / 9,200 Acres (in 20 Years) out of 1.4 Million Acres. (.6%) Without any consideration of reclamation of old wells being plugged. o Biological Opinion states: "Anticipated habitat loss is relatively minor (less than one percent) considering that approximately 1,141,753 acres of ABB habitat exists within the ABB range in Osage County, Oklahoma. A maximum of 4,732 acres (0.41 percent) is expected to be impacted." o Also - "losses constitute a one-time or short-duration pulse effect to the ABB populations.....so they are unlikely to affect ABB populations long-term." • Yet this issue is having the largest impact on economic development of mineral estate.	Environmental Consequences - Special Status Species	KnappeR_20200221_Warrior Exploration and Production	Section 4.6.2 of the FEIS has been revised to add context about the low overall level of threat to the species although take is likely to occur.
1479	2/21/2020	"Impacts of oil and gas development on raptors under Alternative 2 would increase, compared with Alternative 1 (No Action). Specific COAs that minimize surface disturbance, noise, excessive traffic, dust, or other impacts associated with oil and gas operations would be waived. USFWS Impact Avoidance (USFWS 2014b) guidance, described in Section 4.7.2, would mitigate some impacts by reducing the mortality risk." If Operators are following the same USFWS guidance under Alternative 1 and 2, it does not stand to reason that "Impacts of oil and gas development on raptors under Alternative 2 would increase, compared with Alternative 1 (No Action)."	Environmental Consequences - Special Status Species	WallerE_20200221_OsageMineralsCouncil	As described in Section 4.6.3 of the DEIS under Migratory Birds, Alternative 1 would apply additional COAs, such as requiring screening or netting open-top tanks and pits and minimizing noise. Because these measures would not be required under Alternative 2, the effects on migratory birds under Alternative 2 from oil and gas development would be greater, regardless of the fact that compliance with the USFWS Impact Avoidance guidance would be required under both alternatives.
1480	2/21/2020	"Rattlesnake Master Borer Moth No COAs would require identifying or avoiding the rattlesnake master plant before disturbing its habitat under Alternative 2. The rattlesnake master borer moth would continue to be affected by oil and gas development, as described in Section 4.7.2." The Rattlesnake Master Borer Moth would still be protected by the ESA which prevents take of habitat.	Environmental Consequences - Special Status Species	WallerE_20200221_OsageMineralsCouncil	As described in Section 3.6.2 of the DEIS, the rattlesnake master borer moth is not listed as a threatened or endangered species (it is a candidate species). There are no current prohibitions on its taking under the Endangered Species Act of 1973.

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1481	2/21/2020	American Burying Beetle "Like Alternative 1 (No Action), under Alternative 3, lessees would be required to follow the provisions of Oil and Gas Industry Conservation Plan Associated with Issuance of ESA Section 10(a)(1)(B) Permits for the ABB in Oklahoma (USFWS 2014a) to protect the ABB. In addition, in low-density sections under Alternative 3, the BIA would apply a buffer around culturally sensitive areas, such as historic sites, sacred sites, and grave sites. These buffers would preserve vegetation and habitat for the ABB and other special status species found in these areas by reducing surface disturbance. Under Alternative 3, new oil and gas related ground-disturbing activities would not be permitted in 209,100 acres of potential ABB range, including 53,600 acres (11 percent) of conservation priority area (BIA GIS 2017)." Lessees are only required to follow the provisions in the Oil and Gas Industry Conservation Plan if they are enrolled in the plan. If they are not enrolled in the plan they must comply with ESA. Adding buffers to culturally sensitive areas does not pertain to the American burying beetle. The ABB is a habitat generalist and these buffers would have minimal impact on the ABB. Removing 11 percent of the land in Osage County from oil and gas development could result in a "taking" from the oil and gas lessees in the area.	Environmental Consequences - Special Status Species	WallerE_20200221_OsageMineralsCouncil	All lessees in Osage County are required to comply with the ESA. The EIS does not alter or eliminate this requirement. The U.S. Fish and Wildlife Service (FWS) Oil and Gas Industry Conservation Plan Associated with Issuance of ESA Section 10(a)(1)(B) Permits for the American Burying Beetle in Oklahoma (ICP) is a habitat conservation plan for covered activities within areas where Federally-listed or protected species are known or likely to occur. With respect to Osage County, it allows individual lessees to apply for ESA 10(a)(1)(B) permits for incidental take of the ABB if they agree to comply with the terms and conditions of the ICP and meet permit issuance criteria. On July 27, 2018, the U.S Fish and Wildlife Service (FWS) issued a Biological Opinion (BO) for the Osage County Oil and Gas Program (EIS Appendix B). The BO includes an Incidental Take Statement for oil and gas development activities that may impact the ABB. The Incidental Take Statement authorizes the Osage Agency to permit incidental take for a maximum of 600 acres per year (450 acres of temporary disturbance and 150 acres of permanent disturbance). The non-discretionary terms and conditions of the Incidental Take Statement require the Osage Agency to implement and enforce certain conservation and minimization measures from the ICP, all of which are incorporated by reference. The cited language from the EIS is referencing these existing requirements under the BO. COAs 18 and 19 in Table 2-2 of the FEIS have been revised to more closely reflect the requirements under the BO. The purpose of establishing buffers around culturally sensitive areas under Alternative 3 – Low Density is not to protect the ABB or other special status species pursuant to the BO. As the EIS indicates, such buffers are for the protection of culturally significant areas including historic sites, sacred sites, and grave sites. While these buffers are not designed to protect the ABB, the practical impact of establishing buffers is a reduction in surface disturbance. Accordingly, the EIS is noting that the use of such buffers has the potential to preserve vegetation and suitable ABB habitat because they reduce surface disturbance in the planning area. The EIS does not alter or amend a lessee's right, title, or interest in an existing lease. Under all alternatives, lessees holding record title to existing leases remain authorized and obligated to develop the Osage Mineral Estate in accordance with the terms and conditions of the lease and the regulations in 25 C.F.R. part 226. Alternatives 3 provides for the use of directional drilling to extract oil and gas from designated "sensitive areas," to allow for continued development while minimizing surface disturbance. The Bureau of Indian Affairs acknowledges, however, that directional drilling is not feasible in all cases. If the Bureau of Indian Affairs selects an alternative that restricts drilling in designated "sensitive areas," the ROD will include a procedure whereby the Superintendent may approve variances from such restrictions where all, or some portion, of an existing lease is located within a sensitive area and directional drilling is not feasible. In the FEIS, Alternative 3 has been revised to more clearly identify the allowance for directional drilling and explain the variance procedure that would be implemented for existing leases
1410	2/21/2020	"Under all alternatives, oil and gas development would continue to affect topography, geology, paleontology, and soils in the planning area. Under all alternatives, the risk of induced seismicity from injection of wastewater would continue, as would damage to soils due to spills. Alternatives that reduce surface disturbance and require post-disturbance reclamation would reduce some adverse impacts." The writer wrongly and without evidence states that topography, geology, and paleontology have been adversely affected.	Environmental Consequences - Topography, Geology, Paleontology, and Soils	WallerE_20200221_OsageMineralsCouncil	As described in Section 3.2.2 of the DEIS, past oil and gas leasing and development has affected soils in the planning area in a variety of ways, including surface disturbance and soil compaction, salt scarring and soil salinization, tree kills, and brine and oil contamination. These statements are supported by the reference cited in this section. Similarly, Section 3.2.2 of the DEIS documents the risks and past occurrences of induced seismicity, with appropriate supporting references.
1430	2/21/2020	TOPOGRAPHY, GEOLOGY, PALEONTOLOGY, AND SOILS "Assumptions Direct impacts on topography, geology, paleontology, and soils would result from surface-disturbing activities that would occur during the construction phase of oil and gas development and from spills during operation, abandonment, and reclamation. Oil and gas development activities expected to affect geology, soils, paleontology and topography include construction and operation of the following:" The DEIS assumes all oil and gas development have spills, therefore, affecting geology, soils, paleontology and topography. Spills are not common occurrences, however, the DEIS assumes that spills are widespread and occur on a daily basis. "Direct impacts at the project-specific level could alter topography, damage paleontological resources, compact soils, or accelerate erosion rates of soil resources." a) Regarding the direct impacts to paleontological resources, the writer does not take into consideration that: 1) The cultural resources pedestrian survey can lead to paleontological findings, thus preserving these resources. 2) Construction of well pads, lease roads, etc. can lead to paleo discoveries. Although there is not a COA that addresses this, operators who discover paleo resources most often stop construction and allow for preservation. 3) Paleontological resources are more prevalent buried much deeper than what construction activities would disturb. b) Compact soils and accelerate erosion: 1) Construction of well pads, lease roads etc. does to a certain extent require soil compaction to stabilize the surface. However, the well pads, lease road etc. are then covered with gravel and rock to mitigate erosion. 2) Compacting soils and rocking does not accelerate erosion rates. The writer does not quantify how erosion is accelerated.	Environmental Consequences - Topography, Geology, Paleontology, and Soils	WallerE_20200221_OsageMineralsCouncil	The EIS does not assume that spills in Osage County are "widespread and occur on a daily basis." It is commonly accepted that if oil and gas development in an area increases, the risk of spills in that area also increases. The FEIS has been revised to clarify that the relevant assumption is an increase in the risk of spills, not an assumption that spills will be prevalent. The mitigating effects of measures to reduce erosion are discussed under the appropriate alternative in Section 4.2 of the DEIS. The disturbance of vegetation that holds soils in place allows easier transportion of soils. Analysis has been added to Section 4.2.1 of the FEIS clarifying that cultural surveys may result in discovery and avoidance of paleontological resources. The referenced text in Section 4.2.1 of the DEIS is not asserting that soil compaction accelerates erosion rates but that both soil compaction and accelerated erosion are effects of development of oil and gas facilities. Data are not available to quantify accelerated erosion rates; this effect would be dependent on site-specific conditions.
1431	2/21/2020	ALTERNATIVE 1 – NO ACTION "Under Alternative 1 (No Action), none of the COAs that would be applied are specific to paleontological resources, topography or geologic hazards; however, soil COAs would continue to limit surface disturbance by enforcing the confinement of work vehicles to existing roads." COA number 4 addresses topography. "A requirement to return the area to the original contour would reduce long-term impacts on topography." COA 16 addresses this. "To minimize the risk of induced seismicity related to underground injection, approval must be obtained from the EPA prior to the commencement of workover operations related to underground injection, construction, or conversion of saltwater injection/disposal wells." This is a current requirement. This needs to be in Section 3 as a baseline analysis not in the affects analysis.	Environmental Consequences - Topography, Geology, Paleontology, and Soils	WallerE_20200221_OsageMineralsCouncil	Analysis in Section 4.2.3 of the FEIS has been revised to acknowledge COA 4 and its effect on maintaining topography under the No Action Alternative. COA 16 is already acknowledged in this section. The requirement to obtain EPA approval prior to the commencement of workover operations related to underground injection, construction, or conversion of saltwater injection/disposal wells is properly discussed in this analysis of the No Action Alternative in Section 4.2.3 of the FEIS since it is a requirement that is currently in place.
1473	2/21/2020	4.2.2 IMPACTS COMMON TO ALL ALTERNATIVES "Toxic H2S is considered a geologic hazard that may be released during drilling and completion, as leakage or as incomplete combustion during flaring. Under all alternatives, flaring would be prohibited without permission of the BIA Osage Agency Superintendent. This requirement would reduce the release of H2S during flaring by ensuring tighter control and monitoring of flaring. Further impacts of H2S are discussed in Section 4.11, Public Health and Safety." Unless permitted by the BIA, flaring would be prohibited. "This requirement would reduce the release of H2S during flaring by ensuring tighter control and monitoring of flaring." The writer assumes that if the BIA permits flaring there will be some sort of control and monitoring to ensure H2S is being burned off. There is nothing that prescribes "tighter control and monitoring"? What specifically would be implemented to ensure "tighter control and monitoring"? 29	Environmental Consequences - Topography, Geology, Paleontology, and Soils	WallerE_20200221_OsageMineralsCouncil	This statement has been clarified in Section 4.2.2 of the FEIS to note that H2S leakage from flaring could be reduced if the flaring permitting requirement reduced overall flaring amounts.

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1474	2/21/2020	"Disposal of produced water in the Arbuckle formation using injection wells has been shown to stimulate earthquakes (i.e., induced seismicity) in Oklahoma… The risk of induced seismicity would likely increase as the volume of wastewater grows due to an increase in well spuds projected under all alternatives." The DEIS assumes that no other formation could be utilized for accepting disposal water. There is a recent trend where operators are drilling to the Wilcox formation and or plugging back existing wells to the Wilcox formation. This has shown to mitigate induced seismicity. Again, the DEIS assumes that there will be an increase in disposal water with the increase in drilling wells. The writer does not contemplate current producing wells depleting, therefore producing less water. Depletion of wells could result in uneconomic wells, therefore, requiring plugging. A more likely scenario would be that produced water injection would remain the same when there is a balance between new well drills and plugging existing depleted wells. Finally, in Appendix E – Figures, the map showing seismic activity in Osage County concludes that only a couple of earthquakes have occurred in Osage County. The writer does not overlay this to show seismic activity with respect to oil and gas activity and SWD wells. "Increased amounts of produced water could result in a greater number of spills or in larger spills and increased volume of wastewater injection which could result in increased levels of seismicity." The DEIS assumes a correlation between the amount of produced water and the number of spills? Where is the science and studies that proves this? The writer also assumes increased volumes of injection water will lead to increased levels of seismicity. The EPA regulates injection wells in Osage County and often defers to the OCC. The OCC has implemented a program where necessary to reduce daily volume injection rates as a mitigation measure for induced seismicity. To a great degree this has curtailed induced seismicity. Furthermore, the writer does not contemplate other injection formations.	Environmental Consequences - Topography, Geology, Paleontology, and Soils	WallerE_20200221_OsageMineralsCouncil	Information has been added to Section 3.2.2 in the FEIS noting that other formations are now being used for disposal in place of the Arbuckle per EPA management and policy and that this policy has been effective at mitigating induced seismicity risks thus far. The statement about wastewater being expected to increase with increased oil and gas development is reasonable based on the history of oil and gas development in the planning area described in Section 3.3.2 of the DEIS. Wells generally produce the most water early in the well life and the decrease in produced water from the abandonment of late cycle wells is not likely to be enough to offset the increase from new wells brought online. Appendix A of the DEIS acknowledges that wells may be plugged and abandoned but explains why it is not possible to quantify this effect and factor it into overall development projections. The BIA acknowledges that recent trends in Osage County have shown plugging permits outpacing drilling permits and has added language to Section 3.1 of the FEIS to explain that the NEPA analysis still assumes the total number of wells will increase going forward in order to provide maximal NEPA coverage in describing possible effects of these activities. Saltwater disposal wells are not overlaid with the map of earthquakes due to the lack of certainty about the association between each well and each earthquake. Current data and conclusions by the OGS and others are more appropriately described in the text, as currently done in Section 3.2.2 of the DEIS. It is a commonly accepted fact that increased oil and gas development and wastewater production in an area increases the risk of spills occurring in that area. Similarly, increased injection can increase the risk of induced seismicity in the area. The DEIS does not state that induced seismicity would increase. While measures implemented by the EPA and the OCC can mitigate induced seismicity effects, as described in Section 3.2.2 of the DEIS, they are generally applied after induced seismicity has already been associated with an injection well. Therefore, they would not eliminate the risk of induced seismicity occurring.
1475	2/21/2020	"Enhanced oil recovery methods, including water flooding and hydraulic fracturing, have the potential to force oil and contaminated water out of nearby wells that have been improperly abandoned, contaminating soils and groundwater." A permit for an injection well requires an area of review (AOR) of 1-mile around the proposed location. Within the AOR, all types of wells are plotted on a map and the integrity of the wells are reviewed. For example, if a well that is plugged shows up on the AOR, then that well file is pulled to ensure the plugging of the well was adequately performed. If it is not, then the plugged well would require attention and proper plugging to ensure no communication between the well and injection fluids will occur. This review mitigates contamination of water coming up the hole of the plugged well. The writer fails to discuss this in the DEIS.	Environmental Consequences - Topography, Geology, Paleontology, and Soils	WallerE_20200221_OsageMineralsCouncil	Information has been added to Section 4.2.2 of the FEIS to note that data from nearby wells are extensively reviewed to mitigate potential risks from enhanced oil recovery before the activity can occur. However, due to the potential for historical data gaps and changes in conditions surrounding the wells since well records were filed, the risk of contamination still theoretically exists.
1476	2/21/2020	"Under all alternatives, the BIA would apply COAs to oil and gas permits to ensure compliance with applicable laws and regulations, such as the ESA, Section 106 of the NHPA, and the Soil and Water Resources Conservation Act, and to prevent environmental degradation." Applying COA's does not ensure compliance with applicable laws etc. Applying or issuing COA's is a vehicle used to notify operators of specific requirements. Simply issuing the COA does not guarantee that the operator will abide by those COAs. There has to be inspection and enforcement by the BIA to ensure compliance. "Reducing surface-disturbance levels during oil and gas exploration and production would reduce the potential for compaction or erosion impacts on soils and damage to paleontological resources." See discussion above regarding soil compaction and paleo resources.	Environmental Consequences - Topography, Geology, Paleontology, and Soils	WallerE_20200221_OsageMineralsCouncil	For purposes of analysis, it is assumed that COAs would be complied with. The BIA has separate enforcement responsibility outside the scope of this EIS. Analysis has been added to Section 4.2.1 clarifying that cultural surveys may result in discovery and avoidance of paleontological resources.
1402	2/21/2020	Finally, the DEIS does not adequately consider the "best interests" of the Osage Nation and Osage mineral estate. First, the 1929 amendment authorizes and directs the "Secretary of the Interior and the Osage tribal council . . . to offer for lease for oil, gas, and other mining purposes any unleased portion of said land in such quantities and at such times as may be deemed for the best interest of the Osage Tribe of Indians."13 Thus, the best interest of the Osage Nation (formerly the Osage Tribe of Indians) is not a decision the Department through the DEIS can make unilaterally, without the Osage Minerals Council, the Constitutional representative of the Osage Nation on minerals matters. The DEIS best interest determination does not represent the views of the Osage Minerals Council, as required by statute, and thus is fundamentally flawed.	Environmental Consequences - Trust Assets and Osage Nation Interests	WallerE_20200221_OsageMineralsCouncil	As the Minerals Council notes, the Secretary, in consultation with the Osage Nation, must offer lands for lease as is "deemed for the best interrest of the Osage [Nation]." That standard also applies to the Secretary's approval of a lease, permit, workover, or similar action. The publication of an EIS is not such an action. The EIS is an analysis that will be used to support later Secretarial decisons that are based on the best interest of the Nation. In fact, even the Record of Decision resulting from this EIS will choose a strategy for the BIA's management of the Osage Mineral Estate, in consultation with the Nation. The ROD will still not be an offer of lands for lease or approval of a lease, permit, workover, or similar action. It is at that later offer or approval stage where Congress requires the application of the best interest standard, and at that stage, the Secretary will do so, in consultation with the Osage Nation.
1459	2/20/2020	With respect to the Environmental Consequences analyses using Alternative 4, there is an argument in the assumption that restrictions to access to the surface in the recognized sensitive ecological areas, well-head protection zones, or sensitive water supplies is directly related to new well development potential. This is a surface restriction, not a minerals restriction. For example, a 35% reduction in surface land area does not automatically result to a 30-40% reduction in well potential. While the restrictions of Alternative 4 may reduce the total surface land accessible available for leasing, it does not necessarily restrict access to the minerals. In addition, geology and market conditions remain the primary driver for a successful well and not all restricted surface area is a viably productive area;	Environmental Consequences - Trust Assets and Osage Nation Interests	BiehlJ_20200220_Osage land and cattle co	The analysis in Sections 4.16.5 and 4.16.6 of the FEIS has been clarified to better explain how new vs. existing leases may be affected by the prohibitions on new ground-disturbing activity in certain sensitive areas under Alternatives 3 and 4.
1442	2/21/2020	VEGETATION, WETLANDS, AND NOXIOUS WEEDS 4.7.2 IMPACTS COMMON TO ALL ALTERNATIVES "Temporary and permanent vegetation removal associated with construction, drilling, and workover operations directly impacts vegetation and wetland resources. Vegetation could be removed by surface-disturbing activities, such as constructing new or expanding existing access roads or well pads. Where access roads cross wetlands or riparian areas, vegetation could be removed to facilitate construction. Wetlands could be directly affected by filling, draining, or otherwise altering surface or subsurface hydrology. Where disturbed areas are reclaimed and revegetated, impacts would be temporary, lasting less than 5 years. If disturbed areas are not reclaimed and revegetated, for example where a permanent access road or monitoring well was installed, impacts would be permanent." In the first sentence, the writer proposes that all construction of well pads etc. would have a direct impact on vegetation and wetland resources. This is simply not true. Wetlands are sensitive areas found in certain areas with particular habitat.	Environmental Consequences - Vegetation, Wetlands, and Noxious Weeds	WallerE_20200221_OsageMineralsCouncil	This sentence has been clarified in Section 4.7.2 of the FEIS to note "...where overlap with these resources occurs."
1411	2/21/2020	"Under all alternatives, water resources, including surface water and Waters of the United States, groundwater, and aquatic environments, are susceptible to depletion or contamination by oil and gas development. Alternatives 3 and 4 would reduce the risk of spills or surface disposal of wastewater compared with Alternative 1 (No Action), by preventing new drilling in areas with sensitive waters and applying COAs designed to protect water resources." Groundwater is not currently being used for oil and gas activities. Surface water that is used is minimal and is replaced by rainfall.	Environmental Consequences - Water Resources	WallerE_20200221_OsageMineralsCouncil	The quoted statement from Section ES.8.2 in the DEIS does not state that all of these waters are being used for development. It merely says they are susceptible to depletion or contamination from development. This is described in more detail in Section 4.3 of the DEIS.

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1433	2/21/2020	WATER RESOURCES 4.3.1 METHODS AND ASSUMPTIONS Indicators "Indicators of impacts on surface water and groundwater resources are the following: • Miles of roads constructed • Number of spills of hazardous or other harmful materials" How does the number of miles of road construction affect surface water/groundwater? There are so many more contributing factors that could affect SW/GW. This is another example of biased towards the oil and gas industry. Furthermore, the DEIS focuses on the number of spills. It is not so much the number of spills, but rather the quantity and substance of the spill. 4.3.2 IMPACTS COMMON TO ALL ALTERNATIVES "Oil and gas development may affect water resources in several ways, as follows: • Surface disturbance (e.g., road, power line, pipeline, and well pad construction) can increase runoff or change the physical characteristics of waterbodies." The way this is written is that surface disturbance can change the physical characteristics of waterbodies. Does the writer mean that …increase runoff can result in the physical characteristics of waterbodies? "Applying certain COAs could reduce impacts on water resources by reducing surface disturbance, which would restrict discharge of dredge and fill materials into waterways." Dredge and fill material into waterways? What is this? The writer has been discussing erosion, not dredge and fill material.	Environmental Consequences - Water Resources	WallerE_20200221_OsageMineralsCouncil	Section 4.3.2 of the DEIS provides further explanation of how road construction affects surface waters (e.g, erosion and sediment pollution transport to surface water bodies). This EIS is specific to oil and gas, thus is is focused on the impacts from those activities. Effects of non-oil and gas activities on water resources are acknowledged in Section 4.3.7 of the DEIS. The quoted text from Section 4.3.2 of the DEIS on changing the physical characteristics of waterbodies is correctly interpreted as surface disturbance potentially changing the physical characteristics. The mention of dredge and fill material in Section 4.3.2 of the FEIS has been replaced with "flow of sediment into waterways."
1477	2/21/2020	4.3.7 CUMULATIVE IMPACTS "Freshwater resources would be depleted for by oil and gas development in combination with agricultural and industrial use in Osage County (Scanlon et al. 2014a, 2014b; Nicot et al. 2012; Murray 2013). FracFocus 1.0 disclosures indicate that annual water use for oil and gas development was 10 percent, or greater, of total annual water use in 6.5 percent of the counties reporting (EPA 2015h)." This paragraph needs to be deleted. It does not make sense as to the point of cumulative impacts. It seems to be just added in here.	Environmental Consequences - Water Resources	WallerE_20200221_OsageMineralsCouncil	The sentence on FracFocus disclosures has been deleted from Section 4.3.7 of the FEIS.
1478	2/21/2020	4.6.1 ASSUMPTIONS "Under all alternatives, regulations prohibit lessees from locating any well or tank within 200 feet of any established watering place, except with written permission of the Superintendent (25 CFR Section 226.33)." How is "watering place" defined?	Environmental Consequences - Water Resources	WallerE_20200221_OsageMineralsCouncil	"Established watering place" is not defined in the regulations at 25 CFR 226; the Superintendent defines it on a case-by-case basis.
1449	1/7/2020	The Osage Minerals Council, an independent agency within the Osage Nation government that is constitutionally empowered to administer and develop the Osage Mineral Estate, respectfully requests that the Bureau of Indian Affairs (BIA), the U.S. Geological Survey (USGS), and the Environmental Protection Agency (EPA) extend the public comment period on the Draft Environmental Impact Statement for Osage County Oil and Gas, Osage County, Oklahoma (DEIS) by a minimum of forty-five (45) days beyond the currently scheduled public comment deadline of January 22, 2020.	Extension Requests	PipestemW_20120107_PipestemLaw_OsageMineralsCouncil	The Deadline was extended twice, allowing for a full 90 days of review, the same period of time initially allotted for the larger OKT EIS (~2,400 pages). No change required.
1456	1/3/2020	The Osage Minerals Council and other interested parties formally requested an extension to the draft on December 12, 2019. We appreciate that the Department extended to the deadline for comments on the Osage DEIS from January 6 to January 22, 2020, but that is not sufficient time for the Osage Minerals Council to properly address all the issues in the extensive document. Further, much of the work time between the publication of the draft to the proposed deadline was during the holidays.	Extension Requests	PipestemW_20200103_Pipestem Law_OsageMineralsCouncil	The Deadline was extended twice, allowing for a full 90 days of review, the same period of time initially allotted for the larger OKT EIS (~2,400 pages). No change required.
1468	12/11/2019	The Osage Producers Association will have substantive comments on the Osage County Oil and Gas Draft Environmental Impact Statement (Notice of Availability published in the Federal Register on November 22, 2019). However, the comment period, falling over the holidays is unreasonable. We request you please extend the comment period a few months to allow our members whose business interests are directly impacted by this the opportunity to read and respond.	Extension Requests	DeLongJ_20191211_OsageProducersAssociation	The Deadline was extended twice, allowing for a full 90 days of review, the same period of time initially allotted for the larger OKT EIS (~2,400 pages). No change required.
1469	12/10/2019	The Nature Conservancy ("TNC") submits this letter to request a 30-day extension to the public comment period for the Draft EIS. TNC is the landowner of the approximately 40,000-acre Tallgrass Prairie Preserve in Osage County, and has a significant interest in this matter. We seek this extension due to the bulk and complexity of the Draft EIS, and in light of the upcoming holidays. Thank you for your consideration of this request.	Extension Requests	FuhrM_20191210_NatureConservancy	The Deadline was extended twice, allowing for a full 90 days of review, the same period of time initially allotted for the larger OKT EIS (~2,400 pages). No change required.
1470	12/20/2019	I respectfully request that the comment period for the Osage County EIS be extended until April 2020. My personal comment is to thoughtfully consider the entire 566 page document, that was more than 5 years in the making, will require more time. The document was released on November 22 and the short comment period also overlapped with Thanksgiving, Christmas, Hanukkah and Kwanza, and New Year's celebrations. There are several alternative options that if adopted will certainly generate lawsuits and/or at the least require action on the part of the US Congress. Let's give this important document all the time needed for thoughtful consideration.	Extension Requests	WickstromC_20191220_Iron Hawk Energy Group	The Deadline was extended twice, allowing for a full 90 days of review, the same period of time initially allotted for the larger OKT EIS (~2,400 pages). No change required.
1380	1/16/2020	The EIS is not the proper forum for introducing new rules. Whether called Conditions of Approval, Best Management Practices, Superintendent's Order, or Notice to Lessees the EIS must be based on existing authorities. The authorities are described in 25 CFR 226 and a few laws that impose additional responsibilities such as the National Historic Preservation Act. The Draft EIS appears to assume that it is appropriate to impose a BIA defined Best Management Practice (BMP) or a Condition of Approval (COA) to respond to a perceived environmental threat. If the BIA feels a new rule is required it should propose the rule as a change in 25 CFR 226. If the EIS includes lists of BMPs and COAs it should also include the corresponding authority for enforcement.	General EIS comments	DeLongJ_20200116_OsageProducersAssociation	The "rules" that are being referenced here are all either design features or mitigation measures included for the purposes of allowing a determination of no effect or a finding of no significant impact. This is a process wholly allowed under NEPA and is, in fact, an integral part of the process. When discussing similar actions (such as drilling wells), it is far more efficient to acknowledge what has worked in the past and build off of that then try to re-invent the wheel each time you assess an action. In fact, for mitigation measures to be relied upon for a FONSI or determination of no effect, they must be enforceable (e.g., conditions of approval). Cabinet Mountains Wilderness v. Peterson, 685 F.2d 678 (D.C. Cir. 1982).

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1392	2/21/2020	we note that the DEIS does not require site-specific environmental assessments for approval of leases. This is in direct violation of Tenth Circuit's mandate requiring the federal agencies to analyze site-specific impacts prior to leasing. See New Mexico ex rel. Richardson v. Bureau of Land Management, 565 F.3d 683, 717-18 (lOth Cir. 2009) ("assessment of all 'reasonably foreseeable' impacts must occur at the earliest practicable point."). This shell-game approach-lease first and analyze later-fails to satisfy the BIA's mandate under NEPA and its implementing regulations. 1 The Tenth Circuit has made clear that site-specific analysis must be conducted at the "earliest practicable point." Id at 718. That point is at the leasing stage, not after "bureaucratic momentum" has taken over and drilling is virtually assured. See Colorado Wild Inc. v. Us. Forest Serv., 523 F. Supp. 2d 1213, 1220-21 (D. Colo. 2007).	General EIS comments	LeppD_20200221_DrummondLaw	Neither NEPA nor the Osage regulations require a "site-specific" review for every lease or workover. As part of the NEPA process, the agency is faced with defining, amongst other things, the "major Federal action[]" at issue. 42 U.S.C. § 4332(2)(C). The "major Federal action" may be a policy, plan, program, or specific project. 40 C.F.R. § 1508.18. NEPA does not require an individualized analysis for every single federal action, as such an approach would render agency decision making "intractable." Marsh v. Oregon Natural Resources Council, 490 U.S. 360, 373 (1989); see also, New Mexico ex rel. Richardson v. Bureau of Land Management, 565 F.3d 683, 715 (courts should not "make NEPA an insurmountable bar to agency action") [quoting Nat'l Audubon Soc'y v. Dep't of the Navy, 422 F.3d 174, 199 (4th Cir. 2005)]. Instead, the agency is afforded substantial deference to define, in the first instance, the proposal at issue. Ohio Valley Envtl. Coal. v. Aracoma Coal Co., 556 F.3d 177, 197 (4th Cir. 2009); see also Wyoming v. U.S. Dep't of Agric., 661 F.3d 1209, 1244-45 (10th Cir. 2011) ["[A]gencies have considerable discretion to define the purposes and objectives of a proposed action, as long as they are reasonable" (citation omitted)]. A "proposal" means simply that the agency has a goal that it would like to accomplish and "one or more alternative means of accomplishing that goal . . . ." 40 C.F.R. § 1508.23. Here, the proposal addressed in the EIS is "the approval of leases and the approval of drilling and workover permits." Section 1.3, p. 1-3. Under the Osage regulations, a lease authorizes the lessee to "use so much of the surface of the land within the Osage Mineral Estate as may be reasonable for operations and marketing. This includes but is not limited to the right to lay and maintain pipelines, electric lines, pull rods, other appliances necessary for operations and marketing, and the right-of-way for ingress and egress to any point of operations." 25 C.F.R. § 226.19(a). Since the activities allowed under a lease are limited under the regulations such that they will generally have similar impacts no matter where the lease is in Osage County, a programmatic analysis of all of those leases is appropriate. Likewise, the impacts of a subset of workovers, i.e., those that do not extend outside the wellpad, and therefore require no new ground disturbance, do not depend on where the wellpad is in the County, so programmatic analysis of such actions is appropriate. This is consistent with the suggestion in the CEQ regulations that, when an agency is preparing an EIS on a broad action, the agency "may find it useful to evaluate the proposal . . . generically, including actions which have relevant similarities, such as common timing, impacts, alternatives, methods of implementation, media, or subject matter." 40 C.F.R. § 1502.4(c)(2). Since the EIS addresses all current and anticipated leasing and workovers within Osage County, the BIA is not required to prepare a "site-specific" EA every time it approves a lease or workover. This is particularly true where the action is administrative in nature and does not provide for ground disturbance. (Cont.)
1392 (cont.)	2/21/2020	See above	General EIS comments	LeppD_20200221_DrummondLaw	The Tenth Circuit has specifically held that "[t]here is nothing in the statute or CEQ Regulations that requires an agency to include a site-specific analysis for every particular area affected by the proposed action." Wyoming, 661 F.3d at 1255. Wyoming involved the Forest Service's application of a "broad" nationwide rule that addressed environmental affects "generically." Id. at 1256. In that case, the Tenth Circuit affirmed the Forest Service's application of the so-called "roadless rule" "despite the fact that it did not include a detailed site-specific analysis of the environmental consequences at each and every specific [area] affected by the rule." Id. at 1257. The same conclusion is warranted here. Every new lease does not require the BIA to prepare a new and "site-specific" EA. The commenter's reliance on Richardson is misplaced and does not support his argument that the EIS should include a site-specific analysis or that site-specific analysis is required for each lease. In Richardson, the Tenth Circuit found that in light of the facts and circumstances at issue, BLM needed to conduct a site-specific NEPA review for a lease because the assessment of all reasonably foreseeable impacts must occur at the earliest practicable point and must occur before an irretrievable commitment of resources is made. 565 F.3d at 718. Applying the inquiries "necessarily requires a fact-specific inquiry," and that "the inquiry is necessarily contextual." Id. Thus, there is no "mandate" under Richardson that "requires" a site-specific analysis in every case. As the Tenth Circuit held in Wyoming, decided two years after Richardson, nothing in NEPA or its implementing regulations require a "site-specific" analysis in all circumstances. Indeed, courts have recognized that the leasing stage may not be the appropriate stage. Park County Resource Council, Inc. v. U.S. Department of Agriculture, 817 F.2d 609 (10th Cir. 1987), overruled in part on other grounds by Village of Los Ranchos de Albuquerque v. March, 956 F.2d 970 (10th Cir. 1992) is directly on point. In Park County, the U.S. Forest Service issued a lease on the basis of a review conducted pursuant to a programmatic EA, similar to the analysis in this EIS, for oil and gas leasing in the Shoshone and other National Forests in the Rocky Mountain Region. The Tenth Circuit found that use of a programmatic NEPA review was appropriate because the Forest Service did not know at the time of preparing the EA what land would be leased or where wells would be drilled. This was particularly true, the court noted, because full NEPA review would be conducted upon receipt of an APD on the subject lease. The same is true here; use of a programmatic NEPA review to approve leases is appropriate because the BIA does not know what land will be leased, or where drilling will occur – if it may even occur – within Osage County. As was also an important factor in Park County, and as discussed in the EIS, the BIA will conduct site-specific NEPA review prior to the approval of an APD and issuance of a drilling permit. (Cont.)
1392 (cont.)	2/21/2020	See above	General EIS comments	LeppD_20200221_DrummondLaw	The commenter's reliance on Richardson is based on a view that the language in Osage leases allowing for the use of surface for operations and marketing, including "the right to lay and maintain pipelines, electric lines, pull rods, and other appliances necessary for operations . . . the right of way for ingress and egress . . . and the right to use water for Lease operations," is similar to the BLM regulation language allowing for "the right to use so much of the leased lands as is necessary to explore for, drill for, mine, extract, remove, and dispose of all of the leased resources in a leasehold subject to Stipulations attached to the lease," which the Richardson court found to instructive in determining that BLM could not prevent the impacts resulting from surface use after a lease was issued and thus required a site-specific analysis. Id. (quoting 43 C.F.R. § 3101.1-2). This comparison fails. Osage leases do not contain terms allowing for drilling or other operations on the leasehold, instead providing that leases are subject to the regulations governing oil and gas mining operations set forth in 25 C.F.R. part 226. The leases specifically state that a party cannot conduct any drilling operations without approval and the regulations require Superintendent approval before commencing operations, consistent, as noted above, with the Osage regulations. Moreover, the Osage regulations do not allow for the commencement of drilling operations on a lease prior to obtaining the Superintendent's approval of an APD, which is subject to site-specific NEPA review. See 25 C.F.R. § 226.16(b). There is not, therefore, the possibility for the "bureaucratic momentum" that the commenter envisions. Finally, the commenter claims that the Osage regulations themselves require site-specific NEPA review for every lease, noting that 25 C.F.R. § 226.2(c) states that "[e]ach oil and/or gas lease and activities and installations associated therewith subject to these regulations shall be assessed and evaluated for its environmental impact prior to its approval by the Superintendent." That regulation does not, however, state the scope of the NEPA review required, just that it needs to be done before the approval by the Superintendent. Such review, therefore, is not required to be site-specific; it just needs to occur for each lease and workover. By preparing a programmatic review such as this EIS, the BIA is assessing and evaluating the environmental impact of each lease and workover in a more efficient fashion than site-specific review, consistent with the actual mandate of the CEQ regulations to reduce paperwork by "using program, policy, or plan environmental impact statements and tiering from statements of broad scope to those of narrower scope, to eliminate repetitive discussions of the same issues." 40 C.F.R. § 1500.4(i).

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1393	2/21/2020	the Osage regulations themselves provide that site-specific analysis shall occur prior to approval of leases. See 25 C.F.R. § 226.2(c) ("Each oil and/or gas lease and activities and installations associated therewith subject to these regulations shall be assessed and evaluated for its environmental impact prior to its approval by the Superintendent.") (emphasis added). Standard Osage oil and gas leases provide that the lessee "shall have the right to use so much of the surface land within the Osage Mineral Estate as may be reasonable for operations and marketing." The Osage leases further grant the right to "lay and maintain pipelines, electric lines, pull rods, and other appliances necessary for operations ... the right of way for ingress and egress ... and the right to use water for lease operations." Thus, the approval of a lease by the Superintendent virtually guarantees that there will be surface disturbance before any environmental analysis has been conducted. The BIA is urged to revise the DEIS to show that NEPA analysis will be conducted prior to approval of leases, as required by the Tenth Circuit and the Osage regulations.	General EIS comments	LeppD_20200221_DrummondLaw	Neither NEPA nor the Osage regulations require a "site-specific" review for every lease or workover. As part of the NEPA process, the agency is faced with defining, amongst other things, the "major Federal action[]" at issue. 42 U.S.C. § 4332(2)(C). The "major Federal action" may be a policy, plan, program, or specific project. 40 C.F.R. § 1508.18. NEPA does not require an individualized analysis for every single federal action, as such an approach would render agency decision making "intractable." Marsh v. Oregon Natural Resources Council, 490 U.S. 360, 373 (1989); see also, New Mexico ex rel. Richardson v. Bureau of Land Management, 565 F.3d 683, 715 (courts should not "make NEPA an insurmountable bar to agency action") [quoting Nat'l Audubon Soc'y v. Dep't of the Navy, 422 F.3d 174, 199 (4th Cir. 2005)]. Instead, the agency is afforded substantial deference to define, in the first instance, the proposal at issue. Ohio Valley Envtl. Coal. v. Aracoma Coal Co., 556 F.3d 177, 197 (4th Cir. 2009); see also Wyoming v. U.S. Dep't of Agric., 661 F.3d 1209, 1244-45 (10th Cir. 2011) ["[A]gencies have considerable discretion to define the purposes and objectives of a proposed action, as long as they are reasonable" (citation omitted)]. A "proposal" means simply that the agency has a goal that it would like to accomplish and "one or more alternative means of accomplishing that goal . . . ." 40 C.F.R. § 1508.23. Here, the proposal addressed in the EIS is "the approval of leases and the approval of drilling and workover permits." Section 1.3, p. 1-3. Under the Osage regulations, a lease authorizes the lessee to "use so much of the surface of the land within the Osage Mineral Estate as may be reasonable for operations and marketing. This includes but is not limited to the right to lay and maintain pipelines, electric lines, pull rods, other appliances necessary for operations and marketing, and the right-of-way for ingress and egress to any point of operations." 25 C.F.R. § 226.19(a). Since the activities allowed under a lease are limited under the regulations such that they will generally have similar impacts no matter where the lease is in Osage County, a programmatic analysis of all of those leases is appropriate. Likewise, the impacts of a subset of workovers, i.e., those that do not extend outside the wellpad, and therefore require no new ground disturbance, do not depend on where the wellpad is in the County, so programmatic analysis of such actions is appropriate. This is consistent with the suggestion in the CEQ regulations that, when an agency is preparing an EIS on a broad action, the agency "may find it useful to evaluate the proposal . . . generically, including actions which have relevant similarities, such as common timing, impacts, alternatives, methods of implementation, media, or subject matter." 40 C.F.R. § 1502.4(c)(2). Since the EIS addresses all current and anticipated leasing and workovers within Osage County, the BIA is not required to prepare a "site-specific" EA every time it approves a lease or workover. This is particularly true where the action is administrative in nature and does not provide for ground disturbance. (Cont.)
1393 (cont.)	2/21/2020	See above	General EIS comments	LeppD_20200221_DrummondLaw	The Tenth Circuit has specifically held that "[t]here is nothing in the statute or CEQ Regulations that requires an agency to include a site-specific analysis for every particular area affected by the proposed action." Wyoming, 661 F.3d at 1255. Wyoming involved the Forest Service's application of a "broad" nationwide rule that addressed environmental affects "generically." Id. at 1256. In that case, the Tenth Circuit affirmed the Forest Service's application of the so-called "roadless rule" "despite the fact that it did not include a detailed site-specific analysis of the environmental consequences at each and every specific [area] affected by the rule." Id. at 1257. The same conclusion is warranted here. Every new lease does not require the BIA to prepare a new and "site-specific" EA. The commenter's reliance on Richardson is misplaced and does not support his argument that the EIS should include a site-specific analysis or that site-specific analysis is required for each lease. In Richardson, the Tenth Circuit found that in light of the facts and circumstances at issue, BLM needed to conduct a site-specific NEPA review for a lease because the assessment of all reasonably foreseeable impacts must occur at the earliest practicable point and must occur before an irretrievable commitment of resources is made. 565 F.3d at 718. Applying the inquiries "necessarily requires a fact-specific inquiry," and that "the inquiry is necessarily contextual." Id. Thus, there is no "mandate" under Richardson that "requires" a site-specific analysis in every case. As the Tenth Circuit held in Wyoming, decided two years after Richardson, nothing in NEPA or its implementing regulations require a "site-specific" analysis in all circumstances. Indeed, courts have recognized that the leasing stage may not be the appropriate stage. Park County Resource Council, Inc. v. U.S. Department of Agriculture, 817 F.2d 609 (10th Cir. 1987), overruled in part on other grounds by Village of Los Ranchos de Albuquerque v. March, 956 F.2d 970 (10th Cir. 1992) is directly on point. In Park County, the U.S. Forest Service issued a lease on the basis of a review conducted pursuant to a programmatic EA, similar to the analysis in this EIS, for oil and gas leasing in the Shoshone and other National Forests in the Rocky Mountain Region. The Tenth Circuit found that use of a programmatic NEPA review was appropriate because the Forest Service did not know at the time of preparing the EA what land would be leased or where wells would be drilled. This was particularly true, the court noted, because full NEPA review would be conducted upon receipt of an APD on the subject lease. The same is true here; use of a programmatic NEPA review to approve leases is appropriate because the BIA does not know what land will be leased, or where drilling will occur – if it may even occur – within Osage County. As was also an important factor in Park County, and as discussed in the EIS, the BIA will conduct site-specific NEPA review prior to the approval of an APD and issuance of a drilling permit. (Cont.)
1393 (cont.)	2/21/2020	See above	General EIS comments	LeppD_20200221_DrummondLaw	The commenter's reliance on Richardson is based on a view that the language in Osage leases allowing for the use of surface for operations and marketing, including "the right to lay and maintain pipelines, electric lines, pull rods, and other appliances necessary for operations . . . the right of way for ingress and egress . . . and the right to use water for Lease operations," is similar to the BLM regulation language allowing for "the right to use so much of the leased lands as is necessary to explore for, drill for, mine, extract, remove, and dispose of all of the leased resources in a leasehold subject to Stipulations attached to the lease," which the Richardson court found to instructive in determining that BLM could not prevent the impacts resulting from surface use after a lease was issued and thus required a site-specific analysis. Id. (quoting 43 C.F.R. § 3101.1-2). This comparison fails. Osage leases do not contain terms allowing for drilling or other operations on the leasehold, instead providing that leases are subject to the regulations governing oil and gas mining operations set forth in 25 C.F.R. part 226. The leases specifically state that a party cannot conduct any drilling operations without approval and the regulations require Superintendent approval before commencing operations, consistent, as noted above, with the Osage regulations. Moreover, the Osage regulations do not allow for the commencement of drilling operations on a lease prior to obtaining the Superintendent's approval of an APD, which is subject to site-specific NEPA review. See 25 C.F.R. § 226.16(b). There is not, therefore, the possibility for the "bureaucratic momentum" that the commenter envisions. Finally, the commenter claims that the Osage regulations themselves require site-specific NEPA review for every lease, noting that 25 C.F.R. § 226.2(c) states that "[e]ach oil and/or gas lease and activities and installations associated therewith subject to these regulations shall be assessed and evaluated for its environmental impact prior to its approval by the Superintendent." That regulation does not, however, state the scope of the NEPA review required, just that it needs to be done before the approval by the Superintendent. Such review, therefore, is not required to be site-specific; it just needs to occur for each lease and workover. By preparing a programmatic review such as this EIS, the BIA is assessing and evaluating the environmental impact of each lease and workover in a more efficient fashion than site-specific review, consistent with the actual mandate of the CEQ regulations to reduce paperwork by "using program, policy, or plan environmental impact statements and tiering from statements of broad scope to those of narrower scope, to eliminate repetitive discussions of the same issues." 40 C.F.R. § 1500.4(i).

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1398	2/21/2020	The DEIS Wrongly Interprets NEPA to Displace the 1906 Osage Allotment Act and Subsequent Amendments that Require the BIA to Construe Federal Laws in the Best Interests of the Osage Nation The BIA's assumption that NEPA trumps the Secretary's duties under the 1906 Act is undermined by the fact that federal courts have, continuously, concluded that questions regarding the Secretary's authority under the 1906 Act are to be "liberally" construed in favor of the Osage Nation and Osage headright holders. For instance, in Logan v. Andrus, the U.S. District Court for the Northern District of Oklahoma laid out a clear standard for interpreting the 1906 Act. The Act is to be interpreted using the canons of construction of Indian legislation, the most general being "that legislation affecting the Indians is to be liberally construed in their interest and doubtful expressions resolved in their favor." Id. at 1324. Further, while the Department's interpretation of Indian laws is entitled to "[g]reat weight," the regulatory power is "not the power to change the law." Id. (citing United States v. Jackson, 280 U.S. 183 (1930)). Finally, the Court concluded, that "[i]t is within the framework of the above rules of statutory construction that the Osage Allotment Act must be examined." Id. Therefore, according to the Northern District, the 1906 Act obligates the Secretary to "provide for the greatest ultimate recovery of oil and gas underlying the Osage mineral estate." Pub. L. No. 95-496 § 4. This is consistent with the overarching canons of construction of Indian legislation, as affirmed by U.S. Supreme Court precedent. Nowhere in the DEIS does the BIA actually consider whether NEPA's EIS process even applies to a lease issued pursuant to the 1906 Act, as amended. The failure to undertake this consideration, given the clear precedent stating that the 1906 Act imposes strict and enforceable trust duty obligations on the Secretary, constitutes a failure sufficient to preclude the BIA from moving forward with this current DEIS. Even if the BIA had undertaken the requisite analysis to conclude that NEPA applies, it is within the Secretary's discretion to waive NEPA regulations because doing so would serve the best interest of the Osage Nation and Osage mineral estate, and federal law compels the Secretary to uphold his trust duties and obligations to the Osage Nation and headright holders. This is consistent with the congressional aims of the 1906 Act, namely, the goal of maximizing profits from the estate for the benefit of Osage Nation and Osage headright holders. The Secretary could do so in light of his capacity as fiduciary to the Osage mineral estate and the specific applicability of the Osage Acts. Federal regulations compel the Secretary to forego the application of generic regulations where upholding non-Indian specific federal regulations would require the Secretary to abdicate his trust duties and responsibilities to Indian tribes and their citizens. Specifically, 25 C.F.R. § 1.2 states that "[t]he regulations in chapter I of title 25 of the Code of Federal Regulations are of general application. Notwithstanding any limitations contained in the regulations of this chapter, the Secretary retains the power to waive or make exceptions to his regulations as found in chapter I of title 25 CFR in all cases where permitted by law and the Secretary finds that such waiver or exception is in the best interest of the Indians." (emphasis added). (Cont...)	General EIS comments	WallerE_20200221_OsageMineralsCouncil	The Osage Minerals Council claims that the DEIS is the product of a BIA "assumption that NEPA trumps the Secretary's duties under" the 1906 Osage Allotment Act. BIA has made no such assumption. NEPA does not "trump" any other statute; the NEPA process is, rather, applicable to all major Federal actions to ensure that environmental considerations are "infused into the ongoing programs and actions of the Federal Government." Marsh v. Oregon Natural Resources Council, 490 U.S. 360, 371 n. 14 (1989). The Minerals Council argues that the United States trust responsibility under Federal Indian law trumps the application of other "generic" laws, like NEPA. While it is true that "[w]hen the Secretary is acting in his fiduciary role rather than solely as a regulator and is faced with a decision for which there is more than one 'reasonable' choice as that term is used in administrative law, he must choose the alternative that is in the best interests of the Indian tribe," Jicarilla Apache Tribe v. Supron Energy Corp., 728 F.2d 1555,1567 (10th Cir. 1984) (Seymour, J., concurring in part and dissenting in part), adopted as majority opinion as modified en banc, 782 F.2d 855 (10th Cir. 1986), compliance with NEPA in decision making is also required and part of the trust responsibility. Gros Ventre Tribe v. United States, 469 F.3d 801, 810 (9th Cir. 2006). The Minerals Council also asserts that the Secretary cannot prioritize national or governmental interests over the trust responsibility. The BIA is not doing so. The BIA is not trying to accommodate another party while ignoring its duty to the Nation. Pyramid Lake Paiute Tribe of Indians v. Morton, 354 F. Supp. 252, (D.D.C. 1972), supplemented, 360 F. Supp. 669 (D.D.C. 1973), reversed on other grounds, 499 F.2d 1095 (D.C. Cir. 1974). Nor is it entering into a transaction with the Nation and considering its own needs paramount to the Nation's. Navajo Tribe of Indians v. U. S., 364 F.2d 320, 322–23 (Ct. Cl. 1966). Rather, the BIA is balancing the environmental review obligation that Congress has placed on it in NEPA with the trust obligations under the 1906 Act, as the Supreme Court and other courts have instructed it to do. Nevada v. U.S., 463 U.S. 110, 128 (1983). ("The Government does not 'compromise' its obligation to one interest that Congress obliges it to represent by the mere fact that it simultaneously performs another task for another interest that Congress has obligated it by statute to do."); Davis v. Morton, 469 F.2d 593 (10th Cir. 1972) (NEPA review must be done for approval of leases of Indian land under statutes specifically applying to Indian land, even in consideration of the trust responsibility); and Hayes v. Chaparral Energy, LLC, 180 F. Supp. 3d 902 (N.D. Okla. 2016), order vacated, appeal dismissed on other grounds sub nom. Hayes v. Osage Minerals Council, 699 Fed. Appx. 799 (10th Cir. 2017) (cont'd.)
1398(cont)	2/21/2020	Federal courts have upheld the Secretary's use of this waiver in instances where enforcing a particular regulation would require the Secretary to act in a way that harms the interests of tribes and their citizens. See, e.g., Langley v. Edwards, 872 F. Supp. 1531, 1532 (W.D. La. 1995) ("the Secretary has retained the power to waive regulations in all cases where permitted by law and the Secretary finds that such waiver . . . is in the best interest of the Indians.") (internal quotation marks omitted). Other courts have also noted the validity of the waiver authority in a variety of contexts.^9 The DEIS contains no discussion of the clear authority compelling the BIA to consider its assumed application of NEPA's regulations in the context of a framework of federal Indian law that commands strict adherence to fiduciary duties and trust obligations. Federal courts have repeatedly held that the federal government's trust duties and obligations to tribes trump the application of other generic federal laws. See, e.g., Jicarilla Apache Tribe v. Supron Energy Corp., 728 F.2d 1555 (10th Cir. 1984) (concluding that the Secretary violated his fiduciary duties to the Jicarilla Apache Tribe where breaches of various gas leases were executed on tribal lands pursuant to the Indian Mineral Leasing Act of 1938 (IMLA)). In Jicarilla Apache Tribe, the Tenth Circuit held that the federal government "is obligated to act as a fiduciary[,] . . . [and accordingly, its] actions must not merely meet the minimal requirements of administrative law, but must also pass scrutiny under the more stringent standards demanded of a fiduciary." Id. At 1563 (Seymour, J., concurring in part and dissenting in part), adopted as majority opinion as modified *11 en banc, 782 F.2d 855 (10th Cir. 1986)). The BIA is wrong, under applicable law, to assume that administrative/environmental law automatically takes priority to the agency's trust duties and responsibilities to a tribal nation. Courts have also ruled against the federal government in other situations where the Secretary prioritized national or governmental interests over his fiduciary duty to tribal nations. For instance, in Pyramid Lake Paiute Tribe v. Morton, the U.S. District Court for the District of Columbia ruled that the Secretary was obligated to resolve conflicting water claims in a manner consistent with the trust obligation the federal government owes to the tribe. 354 F. Supp. 252 (D.D.C. 1972). There, the Secretary had "fail[ed] to demonstrate an adequate recognition of his fiduciary duty to the Tribe" because the agency did not ensure that adequate water was delivered to the reservation for preservation of Pyramid Lake and tribal fisheries. Id. Specifically, the Court rejected the argument that the Secretary could make a judgment call to reconcile tribal and public interests in the water in favor of generic public water laws. Id. Similarly, in Navajo Tribe of Indians v. United States, the U.S. Court of Claims examined DOI's approval of a lease between the Bureau of Mines and an oil and gas lessee on tribal lands without tribal consent, citing wartime need. 364 F.2d 320, 323 (Ct. Cl. 1966). (Cont...)	General EIS comments	WallerE_20200221_OsageMineralsCouncil	(unpublished) (reversing and remanding BIA approval of an Osage minerals lease for inadequate NEPA review). Furthermore, the Minerals Council argues that there is authority stating that a statute of general applicability (such as NEPA) should not apply to Indian Tribes if it affects self-governance or would abrogate treaty rights or there is some proof that Congress intended the law not to apply to Tribes. In making this argument, the Minerals Council cites cases concerning the application of the Occupational Safety and Health Act to a tribal farm [Donovan v. Coeur d'Alene Tribal Farm, 751 F.2d 1113, 1116 (9th Cir. 1985)]; that same act to a tribal forestry business [Donovan v. Navajo Forest Products Industries, 692 F.2d 709, 710 (10th Cir. 1982)]; and the Age Discrimination in Employment Act to a tribal government [EEOC v. Cherokee Nation, 871 F.2d 937, 938 (10th Cir. 1989)]. None of these, or the principles they articulate, however, are applicable here. The preparation of the EIS is not an attempt to apply NEPA to the actions of the Nation. NEPA, by its terms, only applies to "Federal actions." The Nation does not apply NEPA to any of its actions, nor should it. If an action of the Nation requires funding or approval from the BIA or another Federal agency, the Federal agency must prepare a NEPA review of that Federal action. (cont'd.)
1398(cont)	2/21/2020	The Court found the government's actions unlawfully violated its federal trust duty to tribes, and although the government's actions may have been of national interest and in compliance with generic federal laws outside of the Indian law context, that "[did] not excuse" DOI's "duty to the tribe." Id. at 322. Taken together, Pyramid Lake and Navajo Tribe demonstrate it is improper for the Secretary to prioritize public interest in environmental protection (as in NEPA) over his specific fiduciary obligations to tribes and their citizens. Nor has the BIA adequately considered whether NEPA actually applies as a statute of general applicability. There are many authorities that counsel it does not, and the BIA's failure to undertake this analysis renders its DEIS erroneous, arbitrary, and capricious. The congressional goals of NEPA demonstrate it is a statute of general applicability. Courts have phrased the standard for "general applicability" in a few ways. In Reich v. Great Lakes Indian Fish & Wildlife Comm'n, the Seventh Circuit Court of Appeals considered whether courts have construed the law "liberally, to apply to the furthest reaches consistent with congressional direction, recognizing that broad coverage is essential to accomplish its goals." 4 F.3d 490, 499 (7th Cir. 1993) (quoting Tony & Susan Alamo Found. v. Sec'y of Labor, 471 U.S. 290, 296 (1985)). The Eleventh Circuit Court of Appeals has characterized this inquiry as turning on whether the statute is one that "Congress intended to have broad applicability," as evidenced by the language of the law and the definitions it employs. Fla. Paraplegic Ass'n, Inc. v. Miccosukee Tribe of Indians of Fla., 166 F.3d 1126, 1128 (11th Cir. 1999). The congressional goals of NEPA indicate a "broad coverage" intent: To declare a national policy which will encourage productive and enjoyable harmony between man and his environment; to promote efforts which will prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of man; [and] to enrich the understanding of the ecological systems and natural resources important to the Nation . . . . 42 U.S.C. § 4321 (2020) (emphasis added). By contrast, the Osage statutes are statutes of specific applicability, with clear and particular Secretarial duties.10 The 1906 Act and subsequent amendments makes it clear the Secretary has a responsibility to make oil and gas production on the Osage mineral estate an utmost priority. In fact, the 1978 Act—an act passed eight years after Congress enacted NEPA—states: "In order to conserve natural resources and provide for the greatest ultimate recovery of oil and gas underlying the Osage mineral estate, the Secretary of the Interior is authorized to establish rules and regulations under which oil and gas leases producing from a common source of supply may be unitized." Pub. L. No. 95-496 § 4 (emphasis added). Federal courts have provided clarity as to when statutes of specific applicability trump statutes of general applicability. In this case, strong authority exists to support the conclusion that the Secretary's duties under the 1906 Act create an exception to statutes of general applicability, such as NEPA. The BIA's failure to consider this undermines all of the specific conclusions in the agency's DEIS.	General EIS comments	WallerE_20200221_OsageMineralsCouncil	Also, the statute itself notes that, rather than "trumping" other authorities, "[t]he policies and goals set forth in [NEPA] are supplementary to those set forth in existing authorizations of Federal agencies." 42 U.S.C. § 4335. Thus, while NEPA is, as the OMC agrees, a statute of general applicability across the Federal government, there is no issue whether it takes precedence over a more specific statute, which the OMC alleges is the status of the 1906 Act. Rather than dictating an environmentally preferable outcome (as the OMC seems to allege), NEPA merely requires that agencies prepare a "detailed statement" (an EIS) that includes the purpose and need that the agency is seeking to fulfill with its action, a reasonable range of alternatives to meet that purpose and need, and an analysis of the environmental impacts of each of those alternatives. The purpose of the EIS is "to aid in the [agency's] own decision making process and to advise other interested agencies and the public of the environmental consequences of planned federal action." Calvert Cliffs' Coordinating Committee v. U.S. Atomic Energy Commn., 449 F.2d 1109, 1114 (D.C. Cir. 1971). NEPA review does not dictate the outcome of the agency's analysis, but requires that the agency "insure that presently unquantified environmental amenities and values may be given appropriate consideration in decision making along with economic and technical considerations." 42 U.S.C. § 4332(2)(B). "'Environmental amenities' will often be in conflict with 'economic and technical considerations.' To 'consider' the former 'along with' the latter must involve a balancing process. In some instances environmental costs may outweigh economic and technical benefits and in other instances they may not. But NEPA mandates a rather finely tuned and 'systematic' balancing analysis in each instance. Calvert Cliffs' Coordinating Committee, supra, at 1113. This balancing analysis is required by NEPA for "every . . . major federal action significantly affecting the quality of the human environment." 42 U.S.C. § 4332(2)(C). "Actions include new and continuing activities, including projects and programs entirely or partly financed, assisted, conducted, regulated, or approved by federal agencies." 40 C.F.R. § 1508.18(a). (Cont.)

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1398(cont)	2/21/2020	A significant amount of federal authority supports the conclusion that the 1906 Act constitutes an exception to NEPA's EIS process. See, e.g., Donovan v. Coeur d'Alene, 751 F.2d 1113, 1116 (9th Cir. 1985) (supporting "the proposition that Indian tribes are subject only to those laws of the United States expressly made applicable to them."); Donovan v. Navajo Forest Products Industries, 692 F.2d 709 (10th Cir. 1982) (statutes of general applicability are not applicable to Indian Tribes if the law would "be in derogation of Indians' treaty rights."); EEOC v. Cherokee Nation, 871 F.2d 937, 939 (10th Cir. 1989) ("Supreme Court precedent dictates that in cases where ambiguity exists (such as that posed by the ADEA's silence with respect to Indians), and there is no clear indication of congressional intent to abrogate Indian sovereignty rights (as manifested, e.g., by the legislative history, or the existence of a comprehensive statutory plan), the court is to apply the special canons of construction to the benefit of Indian interests."). Furthermore, in considering statutes of general applicability, where those statutes are "silent on the issue of applicability to Indian tribes" the general statutes "will not apply to them if: (1) the law touches 'exclusive rights of self-governance in purely intramural matters'; (2) the application of the law to the tribe would 'abrogate rights guaranteed by Indian treaties'; or (3) there is proof 'by legislative history or some other means that Congress intended [the law] not to apply to Indians on their reservations . . . .'" United States v. Farris, 624 F.2d 890, 893-94 (9th Cir. 1980). In any of these three situations, "Congress must expressly apply a statute to Indians before [courts] will hold that it reaches them." Id. at 1116.11 In this instance, all three exceptions apply. The specifically applicable 1906 Act demonstrates a Congressional directive for the Secretary to prioritize the highest return for oil and gas proceeds on the Osage mineral estate, in direct opposition to the proposals contained in the DEIS under the generally applicable statute, NEPA. NEPA makes no mention of its application to Indian tribes, and given Congress' clear edict that the Secretary must "provide for the greatest ultimate recovery of oil and gas underlying the Osage mineral estate[,]"12 the BIA's failure to consider whether its assumption that NEPA applies to the actions the Secretary as to the Osages renders the DEIS arbitrary and capricious.	General EIS comments	WallerE_20200221_OsageMineralsCouncil	Assuming that NEPA applies (as it does), the Minerals Council also suggests that the Secretary should use his authority under 25 C.F.R. § 1.2 "to waive NEPA regulations." That section authorizes the Secretary to "waive or make exceptions to his regulations as found in chapter I of title 25 CFR in all cases where permitted by law and the Secretary finds that such waiver or exception is in the best interest of the Indians." The Minerals Council focusses on the last portion of that sentence, arguing that a waiver would be in the best interest of the Osage Nation. Only one "NEPA regulation" would actually qualify for a waiver, however. That regulation is 25 C.F.R. § 226.2(c), which requires that "[e]ach oil and/or gas lease and activities and installations associated therewith subject to these regulations shall be assessed and evaluated for its environmental impact prior to its approval by the Superintendent." If, however, the Secretary found that such a waiver were in the best interest of the Nation and granted it, that waiver would not result in NEPA review being inapplicable to oil and gas development in Osage County. Such review, as pointed out above, is required under NEPA itself, the CEQ regulations at 40 C.F.R. Parts 1500-1508, and the Department's NEPA regulations at 43 C.F.R. Part 46. As part of the Executive Branch, the Secretary has no authority under the Constitution to waive application of a Federal statute. Furthermore, not only are the CEQ and Departmental regulations not in "chapter I of title 25 CFR," but they are also required to be promulgated under NEPA, 42 U.S.C. § 4332(b), so waiver of them would not be "permitted by law." Therefore, the Secretary has no power to waive all "NEPA regulations," even if he found that such waiver were in the best interest of the Nation. Finally, the general thrust of the Minerals Council's comment is that BIA's preparation of the DEIS is tantamount to a decision to take an environmentally-driven action that is allegedly contrary to the trust responsibility and the 1906 Act. The preparation of the DEIS (and of this FEIS) is not a decision to do anything. Any decision based on the analysis in the EIS will come in the Record of Decision (ROD). While the BIA must identify an environmentally preferable alternative in the ROD, 40 C.F.R. § 1505.2(b), see also, Questions 6a and 6b, Forty Most Asked Questions on NEPA Regulations, 46 Fed. Reg. 18027, 18028 (1981), it is not required to choose that alternative. 43 C.F.R. § 46.450. Furthermore, in making the decision documented in the ROD, the BIA will consider other factors in addition to the EIS analysis, including the trust responsibility under the 1906 Act. 40 C.F.R. § 1505.2(b).
1400	2/21/2020	Further, the DEIS does not lend itself to be tiered with an EA for future oil and gas development. Just one example of this would be found in the Wetlands discussion in Section 3.7 and Section 4.7. In Section 3.7, the writer gives a broad overview of the various wetland types and the number of acres within the Planning Area for each type. There are no associated maps to illustrate where and what type the wetlands are located within the Planning Area. In the effects analysis in Section 4.7, the writer makes broad statements such as "Where access roads cross wetlands or riparian areas, vegetation could be removed to facilitate construction." It is in violation of the Clean Water Act to destroy or disturb a wetland without proper permitting and mitigation (notwithstanding any listed COAs). The writer assumes this would occur. It is very difficult to tier a project specific EA to this DEIS when the analysis within the DEIS is broad and assumes violations of federal law. An EA could be tiered more efficiently to an EIS if there were maps provided showing where Wetlands are located. Furthermore, there is a threshold of allowable disturbance based on the activity and the type of wetland being disturbed. This information should also be included in the analysis. Blanket statements with no specific analysis translate to a deficient EIS that precludes efficient EA tiering. Without major revisions and thorough analysis-approach to this DEIS, dense EAs as currently written for each project would remain unchanged.	General EIS comments	WallerE_20200221_OsageMineralsCouncil	Section 4.7.2 of the DEIS states that under all alternatives, lessees must comply with, and obtain, any permits or authorizations necessary to comply with Federal laws, including the Clean Water Act (CWA) and Federal Noxious Weed Act. The EIS does not assume that all the analyzed environmental impacts will occur, nor does it assume that lessees will violate Federal law. As set forth in Section 4.1.1 – General Method for Analyzing Impacts, the EIS analyzes "potential impacts and effects." The language used in Section 4.7 is consistent with this statement, providing that "…vegetation could be removed to facilitate construction." The Bureau of Indian Affairs used the word "could" to indicate that vegetation removal is a possibility, not to indicate that it is a guarantee. If the Bureau of Indian Affairs was conducting its analysis based an assumption of noncompliance with Federal law, Section 4.7 would have stated that "…vegetation will be removed to facilitate construction." A new figure has been added, referenced now in the discussion in Section 3.7.2 of the FEIS, showing wetlands in the planning area.
1407	2/21/2020	ES.3 EIS DECISION FRAMEWORK "Operators may prepare a site-specific EA for one individual well, a 'batched' group of wells that will be located within the same area, an entire lease, a quarter-section, a section, or any larger area that they so choose." The Operators are not responsible for preparing an EA. NEPA requires that a federal agency prepares the NEPA documentation. Operators are in the business of drilling and operating oil and gas wells, not in the business of preparing EAs and other NEPA documentation.	General EIS comments	WallerE_20200221_OsageMineralsCouncil	The Minerals Council is correct that the ultimate responsibility for NEPA review lies with the Federal Agency. The CEQ Regulations, however, provide for preparation of NEPA reviews by contractors or applicants (e.g., producers) with independent evaluation by the Federal agency. 40 C.F.R. 1506.5. This is a recognition that preparation by an outside party may be faster than relying on the agency to prepare the review as it has resources and budget to do so. The BIA's NEPA Handbook has reflected its policy of requesting preparation by applicants since at least 2005. The Osage Agency adopted such a policy in 2014.
1429	2/21/2020	Chapter 4. Environmental Consequences 4.1 INTRODUCTION "The baseline used for the impact analysis is the current condition or situation of the resources in the planning area, as described in Chapter 3, Affected Environment." This sentence is true, however, the reader makes conclusions and impact analysis throughout Section 3 where the impact analysis should be in Section 4 as stated.	General EIS comments	WallerE_20200221_OsageMineralsCouncil	Chapter 3, Affected Environment, is intended to establish a baseline for comparison of the direct, indirect, and cumulative impacts of each of the alternatives in Chapter 4, Environmental Consequences. The proposed action in this EIS – oil and gas development – has been ongoing in Osage County for over 100 years. Accordingly, the baseline for the affected environment in Osage County must take historic development of the Osage Mineral Estate into account. For example, the baseline for Osage County water resources must acknowledge that there have been prior accidental releases of deleterious substances that have affected surface and groundwater. The acknowledgment of such prior or existing effects of development on the environment in Osage County is not an analysis of the potential impacts thereof.
1432	2/21/2020	ALTERNATIVE 2 "Lessees would still be required to comply with all applicable laws and regulations but would have latitude to determine how best to comply." Most of the COAs that would apply here do not contain specific instructions or procedures on how to comply. Furthermore, for all alternatives, the lessee would be required to comply with all applicable laws and regulations. This is written in a way where the reader could conclude that not all alternatives require this. "Removing requirements that waste and old equipment be removed from sites would increase the risk of soil contamination and salt scarring, compared with Alternative 1 (No Action)." This requirement is contained in 25 C.F.R. §226.19(a), regardless of applying the COA. "Waiving COAs that limit surface disturbance would also increase soil compaction and increase the risk of damage to paleontological resources compared with Alternative 1 (No Action)." Regardless of issuing a COA that limits the surface disturbance (COA 3), 25 C.F.R. § 226.37 authorizes the right to use so much of the surface of the land within the…as may be necessary. Surface damages are paid to the surface owner based on footprint size. The operator has an incentive to keep surface disturbance to minimum because they do not want to use and pay more than they have to.	General EIS comments	WallerE_20200221_OsageMineralsCouncil	COA 3 states that lessees must "avoid or minimize soil and vegetation disturbance" and should not "remove or damage trees, shrubs, and groundcover to the extent possible." This Bureau of Indian Affairs implemented this COA in 2014 for all new ground-disturbing activities and lessees have been complying therewith. COA 3 does not prohibit soil and vegetation disturbance, it requires lessees to take care to minimize such disturbance where they are able to do so. Accordingly, the COA does not interfere with lessees "right to use so much of the surface of the land within the Osage Mineral Estate as may be reasonable for operations and marketing," as set forth in § 226.19(a) of the regulations.
1447	2/21/2020	Appendix A Reasonably Foreseeable Development Scenario C. Drilling Activity by Well Type Page 9 42 This data does not support the expected number of wells to be drilled. Clearly, the trend is that new well spuds is declining and has declined since 2010. This is inconsistent with the writers' conclusion that well spuds will continue to increase and that there is a correlation between oil prices and new well spuds. The prices of oil were at an all-time high through those years, above $100/bbl. This needs to be reconciled throughout the DEIS. This is an inconsistent representation with other benchmarks. It fails to show 2008 –2014 where well spuds decreased and oil prices remained above $100/bbl. What is the justification for an increase in rig activity?	General EIS comments	WallerE_20200221_OsageMineralsCouncil	The projections are based on trends that occured prior to litigation which may have impacted the rate new well spuds. Additionally the projection is designed to project an optimistic scenario in order to allow analysis of potential maximum impacts in order to avoid having to conduct additional NEPA analysis if a high number of spuds occur.

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1461	2/20/2020	The DEIS will have to comply with the 1906 Allotment Act and the 1929 amendment to the 1906 Allotment Act , which States that drilling for oil and gas on the Osage Mineral Estate is mandatory. All regulations are waived.	General EIS comments	RedEagleR_20200220	Neither the 1906 Act, nor the 1929 Act reference "drilling" or contain language supporting the assertion that "drilling for oil and gas on the Osage Mineral Estate is mandatory." To the extent that the Acts govern leasing of the Osage Mineral Estate, such action is discretionary. The Act of June 28, 1906, § 3, 34 Stat. 539, as amended ("1906 Act"), vests the Secretary with broad authority over leasing of the Osage Mineral Estate. Specifically, the 1906 Act provides that the Osage Nation may lease the Osage Mineral Estate for oil and gas mining "…subject to the approval of the Secretary of the Interior, and under such rules and regulations as he may prescribe." The U.S. Congress' use of the word "may" indicates that leasing of the Osage Mineral Estate is permissive, as opposed to mandatory. Thus, the Osage Nation has the option of leasing the Osage Mineral Estate, but is not required to do so. To the extent that the Osage Nation exercises its authority to execute a lease of the Osage Mineral Estate, such lease does not become effective unless and until the Secretary of the Interior approves it. The 1906 Act does not require the Secretary of the Interior to approve any or all leases of the Osage Mineral Estate. To the contrary, the Act provides the Secretary with discretion regarding such approval. In 1929, the U.S. Congress amended the 1906 Act, adding a provision requiring that a certain number of acres of the Osage Mineral Estate be offered for lease annually. The Act of March 2, 1929, §1, 45 Stat. 1478 ("1929 Act") authorizes and directs the Secretary of the Interior and Osage Nation to offer for lease "…any unleased portion of [the Osage Mineral Estate] in such quantities and at such times as may be deemed in the best interest of the Osage [Nation], Provided, That not less than twenty-five thousand acres shall be offered for lease for oil and gas mining purposes during any one year." While the 1929 Act does require the Secretary of the Interior and Osage Nation to offer a minimum of 25,000 acres for lease annually, it does not require that the acreage offered be leased. Accordingly, the Osage Nation retains the authority to determine whether to execute a lease of the Osage Mineral Estate and the Secretary of the Interior retains discretion regarding the approval of any such lease. The assertion that the 1906 and 1929 Acts require that "[a]ll regulations are waived," is similarly unsupported. As noted above, the 1906 Act explicitly provides the Secretary of the Interior with sole authority to establish and implement the rules and regulations governing leasing of the Osage Mineral Estate. At present, the regulations governing the Osage Mineral Estate are set forth in 25 C.F.R. part 226 and the Superintendent of the Osage Agency is delegated the authority to interpret and supplement those regulations, as well as issue additional mandatory guidance, via orders and notices. It should be noted that even where the Secretary of the Interior approves a lease of the Osage Mineral Estate executed by the Osage Nation pursuant to the 1906 Act, nothing in the 1906 or 1929 Acts, nor 25 C.F.R. part 226, requires the Secretary to approve subsequent drilling thereon.
1405	2/21/2020	"The BIA needs this EIS in order to fulfill its trust responsibility under the 1906 Act to administer leasing and development of the Osage Mineral Estate." The trust responsibility is not the trigger that requires the EIS. The federal action of leasing and permitting to drill the mineral estate within the Osage Reservation does not constitute a "federal action" sufficient to trump the Secretary's trust duties and obligations under the 1906 Act, as amended.	Purpose and Need	WallerE_20200221_OsageMineralsCouncil	NEPA does not "trump" any other statute; the NEPA process is, rather, applicable to all major Federal actions to ensure that environmental considerations are "infused into the ongoing programs and actions of the Federal Government." Marsh v. Oregon Natural Resources Council, 490 U.S. 360, 371 n. 14 (1989). Compliance with NEPA is, therefore, a necessary part of BIA's fulfillment of its trust responsibility.
1406	2/21/2020	"In addition, the BIA is required, under more generally applicable statutes, to include in the best interest calculation, protection of the environment in Osage County in order to enhance conservation of resources and protection of the health and safety of the Osage people." As explained above, this stated requirement is contrary to law. The "best interest" in this context means "best interest of the Osage Tribe of Indians" that in turn means minerals leasing and production. Furthermore, the best interest determination is not one that can be made by the Secretary unliterally, as the law requires the Osage Minerals Council (formerly the Osage Tribal Council) to concur in the determination of what constitutes the best interest of the Osage. The Secretary of the Interior and the Osage tribal council are hereby authorized and directed to offer for lease for oil, gas, and other mining purposes any unleaded portion of said land in such quantities and at such times as may be deemed for the best interest of the Osage Tribe of Indians: Provided, That not less than twentyfive thousand acres shall be offered for lease for oil- and gas-mining purposes during any one years: Provided further, That as to all lands hereafter leased, the regulations governing same and the leases issued thereon shall contain appropriate provisions for the conservation of the natural gas for its economic use, to the end that the highest percentage of ultimate recovery of both oil and gas may be secured: Provided, however, That nothing herein contained shall be construed as affecting any valid existing lease for oil or gas or other minerals, but all such leases shall continue as long as gas, oil, or other minerals are found in paying quantities.^21 The statutes specifically applying to the Osage Reservation apply. 21 Act of June 24, 1938, 52 Stat. 1034 (emphasis added).	Purpose and Need	WallerE_20200221_OsageMineralsCouncil	There is no definition in the 1906 Act, or in the regulations implementing that Act, defining what factors the Secretary, in consultation with the Osage Nation, is to consider in the determination of what is in the "best interest" of the Nation. [The consultation is with the Nation, as the successor to the Osage Tribal Council, as held by the Osage Supreme Court in Boone v. Osage Nation of Oklahoma, SCV-2015-01 (September 9, 2016).] To determine what this phrase means, the Secretary can look to the general Indian mineral leasing regulations at 25 C.F.R. Part 211. United States v. Osage Wind, 872 F.3d 1078 (10th Cir. 2017) (interpreting "mining" in Osage regulations with reference to the Part 211 regulations). In 25 CFR 211.3, "in the best interest of the Indian mineral owner" is defined as the standard to be applied by the Secretary in considering whether to take an action. The definition goes on to state that "[i]n considering whether it is "in the best interest of the Indian mineral owner" to take a certain action . . . , the Secretary shall consider any relevant factor, including , but not limited to: economic considerations, such as date of lease expiration; probable financial effect on the Indian mineral owner; leasability of land concerned; need for change in the terms of the existing lease; marketability; and potential environmental, social, and cultural effects." Thus, when approving leases, permits, and workovers concerning the Osage Mineral Estate, the Secretary is required to consider many factors, including environmental, social, and cultural effects of the decision, to determine whether that approval is in the best interest of the Osage Nation.
1458	2/20/2020	The Purpose and Need Statement is framed in a manner that puts undo emphasis on the "maximization of oil & gas production" and downplays the importance of environmental conservation to Osage County, specifically in terms of socio-economic factors that are dependent on resource conservation (i.e., agriculture/ranching and tourism). The purpose statement should be to promote the leasing and development opportunities of the Osage Nation pursuant to the 1906 Act that emphasizes comprehensive and efficient administration of leases and to ensure the protection and conservation of natural reso urces critical to Osage County;	Purpose and Need	BiehlJ_20200220_Osage land and cattle co	The purpose and need statement reflects not only the scope of the EIS (oil and gas development in Osage County, not agricultural/ranching or tourism), but also the scope of the BIA's mission as the trustee of the Osage Mineral Estate for the benefit of the Osage Nation and Osage people, not non-Indian surface owners.
1373	2/6/2020	As currently presented, Alternative 2 fails to meet the required purpose and is thus not a reasonable alternative. The DEIS expressly finds that the environmental consequences to virtually every resource are worse under Alternative 2 than under the No Action Alternative, which is the only alternative that is not required to conform to the purpose and need of the proposed action. DEIS, p. 2-8. With respect to public health and safety, the DEIS is explicit that the impacts may increase under this Alternative. "People living or working on or near a well site could be exposed to higher levels of H2S compared with Alternative 1 (No Action) due to the lack of required air quality measures." DEIS, p. 4-79. Yet, while the focus of Alternative 2 is oil and gas development at the cost of the environment, the number of new wells estimated under Alternative 2 is not increased but is identical to that allowed under the No Action Alternative - the full foreseeable amount of 4,761 wells. DEIS, pp. 2-9, 2-10. Thus, as compared to the No Action Alternative, there is no promotion of oil and gas development nor is there any avoidance or minimization of potential adverse impacts as required to meet the purpose of this action. In fact, Alternative 2 will result in a substantial degradation of many environmental resources, as compared to business as usual under the No Action Alternative.	Range of Alternatives	FuhrM_20200206_NatureConservancy	The CEQ NEPA regulations at 43 CFR 1502.14, as clarified in the CEQ NEPA 40 Most Asked Questions, Questions 1a and 1b, require the BIA to consider a reasonable range of alternatives. Alternative 2 represents one end of this range of alternatives while still satisfying the purpose and need. Assessments of how well a given alternative would satisfy specific goals within the purpose and need statement is not a reason to eliminate the alternative from detailed analysis but is rather a consideration for the decisionmaker.
1374	2/6/2020	Alternative 3, however, allows the problematic and unreasonable conversion of a low-density section into a high-density section based on the proposal of the driller: "In sections where drilling additional wells changes the section from low to high density, existing wells would continue to be managed according to low-density management, and new wells would be managed according to high-density management." DEIS, p. 2-12. When a driller proposes to drill in a low-density area, the COAs applied to the drilling should be based on the existing condition of section, i.e., those designed for a low-density area, so as to provide a minimum level of environmental protection. But if the driller proposes to drill enough wells that the density threshold is exceeded and the area subsequently converted to a high-density area, then all of these many new wells drilled by the converter are apparently subject only to the wholly inadequate COAs of Alternative 2. This apparent allowance creates perverse incentives for the driller to propose enough wells to exceed the density threshold and could result in the widespread conversion of low-density areas to high-density areas, with all of its attendant environmental degradation.	Range of Alternatives	FuhrM_20200206_NatureConservancy	Alternative 3 has been revised to state that sections identified as low-density in this EIS would have the more stringent COAs applied even as the number of wells in those sections surpasses 17.
1375	2/6/2020	To maintain the reasonableness and credibility of Alternative 3, BIA should clarify that the driller proposing to convert an area to high density will be obliged for all of its wells to follow the COAs applicable to low density areas	Range of Alternatives	FuhrM_20200206_NatureConservancy	Alternative 3 has been revised to state that sections identified as low-density in this EIS would have the more stringent COAs applied even as the number of wells in those sections surpasses 17.
1384	2/20/2020	We propose an amendment be made to the DEIS to include an exclusion of further oil and gas development in areas of highest importance of habitat for the Greater Prairie Chicken. We propose that any area of importance of a 6 or higher from Figure 3-9 on page E-17 of the DEIS be excluded from any further development of oil and gas production to aid in preserving habitat for Greater Prairie Chickens.	Range of Alternatives	WallisB_20200220_OsageBuckCreek	The greater prairie chicken is not a threatened or endangered species and therefore does not warrant this level of protection in the alternatives. This proposal has been added to Section 2.5 in the FEIS as an alternative considered but eliminated from detailed analysis.

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1385	2/20/2020	Alternative concepts • Include exclusion of areas of highest importance (6 or higher) of habitat for the Greater prairie Chicken from any further oil and gas development. • COAs should be enforceable actions with consequences should they not be followed. • COAs should be readily available to landowners to facilitate more straightforward dealings with oil producers. • Oil companies and their associates should be required to execute surface damage agreements prior to entry on the property. • There must be requirements for producers to remediate surface damages caused by oil and gas activities, and requirements to restore the land back to tall grass prairie once oil and gas operations on the lease have ceased. • There must be enforceable limits and standards governing remediation of brine and petroleum contamination of soil and water. • Include burying of power lines in the COAs to reduce the wildfire potential and have less intrusion in to areas of importance for greater prairie chickens. • Include burying of oil and water flow lines in the COAs to reduce the risk of unnecessary leaks.	Range of Alternatives	WallisB_20200220_OsageBuckCreek	First bullet - The greater prairie chicken is not a threatened or endangered species and therefore does not warrant this level of protection in the alternatives. This proposal has been added to Section 2.5 in the FEIS as an alternative considered but eliminated from detailed analysis. Second bullet - Failure to adhere to a condition of approval is a violation of the lease and permit terms and results in consequences for the operator. Third bullet - The EIS is a public document. Upon completion, an electronic copy of the Final EIS will be available on the Osage Agency's website and a hard copy will be available in the Osage Agency's Owners' Room. Accordingly, the standard COAs will be available to lessees, surface owners, members of the public, and other interested parties. Fourth bullet - This proposal is beyond the scope of this EIS. Fifth bullet - This proposal is beyond the scope of this EIS. Sixth bullet - This proposal is beyond the scope of this EIS. Seventh bullet - Burying of power lines would cause more intrusion into areas of greater prairie chicken habitat due to the surface disturbance associated with burying and maintaining them. The lack of a COA does not preclude surface owners and lessees from entering into agreements for burial of power lines. Eighth bullet - COA 34 addresses this proposal.
1395	2/21/2020	It is important that the BIA be permitted to utilize a patchwork of differing constraints and rules based upon the differing conditions in the county. We would also propose that the BIA consider differing types of leases, as opposed to the standard Osage Oil and Gas Lease. An example of additional types of leases that should be considered include No Surface Occupancy ("NSO") leases, (2) Controlled Surface Use ("CSU") leases and (3) Timing Limitation ("TL") leases. An NSO lease prohibits occupation of the surface and requires directional drilling. A CSU lease imposes restrictions beyond that in traditional leases in order to address site specific issues for the property subject to the lease. A TL lease prohibits drilling activity for a certain period of time. This Alternative should be strongly considered by the BIA.	Range of Alternatives	LeppD_20200221_DrummondLaw	Section 2.4 of the DEIS states that the list of COAs identified under an alternative is not the final list that would be applied to every permit under that alternative. The BIA may waive COAs or apply additional COAs, based on site-specific determinations. Application of the proposed stipulations to leases would need to be authorized in the governing regulations. Even if authorized, these stipulations could only be applied at the time of lease issuance. Execution of leases is the purview of the Osage Minerals Council.
1397	2/21/2020	Further, the content of the DEIS falls far short of the mandates of the 1906 Osage Allotment Act and subsequent amendments, as well as the BIA's own stated purpose of the DEIS, positing two alternatives three and four that would overtly violate federal statutes related to the Osage mineral estate. Specifically, the final EIS cannot limit any area of the Osage Reservation from minerals development, but rather, must carry out the statutory mandate Congress has handed to the Secretary of the Interior and Osage Nation, that is, to: offer for lease for oil, gas, and other mining purposes any unleased portion of [the Osage Reservation] in such quantities and at such times as may be deemed for the best interest of the Osage Tribe of Indians . . . [in] the highest percentage of ultimate recovery of both oil and gas [that] may be secured.1 While the OMC does not approve of any of the alternatives as currently drafted in the DEIS, Alternative Two is the least objectionable, although it does not provide for efficient EA tiering and unlawfully prohibits leasing in certain Reservation areas.	Range of Alternatives	WallerE_20200221_OsageMineralsCouncil	Alternatives 3 and 4 do not diminish, nor are they intended to diminish, the Osage Nation's ownership of the Osage Mineral Estate or the total acreage thereof. The alternatives in the EIS represent a reasonable range of management decisions the Bureau of Indian Affairs can make regarding development of the Osage Mineral Estate. The Act of June 28, 1906, § 3, 34 Stat. 538, as amended ("1906 Act"), vests the Secretary of Interior with broad authority over leasing of the Osage Mineral Estate. Specifically, the 1906 Act provides that the Osage Nation may lease the Osage Mineral Estate for oil and gas mining "...subject to the approval of the Secretary of the Interior, and under such rules and regulations as he may prescribe." In 1929, the U.S. Congress amended the 1906 Act, adding a provision governing the number of acres of the Osage Mineral Estate that must be offered for lease annually. The Act of March 2, 1929, § 1, 45 Stat. 1478 ("1929 Act") directs the Secretary of the Interior and Osage Nation to offer for lease..."any unleased portion of [the Osage Mineral Estate] in such quantities and at such times as may be deemed in the best interest of the Osage [Nation], Provided, That not less than twenty-five thousand acres shall be offered for lease for oil and gas mining purposes during any one year." Alternatives 3 and 4 are consistent with this statutory mandate.
1399	2/21/2020	The DEIS Purpose and Need Statement Does Not Match the DEIS Substantive Content. ES.2 PURPOSE AND NEED FOR THE DEIS "The purpose of the BIA's actions is to promote leasing and development of the Osage Mineral Estate in the best interest of the Osage nation pursuant to the 1906 Act, as amended, balancing resource conservation and maximization of oil and gas production in the long term." While the DEIS says its purpose is to promote oil and gas leasing of the Osage mineral estate, it, as written, does not adequately match the alternatives. The purpose and need section is supposed to drive the reasonable range of alternatives. The alternatives do not meet the need to promote oil and gas leasing within a "reasonable range" as CEQ regulations require. The alternatives developed for this DEIS would not meet the requirements of the 1906 Act, subsequent amendments, nor the CEQ regulations. They appear to have been developed for alternative land use such as what BLM might consider in their decision-making. To meet the BIA's stated purpose and need, the DEIS alternatives should have been developed in concert with the OMC as a fully cooperating agency and should emphasize enhanced recovery, new technologies and other alternatives that would optimize the mineral rights of the Osage Nation.	Range of Alternatives	WallerE_20200221_OsageMineralsCouncil	The purpose and need section of the EIS focuses on strategies for BIA's management and administration of the Osage Mineral Estate in the best interest of the Osage Nation. Under the CEQ Regulations, the alternatives in the EIS flow from the purpose and need, not the other way around. 40 C.F.R. 1502.13. The Osage Minerals Council, as a cooperating agency, was consulted during the alternatives development process and provided comments and suggestions for alternatives, which are addressed in the EIS. There was no suggestion for new technologies or the other measures proposed in the comment, and use of such measures is within the scope of industry to propose and the Minerals Council to agree, not within the BIA's management.
1403	2/21/2020	Second, the 1929 amendment requires the Department to lease "not less than twenty-five thousand acres shall be offered for lease for oil and gas mining purposes during any one year."14 This leasing requirement is not optional. No lands under which the Osage mineral estate exist are exempt from being leased for oil and gas production, a fact evidenced by this statute that requires minimum leasing standards every year, with no cap or caveats considered.	Range of Alternatives	WallerE_20200221_OsageMineralsCouncil	Neither the language in the 1906 Act, nor the 1929 Act, supports the contention that the entire acreage of the Osage Mineral Estate must be made available for lease annually or at any other time. The Act of June 28, 1906, § 3, 34 Stat. 539, as amended ("1906 Act"), vests the Secretary with broad authority over leasing of the Osage Mineral Estate. Specifically, the 1906 Act provides that the Osage Nation may lease the Osage Mineral Estate for oil and gas mining "…subject to the approval of the Secretary of the Interior, and under such rules and regulations as he may prescribe." The U.S. Congress' use of the word "may" indicates that leasing of the Osage Mineral Estate is permissive, as opposed to mandatory. Thus, the Osage Nation has the option of leasing the Osage Mineral Estate but is not required to do so. To the extent that the Osage Nation exercises its authority to execute a lease of the Osage Mineral Estate, such lease does not become effective unless and until the Secretary of the Interior approves it. The 1906 Act does not require the Secretary of the Interior to approve any or all leases of the Osage Mineral Estate. To the contrary, the Act provides the Secretary with discretion regarding such approval. In 1929, the U.S. Congress amended the 1906 Act, requiring that a certain number of acres of the Osage Mineral Estate be offered for lease annually. The Act of March 2, 1929, §1, 45 Stat. 1478 ("1929 Act") authorizes and directs the Secretary of the Interior and Osage Nation to offer for lease "…any unleased portion of [the Osage Mineral Estate] in such quantities and at such times as may be deemed in the best interest of the Osage [Nation], Provided, That not less than twenty-five thousand acres shall be offered for lease for oil and gas mining purposes during any one year." While the 1929 Act does require the Secretary of the Interior and Osage Nation to offer a minimum of 25,000 acres for lease annually, it does not require that the acreage offered be leased. Accordingly, the Osage Nation retains the authority to determine whether to execute a lease of the Osage Mineral Estate and the Secretary of the Interior retains discretion regarding the approval of any such lease.

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1404	2/21/2020	Third, the 1929 amendment requires "as to all lands hereafter leased, the regulations governing the same and the leases issued thereon shall contain appropriate provisions for the conservation of the natural gas for its economic use, to the end that the highest percentage of ultimate recovery, of both oil and gas may be secured."^15 To be clear, conservation, as discussed in this provision, is not for the purpose of ensuring there is always natural gas, but rather, to ensure that natural gas is not wasted in the production process. The intent of Congress in enacting this conservation provision was made clear in a hearing before the House Subcommittee on the Committee on Indian Affairs, where it was stated that: Congress by the action of 1921 continued ownership of the tribe in the minerals until 1946 and directed that all of the lands unleased should be offered for lease for minerals, oil, and gas by 1931 at the rate of one-tenth per year. . . . but we will not lease all of the land by 1931, and there is no provision in the act of 1921 authorizing the lease to be made after 1931. The Secretary . . . has suggested to Congress, in the interest of conservation of oil and gas, that the law requiring him to offer 100,000 acres each year, independent of conditions of the oil industry, does not conserve the oil, and, therefore, he has recommended . . . that the law be changed to enable the Secretary to offer leases for oil at such times as the interest of the oil industry would warrant. Such being the case, if Congress so provided it would take care of leasing in the future . . . . That is the object of this provision.^16 Nine years later, when Congress was considering—and ultimately passed—another amendment to the 1906 Act, it reaffirmed the conservation provisions related to oil and gas in the 1929 amendment. Again preserving the requirement that leasing and production be conducted in a manner that would see the Osage receive all the benefit from the development of the Osage mineral estate, ensuring that leasing and production was in line with market demand to ensure the maximum return to the Osage. The Osage Indians are very anxious that the trust period be extended at this time in order that their rights may be fixed and that they may be better able to cooperate with the Government in the conservation policies regarding oil and gas, this extension being necessary in order to follow such conservation practices in the exploration and extraction of the oil and gas from the Osage Reservation of 1,470,933 acres . . . . By the year 1920 . . . . it was clearly seen that the mineral deposits could not be removed and sold by the expiration of the trust period then upon the mineral estate expiring April 8, 1931. . . . A further extension has been provided for, at the request of the Osage Tribal Council . . . . 15 Act of March 2, 1929, § 1, 45 Stat. 1478. 16 Osage Tribal and Individual Affairs: Hearing on H.R. 9294 Before the House Subcomm. of the Comm. on Indian Affairs, 70th Cong. 7 (1928), https://babel.hathitrust.org/cgi/pt?id=umn.31951d035180515&view=1up&seq=13. Under the present methods of production it is estimated that from 25 to 35 percent of the oil only is recovered from the sands, the balance remaining in the natural formations.	Range of Alternatives	WallerE_20200221_OsageMineralsCouncil	The National Environmental Policy Act ("NEPA") requires the Bureau of Indian Affairs ("BIA") to consider the effect of its proposed actions prior to authorizing "major Federal actions significantly affecting the quality of the human environment." 42 U.S.C. § 4322(2)(C). While NEPA requires the BIA to take a hard look at the potential environmental consequences of the approval of oil and gas leases, drilling permits, and workover permits in Osage County, it is not obligated to reach a decision that protects the environment. NEPA's requirements are procedural, as opposed to substantive, in nature. "NEPA describes a process, not an outcome." Robertson v. Methow Valley Citizens Council, 490 U.S. 332, 350-51 (1989). The purpose and need statement outlines the BIA's objectives in conducting the NEPA process. As stated in the EIS, "[t]he purpose of the BIA's action is to promote leasing and development of the Osage Mineral Estate in the best interest of the Osage Nation pursuant to the 1906 Act, as amended, balancing resource conservation and maximization of oil and gas production in the long term." "Resource conservation," as that term is used in the purpose and need statement, is not limited to conservation of the environment as the Osage Minerals Council implies; it also encompasses conservation of natural resources, including oil, gas, and other minerals. In stating that the purpose of the EIS is to both conserve resources and maximize oil and gas production, the Bureau of Indian Affairs is not prioritizing conservation over its trust responsibility to the Osage Nation. Rather, the BIA is balancing the environmental review obligation that the U.S. Congress imposed on the Federal Government under NEPA with the trust obligations the U.S. Congress imposed on the Secretary under the 1906 Act. The Supreme Court has directed Federal Government agencies to engage in such balancing, as have other courts. See Nevada v. United States, 463 U.S. 110, 128 (1983) ("The Government does not 'compromise' its obligation to one interest that Congress obliges it to represent by the mere fact that it simultaneously performs another task for another interest that Congress has obligated it by statute to do."); see also Davis v. Morton, 469 F.2d 593 (10th Cir. 1972). The U.S. Congress also recognized the need to balance statutory mandates, including a provision in NEPA expressly providing that "[t]he policies and goals set forth in [NEPA] are supplementary to those set forth in existing authorizations of Federal agencies." 42 U.S.C. § 4335. Accordingly, the BIA is required to satisfy the obligations set forth in both NEPA and 1906 Act. The 1906 Act, as amended, does not supersede, or otherwise remove the BIA's obligations under NEPA. It appears from the Osage Minerals Council's comment that there may be confusion regarding a particular reference to "conservation" that readers see in multiple chapters of the EIS. The Osage Minerals Council states that "…the DEIS implements conservation standards that create barriers to obtaining "the highest percentage of recovery of both oil and gas," rather than promoting the highest percent of recovery." The footnote associated with this comment (Footnote 20) cites to Section 3.7.3 of the Draft EIS as supporting this assertion: (Cont.)
1404 (cont)	2/21/2020	Again, in 1978, eight years after the passage of NEPA, Congress authorized the Secretary to establish regulations that allow for unitization of Osage oil and gas leases—or merger of leases producing from a common source of supply without regard to surface boundary issues—to "provide for the greatest ultimate recovery of oil and gas under lying the Osage mineral estate . . . .").^18 The 1979 amendment to the 1906 Act provided for unitization as a method to "conserve natural resources", in this case, oil and gas: The act of June 24, 1938 (52 Stat. 1034) provided that leases of Osage lands for has purposes would contain provisions for conservation has through maximum recovery. Since the passage of that act, a number of States have recognized the need for unitization of leasehold interests from common sources of supply. Section 4 [of the 1978] amendment would authorize the Secretary of the Interior to publish and enforce appropriate regulations for conservation of oil and gas production from the Osage reservation through unitization.^19 The DEIS discusses maximized oil and gas production in broad, sweeping statements a total of seven times, while discussions on conservation-related provisions are mentioned no fewer than 200 times. At no point does the DEIS discuss conservation as it was intended in the 1906 Act, as amended, nor does it lawfully establish that it represents the best interest of the Osage. The notion that the DEIS balances conservation of natural resources and the maximization of oil and gas resources within the meaning of the 1906 Act and subsequent amendments is ludicrous, as the DEIS implements conservation standards that create barriers to obtaining "the highest percentage of recovery, of both oil and gas," rather than promoting the highest percent of recovery.^20 Congress affirmed and reaffirmed—both before and after NEPA was enacted—that the only conservation measures that Congress considered in relation to the Osage mineral estate were those that would ensure oil and gas was not wasted, and more importantly, that production could continue on all acreage of the Osage Reservation. 17 Osage Tribal and Individual Affairs: Hearing on S. 3980 and S. 4036 Before the Senate Comm. on Indian Affairs, 75th Cong. 11 (1938). https://babel.hathitrust.org/cgi/pt?id=umn.31951d035051863&view=1up&seq=39 18 Act of October 21, 1978, § 3, 92 Stat. 1660. 19 S. Rep. 95-1157, at 7 (1978) (emphasis added) (The Senate Report for the 1978 amendment indicates that conservation of natural resources is consistent with the 1929 and 1938 amendments, referring to conservation only to the extent that the practices being used are those that will not waste oil and gas natural resources and ensure maximum recovery of both oil and gas.). 20 DEIS, 3.7.3 Trends ("Other Considerations: Oil and gas development will continue throughout the planning area. As part of the BA, the BIA proposes conservation and mitigation measures to reduce or mitigate impacts of oil and gas development . . . .").	Range of Alternatives	WallerE_20200221_OsageMineralsCouncil	DEIS, 3.7.3, Trends ("Other Considerations: Oil and gas development will continue throughout the planning area. As part of the BA, the BIA proposes conservation and mitigation measures to reduce or mitigate the impacts of oil and gas development…") The language in the Osage Mineral Council's footnote is a partial quotation that eliminates a critical portion of the second sentence. In its entirety, the second sentence reads: "As part of the BA, the BIA proposes conservation and mitigation measures to reduce or mitigate the impacts of oil and gas development on ABB habitat." The BIA Osage County Oil and Gas Biological Assessment ("BA") and resulting USFWS Biological Opinion for the Osage County Oil and Gas Program for Years 2018-2026 ("BO") are referenced in the EIS and included as appendices thereto (see Appendix B) because they are directly related to, and support, the approval of drilling and workover permits in Osage County – two of the Federal actions analyzed in the EIS. Contrary to the Osage Minerals Council's assertion, the BA and BO demonstrate that the BIA is taking proactive steps to facilitate, not inhibit, development of the Osage Mineral Estate within the confines of applicable Federal law. The BIA submitted the BA to USFWS in July 2017, requesting formal, programmatic consultation under Section 7 of the Endangered Species Act ("ESA"). The BIA submitted the BA for the purpose of obtaining a BO and Incidental Take Statement for the ABB. The BIA also sought to assume certain USFWS responsibilities relating to the review of proposed oil and gas development activities within the ABB's range. The BIA's objective under the BA was to reduce burdens on lessees by simplifying the ESA consultation process and streamline permit processing. The BO and Incidental Take Statement resulting from the BA achieved those objectives. Among other things, the BO eliminated the requirement for the BIA and lessees to submit site-specific ESA consultation packages to the USFWS as well as the 45-day processing period associated therewith. The Incidental Take Statement authorized the BIA to approve incidental take of the ABB for up to 600 acres of the Osage Mineral Estate annually without further consultation with USFWS. The USFWS authorized the procedural changes set forth in the BO and Incidental Take Statement on the condition that the BIA would apply and enforce certain "conservation measures" that were proposed in the BA. These conservation measures were based on the BIA's existing best management practices (BMPs), which were applied to all permits via Attachment A and enforced as conditions of approval (COAs). The language the Osage Minerals Council cited from Section 3.7.3 of the EIS is referencing the BIA's existing requirements that were incorporated by reference into the BO as "conservation measures." Lessees have been complying with these measures since at least 2015 and have continued to comply with these measures since the BO and Incidental Take Statement were issued in July 2018. (Cont.)
1404 (cont)	2/21/2020	See above	Range of Alternatives	WallerE_20200221_OsageMineralsCouncil	As trustee, it is appropriate for the Bureau of Indian Affairs to give substantial weight to the Osage Nation's goals relating to development of the Osage Mineral Estate. The Bureau of Indian Affairs cannot, however, define the purpose and need for agency action analyzed in the EIS so narrowly that it can be accomplished by just one alternative. See Davis v. Mineta, 302 F.3d 1104 (10th Cir. 2002). In order to carefully weigh the environmental impacts of the Federal actions described in the EIS as required by NEPA, the Bureau of Indian Affairs must develop and consider a range of reasonable alternatives. See 40 C.F.R. §1502.1 (An EIS must provide "a full and fair discussion of significant environmental impacts and shall inform decisionmakers and the public of the reasonable alternatives which would avoid or minimize adverse impacts or enhance the quality of the human environment."). The BIA complied with this mandate, identifying four reasonable alternatives for analysis in the EIS. During the decision-making process, the BIA will assess how well each alternative satisfies the specific objectives outlined in the EIS's purpose and need statement, taking public comments into consideration. As the Osage Minerals Council notes, the 1929 Act authorizes and directs the Secretary of the Interior and Osage Nation to offer tracts of the Osage Mineral Estate for lease "…in such quantities and at such times as may be deemed in the best interest of the Osage [Nation]." While the 1929 Act does not specify the parameters of the Secretary of the Interior's best interest calculation, 25 C.F.R. § 211.3 is informative. See United States v. Osage Wind, 872 F.3d 1078 (10th Cir. 2017) (applying the definition of "mining" set forth in 25 C.F.R. § 211.3 to Osage Mineral Estate). 25 C.F.R. § 211.3 states that "in the best interest of the Indian mineral owner" refers to the standards the Secretary of the Interior is to apply in considering whether to take an administrative action affecting the mineral owner's interests (such as approval of a lease, permit, or unitization agreement). The section further states that as part of such consideration, the Secretary must consider "any relevant factor, including, but not limited to: economic considerations, such as date of lease expiration; probably financial effect on the Indian mineral owner; leasability of land concerned; need for change in the terms of the existing lease; marketability; and potential environment, social, and cultural effects." While the "best interest" standard applies to the Federal actions analyzed in the EIS – the approval of leases, drilling permits, and workover permits – it does not apply the Secretary's publication of the EIS. Publication of the EIS is a step in the NEPA process; it is not a decision regarding the Secretary's approval of any particular lease or permit. The Secretary of the Interior will use the analysis in the EIS to support subsequent decisions regarding the covered Federal actions and, in making such decisions, will consider the best interests of the Osage Nation.

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1408	2/21/2020	Alternative 3 is in direct violation of the 1906 Act, as amended, treating the Osage mineral estate in a manner similar to public lands. Rules and regulations concerning the Osage mineral estate must be adopted by the Secretary as contemplated by the 1906 Act, as amended, not through an EIS that makes almost no mention of the Secretary's requirements related to the Osage mineral estate, and improperly gives weight to the subservient surface estate. Furthermore, the definition of High-density and low-density is arbitrary. There is no explanation as to why 17 or more total wells that have been drilled constitutes "High-density." A total of 16 wells in a section translates to an area that does not "have historic development and is not part of the setting," however, a total of 17 wells does? This is subjective rather than scientific. Additionally, future drilling technology may lead to discoveries of efficient oil and gas extraction which could lead to drilling and exploration in what is now considered low-density areas, a fact that Congress has directly considered related to the Osage mineral estate, and addressed to ensure the Osage would always be able to obtain the maximum benefit from the Osage mineral estate.22 There are many instances across the country where areas that had little or no drilling activity suddenly became high-profile drilling areas. An example of this would be Blaine and Canadian County, OK. The area was historically drilled, however, in the last 10 years, these two counties have seen a tremendous increase in drilling. An area that once may have been considered a low-density area has become a high-density area. This option assumes no expansion or future discoveries and directly conflicts with congressional intent established by the 1929 amendment to the 1906 Act. Furthermore, denying an APD in a sensitive area could result in breach of contract according to the terms of the lease. If the areas that are determined to be sensitive are currently under lease, denying an application would be a breach of contract under the terms of the lease. This could be construed as a taking where regulations restrict the use of property. Designating a municipality as a sensitive area is overreaching. The DEIS does not explain the rationale behind limiting COA's in areas of high-density areas as opposed to low-density areas. As stated previously, an area that once was a low-density area and becomes a high-density area would have a mixed bag of COA's through development stages. This could lead to confusion from operators as to what COA's apply.	Range of Alternatives	WallerE_20200221_OsageMineralsCouncil	Alternative 3 does not violate the 1906 Act. The Act of June 28, 1906, § 3, 34 Stat. 538, as amended ("1906 Act"), vests the Secretary of Interior with broad authority over leasing of the Osage Mineral Estate. Specifically, the 1906 Act provides that the Osage Nation may lease the Osage Mineral Estate for oil and gas mining "...subject to the approval of the Secretary of the Interior, and under such rules and regulations as he may prescribe." The Secretary's regulations for leasing and management of the Osage Mineral Estate are in 25 C.F.R. Part 226. The alternatives in this EIS are not amendments to those regulations; they are, rather a reasonable range of strategies for management of the Osage Mineral Estate under those regulations. Any amendments to the regulations necessary to implement any strategy chosen in the ROD would be promulgated through the standard notice and comment rulemaking process under the Administrative Procedure Act, 5 U.S.C. 553. Section 2.3.4 of the FEIS has been updated to explain the rationale behind the 17-well threshold for high-density vs. low-density sections. Alternative 3 does not prohibit drilling in low-density sections; therefore, it allows for expansion into newly discovered fields if such circumstances should arise. Under 25 C.F.R. 226.16(b), a lessee cannot begin to drill without securing the approval of the Superintendent. Nowhere in the lease terms or the regulations is that approval guaranteed. Furthermore, the United States cannot breach a contract (the lease) to which it is not a party. The only parties to the lease are the lessee and the Osage Minerals Council. Section 2.3.4 of the DEIS explains the rationale behind the different COAs applied in high-sensity vs. low-density sections.
1409	2/21/2020	Denying an APD in a sensitive area could result in breach of contract. If the areas that are determined to be sensitive are currently under lease, denying an application would be a breach of contract under the terms of the lease. This could be construed as a taking where a subsequent EIS restricts the use of property.	Range of Alternatives	WallerE_20200221_OsageMineralsCouncil	Under 25 C.F.R. 226.16(b), a lessee cannot begin to drill without securing the approval of the Superintendent. Nowhere in the lease terms or the regulations is that approval guaranteed. Furthermore, the United States cannot breach a contract (the lease) to which it is not a party. The only parties to the lease are the lessee and the Osage Minerals Council.
1414	2/21/2020	2.3.4 Alternative 3—Hybrid Development of High- and Low-Density Development Sections National Historic Preservation Act Compliance "Under Alternative 3, in addition to standard NHPA procedures, the BIA would apply buffers around identified cultural sites in low-density sections. Table 2-2, Cultural Site Buffers, describes the distance that any surface disturbance on an oil and gas lease would have to be from cultural sites. In high-density sections, the BIA would determine buffers on a case-by-case basis, in consultation with the THPO, interested Tribes, and appropriate other parties. The BIA may apply additional COAs, if necessary, based on a site-specific EA and otherwise would ensure compliance with Section 106 of the NHPA on a case-by-case basis." As a matter of procedure, defined buffer zones around various cultural resources can be beneficial. There would be no interpretation or subjectivity associated with buffer zones and the protection of cultural resources. However, there should be a clause where discretion can be implemented in accordance with the THPO and the BIA archeologist consultation	Range of Alternatives	WallerE_20200221_OsageMineralsCouncil	As noted at the bottom of Table 2-2 in the DEIS, all buffers around cultural resources were developed in consultation with the THPO. Sections 2.3.4 and 2.3.5 of the DEIS state that the BIA may apply additional COAs, if necessary, based on a site-specific EA and otherwise would ensure compliance with Section 106 of the NHPA on a case-by-case basis. This allows the necessary flexibility to make adjustments in buffers based on site-specific circumstances.
1415	2/21/2020	Condition of Approval (Source) (Pg 2-23) "30. The lessee must not locate well sites or pits in areas subject to frequent flooding, according to the NRCS Soil Survey. Facilities in such areas—for example, storage tanks—may be subject to additional controls or conditions that the BIA deems necessary, in order to minimize or eliminate pollution (OCC 2014)." Due to the fact that Osage County participates in the NFIP, each operator must obtain a floodplain permit and comply with the rules of the County as it relates to development in floodplains. This is regardless of any of the applicable alternatives or COAs. The well-established benchmark for well locations and tank batteries located in areas prone to flooding is whether the action is located in a flood plain as established by FEMA for those counties that participate in the NFIP. Therefore, the applicable COA should be that well sites, pits, and facilities shall be subject to the rules and regulations of the Osage County Floodplain Manager.	Range of Alternatives	WallerE_20200221_OsageMineralsCouncil	BIA confirmed 3/31 that Osage County is a participant in the NFIP. Working to reach someone to confirm how the program works in Osage County. Need to confirm whether this program would result in protections that are as stringent as or more stringent than that described in COA 30 (no siting in areas subject to frequent flooding based on NRCS soil survey). Checking with field ops staff to try to find confirmation on this
1416	2/21/2020	COA 33. The lessee must avoid new road and pipeline crossings of aquatic environments and alterations to hydrology (the surface and subsurface flow of water), to the extent practicable. Where crossing cannot be avoided, such crossings must be designed and constructed to minimize impacts on riparian and aquatic habitat." New pipeline installations across the country cross aquatic environments rather frequently. There are well established BMP's for this activity. This COA is not necessary. Notwithstanding, it should be established who approves the "designed and constructed to minimize impacts on riparian and aquatic habitat."	Range of Alternatives	WallerE_20200221_OsageMineralsCouncil	While BMPs may be in use in the planning area, the COA provides additional certainty that these measures would be implemented by operators. The BIA would determine whether crossings are designed and constructed to minimize impacts on riparian and aquatic habitat.
1417	2/21/2020	COA 34. The lessee must bury pipelines to protect important aquatic environments or sensitive areas, when appropriate (new requirement)." There is no definition of "important aquatic environments" or who determines that burying pipelines for the reasons stated is appropriate. This should not be subjective.	Range of Alternatives	WallerE_20200221_OsageMineralsCouncil	Determination of important aquatic environments and appropriateness of burying pipelines is at the discretion of the BIA.
1450	1/7/2020	(The DEIS) includes provisions that are in stark conflict with the views of the Osage Mineral Council, and in conflict with federal law governing the Osage Mineral Estate. For instance, the DEIS proposes an Alternative 4 that would prohibit "permits for new ground-disturbing activities"^3 in areas that include, among others, the Tallgrass Prairie Preserve, State Parks, State wildlife management areas (WMAs) and BLM wild horse and burrow pasture facilities.4 Alternative 4 seems to contemplate multi-use purposes for the land in question, however, the Osage Allotment Act of 1906, along with subsequent amendments, make clear that the BIA is required to develop the mineral estate, aimed at "the highest percentage of ultimate recovery"^5 and that the surface estate is subservient to the Osage Mineral Estate. Alternative 4 goes far beyond the scope of the BIA's authority when it comes to regulating the Osage Mineral Estate and raises a number of questions about other provisions within the DEIS.	Range of Alternatives	PipestemW_20120107_PipestemLaw_OsageMineralsCouncil	Alternatives 3 and 4 do not diminish, nor are they intended to diminish, the Osage Nation's ownership of the Osage Mineral Estate or the total acreage thereof. The alternatives in the EIS represent a reasonable range of management decisions the Bureau of Indian Affairs can make regarding development of the Osage Mineral Estate. The Act of June 28, 1906, § 3, 34 Stat. 538, as amended ("1906 Act"), vests the Secretary of Interior with broad authority over leasing of the Osage Mineral Estate. Specifically, the 1906 Act provides that the Osage Nation may lease the Osage Mineral Estate for oil and gas mining "...subject to the approval of the Secretary of the Interior, and under such rules and regulations as he may prescribe." In 1929, the U.S. Congress amended the 1906 Act, adding a provision governing the number of acres of the Osage Mineral Estate that must be offered for lease annually. The Act of March 2, 1929, § 1, 45 Stat. 1478 ("1929 Act") directs the Secretary of the Interior and Osage Nation to offer for lease..."any unleased portion of [the Osage Mineral Estate] in such quantities and at such times as may be deemed in the best interest of the Osage [Nation], Provided, That not less than twenty-five thousand acres shall be offered for lease for oil and gas mining purposes during any one year." Alternatives 3 and 4 are consistent with this statutory mandate.
1451	2/21/2020	Alternatives 3 & 4 violate the 1906 Congressional Allotment Act and Amendments. More specifically, they violate the goal of the "highest ultimate recovery" in Act of March 2, 1929, 45 Stat. 1478, Sec 1, Act of June 24, 1938, 52 Stat. 1034, Sec 3; Act of October 21, 1978, 92 Stat. 1660, Sec 4. Both are Non- Starters and must be removed. It would be a Taking of our property value. Not only for the headright owners but also for the Producers and Investors who have leases in the properties that this EIS is condemning for fossil fuel extraction. Alternative 2 would only be workable if it took out any reference to acreage that cannot be drilled upon among other issues.	Range of Alternatives	FormanS_20200221	Alternatives 3 and 4 do not diminish, nor are they intended to diminish, the Osage Nation's ownership of the Osage Mineral Estate or the total acreage thereof. The alternatives in the EIS represent a reasonable range of management decisions the Bureau of Indian Affairs can make regarding development of the Osage Mineral Estate. The Act of June 28, 1906, § 3, 34 Stat. 538, as amended ("1906 Act"), vests the Secretary of Interior with broad authority over leasing of the Osage Mineral Estate. Specifically, the 1906 Act provides that the Osage Nation may lease the Osage Mineral Estate for oil and gas mining "...subject to the approval of the Secretary of the Interior, and under such rules and regulations as he may prescribe." In 1929, the U.S. Congress amended the 1906 Act, adding a provision governing the number of acres of the Osage Mineral Estate that must be offered for lease annually. The Act of March 2, 1929, § 1, 45 Stat. 1478 ("1929 Act") directs the Secretary of the Interior and Osage Nation to offer for lease..."any unleased portion of [the Osage Mineral Estate] in such quantities and at such times as may be deemed in the best interest of the Osage [Nation], Provided, That not less than twenty-five thousand acres shall be offered for lease for oil and gas mining purposes during any one year." Alternatives 3 and 4 are consistent with this statutory mandate.

Comment ID	Received Date	Comment	Comment Code	File Name	Response
1453	2/21/2020	I would first like to address Alternatives 3 and 4. The BIA has a mandate to work for the benefit of the Osage Shareholders that is clearly defined in the Osage Allotment Act of 1906 and its amendments. Both Alternatives will reduce the Mineral Estate and are thereby at best improper and possibly illegal. The end result of implementing either will be legal action against the BIA.The inclusion of these intrusive and illegitimate Alternatives reinforces a continuing pattern by the BIA of putting the interest of the surface land owners above the interest of the shareholders of the Osage Mineral Estate.	Range of Alternatives	RyanJ_20200221	Alternatives 3 and 4 do not diminish, nor are they intended to diminish, the Osage Nation's ownership of the Osage Mineral Estate or the total acreage thereof. The alternatives in the EIS represent a reasonable range of management decisions the Bureau of Indian Affairs can make regarding development of the Osage Mineral Estate. The Act of June 28, 1906, § 3, 34 Stat. 538, as amended ("1906 Act"), vests the Secretary of Interior with broad authority over leasing of the Osage Mineral Estate. Specifically, the 1906 Act provides that the Osage Nation may lease the Osage Mineral Estate for oil and gas mining "...subject to the approval of the Secretary of the Interior, and under such rules and regulations as he may prescribe." In 1929, the U.S. Congress amended the 1906 Act, adding a provision governing the number of acres of the Osage Mineral Estate that must be offered for lease annually. The Act of March 2, 1929, § 1, 45 Stat. 1478 ("1929 Act") directs the Secretary of the Interior and Osage Nation to offer for lease..."any unleased portion of [the Osage Mineral Estate] in such quantities and at such times as may be deemed in the best interest of the Osage [Nation], Provided, That not less than twenty-five thousand acres shall be offered for lease for oil and gas mining purposes during any one year." Alternatives 3 and 4 are consistent with this statutory mandate.
1460	2/20/2020	Alternative 4 should include the viable tall grass prairie as an exclusion zone, eliminate any high-density sections within this prairie corridor or add conditions of approval that minimize the fragmentation of tall grass prairie ecosystem and associated wildlife habitat.	Range of Alternatives	BiehlJ_20200220_Osage land and cattle co	Alternative 4 lists sensitive areas that are identifiable with established boundaries and have been identified as sensitive by another entity for protection. There is no established boundary for all viable tallgrass prairie in the planning area. A COA has been added to Alternative 4 and Alternative 3 (low-density sections) stating that new facilities must be collocated with existing facilities (e.g., roads and pipelines) when feasible.
1466	2/21/2020	Producers, including Warrior Exploration & Production, have Leasehold located within propsed "no-drilling" areas. These leases have been purchased and developed at great expense based on the assumed value of undeveloped minerals which are present and available through drilling and completion of new wells. The development of those minerals is essential to achieve the planned returns expected when purchased or initially drilled. This includes the installation of infrastructure which would accommodate future drilling. Alternative 3 & 4, prohibit the ability for the lease owner to achieve development of minerals and the associated value which was anticipated when purchased, and when initially developed or drilled. How can those rights and values which are outlined within the lease contract be removed arbitrarily, and without sufficient justification.	Range of Alternatives	KnappeR_20200221_Warrior Exploration and Production	Alternatives 3 and 4 do not impact the right of lessees to develop leases of the Osage Mineral Estate executed prior to issuance of the Record of Decision ("ROD") for the EIS ("existing leases"). The EIS does not alter or amend a lessee's right, title, or interest in an existing lease. Under all alternatives, lessees holding record title to existing leases remain authorized and obligated to develop the Osage Mineral Estate in accordance with the terms and conditions of the lease and the regulations in 25 C.F.R. part 226. Alternatives 3 and 4 provide for the use of directional drilling to extract oil and gas from designated "sensitive areas," to allow for continued development while minimizing surface disturbance. The Bureau of Indian Affairs acknowledges, however, that directional drilling is not feasible in all cases. If the Bureau of Indian Affairs selects an alternative that restricts drilling in designated "sensitive areas," the ROD will include a procedure whereby the Superintendent may approve variances from such restrictions where all, or some portion, of an existing lease is located within a sensitive area and directional drilling is not feasible. In the FEIS, Alternatives 3 and 4 have been revised to more clearly identify the allowance for directional drilling and explain the variance procedure that would be implemented for existing leases located within designated sensitive areas.
1467	2/21/2020	Conditions of Approval – o 12. – Currently, earthen pits are utilized temporarily to capture fluids during air rotatory drilling which may include both fresh and salt water. At conclusion of drilling, these pits are emptied out, and then closed before completion of the well. COA 12. Seems to prohibit any "temporary" storage of saltwater. This is not reasonable, and would add costs to drilling in Osage County that would further prohibit development in a cost sensitive, low reserve environment. It's not necessary given lack of evidence associated with any potential impact of temporary water in earthen pits during drilling. o 28. – Should not be considered. What noise levels "may" constitute "a public nuisance that is harmful to people or sensitive environmental receptors." Unknown requirements increase risk of investment and reduce potential development of the mineral estate. Different noise levels are a nuisance to different people at different times.	Range of Alternatives	KnappeR_20200221_Warrior Exploration and Production	COA 12 has been deleted because it is duplicative with measures already required in 25 CFR 262.22(d). Lessees are currently required to comply with § 226.19(a) of the regulations governing the Osage Mineral Estate which prohibits lessees from permitting avoidable nuisance to be committed upon the lease. COA 28 does not represent a departure from current practice. The Bureau of Indian Affairs will continue to evaluate potential "nuisance" based on site-specific conditions.

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Appendix K

Emissions Inventory

May 11, 2016

MEMORANDUM

To: Craig Nicholls, BLM
From: John Grant, Rajashi Parikh, Krish Vijayaraghavan, Ralph Morris, Ramboll Environ
CC: Amy Cordle, Holly Prohaska, David Batts, EMPSi
Subject: Kansas, Oklahoma, and Texas Oil and Gas and Mining Sector Emissions

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1.0 INTRODUCTION

Annual emission inventories of criteria air pollutants (CAPs), hazardous air pollutants (HAPs) and greenhouse gases (GHGs) were developed for oil and gas and mining sectors for the states of Kansas, Oklahoma, and Texas. Emissions were developed for the base year 2011 and also forecast to future years 2015, 2020, 2025, and 2030. Area source emissions were estimated by county and source classification code (SCC), while point source emission were taken from existing databases with specific latitude/longitude locations and stack parameters. Both point and area source emissions were differentiated by mineral ownership (i.e., Bureau of Land Management (BLM), United States Forest Service (USFS), Bureau of Indian Affairs (BIA), and private/state fee). Under BLM guidance, Ramboll Environ worked with the emission inventory and resource experts at the BLM, BIA, Oklahoma Department of Environmental Quality (DEQ), Kansas Department of Health and Environment (KDHE), and Texas Commission on Environmental Quality (TCEQ) to obtain the latest 2011 base year activity and emissions data upon which the future development scenario forecast was based.

1.1 Scope and Goals

The purpose of this document is to explain the emissions development procedures used to develop the oil and gas and coal mining emissions for the Oklahoma, Kansas, and Texas Joint Environmental Impact Statement (EIS) and BLM Resource Management Plan (RMP)/BIA Integrated RMP (see Figure 1-1). The oil and gas emissions inventory development is consistent with the Oil and Gas Development Air Resources Technical Report (BLM, 2014). Detailed emission inventories are provided in the spreadsheets that accompany this report.

Oil and gas basins in the Central States Air Resource Agencies (CENSARA) states[1] are shown in Figure 1-2. Listed below are the oil and gas basins in three CENSARA states of interest in this study: Kansas, Oklahoma, and Texas. Coal basins in the region are shown in Figure 1-3.

- Kansas
  - Anadarko Basin
  - Cambridge Arch-Central Kansas Uplift

[1] http://www.censara.org

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  - Cherokee Platform
  - Forest City Basin
  - Nemaha Uplift
  - Salina Basin
  - Sedgwick Basin
- Oklahoma
  - Anadarko Basin
  - Arkoma Basin
  - Bend Arch-Fort Worth Basin
  - Cherokee Platform
  - Nemaha Uplift
  - Palo Duro Basin
  - Southern Oklahoma
- Texas
  - Anadarko Basin
  - Bend Arch-Fort Worth Basin
  - East Texas Basin
  - Marathon Thrust Belt
  - Palo Duro Basin
  - Permian Basin
  - Western Gulf

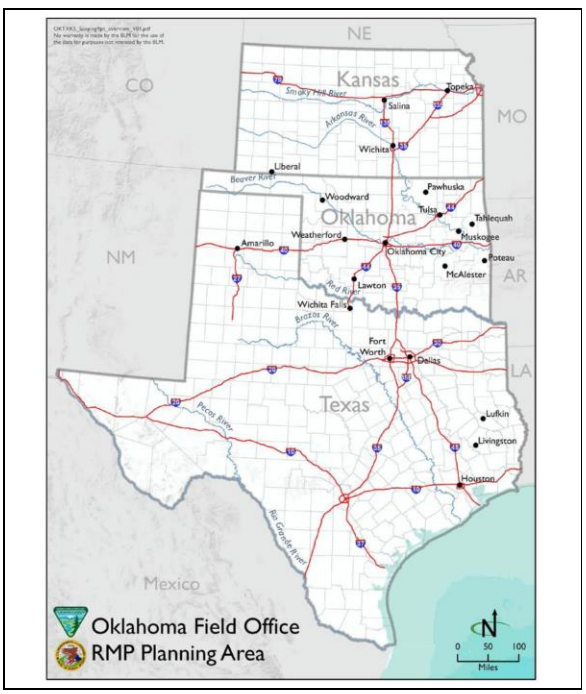

Figure 1-1. BLM-BIA Environmental Impact Statement for the Resource Management Plan (RMP) Planning Area (source: BLM and BIA, 2014).

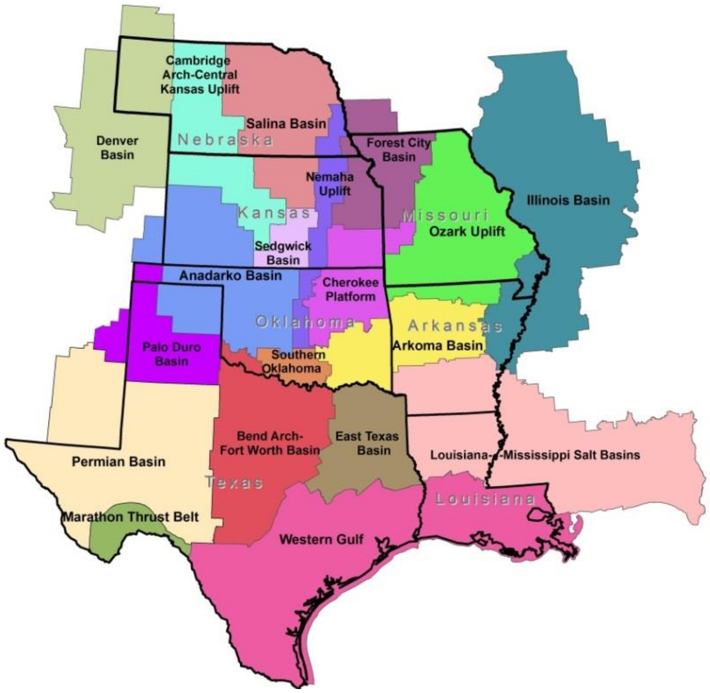

Figure 1-2. Map of CENSARA state oil and gas Basins (ENVIRON, 2012).

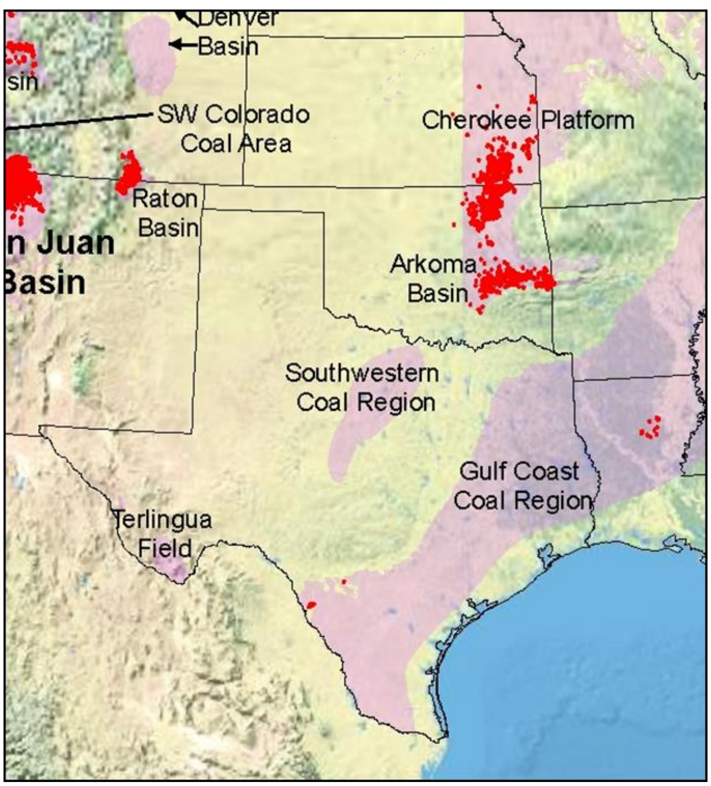

Figure 1-3. Coal resources map (adapted from US EIA[2]).

[2] Coalbed Methane Fields, Lower 48 States, http://www.eia.gov/oil_gas/rpd/coalbed_gas.jpg

1.2 Inventory Overview

Emissions have been developed for area (well site) and point (midstream) oil and gas emissions as well as for coal mining sources.

1.2.1 Pollutants

The inventories include estimates of emissions of CAPs, GHGs, and HAPs as follows:

- Criteria Air Pollutants (CAPs)
  - Carbon monoxide (CO)
  - Nitrogen oxides (NO_X)
  - Particulate matter less than or equal to 10 microns in diameter (PM_{10})
  - Particulate matter less than or equal to 2.5 microns in diameter ($PM_{2.5}$)
  - Sulfur dioxide (SO_2)
  - Volatile Organic Compounds (VOCs)
- Greenhouse Gases (GHGs)
  - Carbon dioxide (CO_2)
  - Methane (CH_4)
  - Nitrous oxide (N_2O)
- Hazardous Air Pollutants (HAPs)
  - Formaldehyde
  - N-hexane
  - benzene, toluene, ethylbenzene, xylene (BTEX)

HAP pollutants were selected based on the pollutants expected to be emitted in the most significant amounts by oil and gas sources consistent with other NEPA planning documents (e.g., Continental Divide-Creston Natural Gas Project Environmental Impact Statement[3]). While lead (pb) is a criteria pollutant, emissions of lead associated with the oil and gas and mining sectors in the three state planning area are expected to be extremely low and are therefore not included in this analysis.

Anthropogenic greenhouse gas emission inventories typically include carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and fluorinated gases. Fluorinated gases are not expected to be emitted in appreciable quantities by any category considered in this emission inventory and were therefore not included in this analysis.

1.2.2 Temporal

Emissions were estimated for a single scenario for the base year 2011 and for future years 2015, 2020, 2025, and 2030.

[3] http://www.blm.gov/wy/st/en/info/NEPA/documents/rfo/cd_creston.html

2.0 Oil and Gas Inventory Development

An oil and gas emission calculator was developed to forecast emissions from 2011 to future years. In order to facilitate handling of the large emissions datasets, the emission calculator was designed to estimate emissions for a specific year and state. Multiple emission calculators are used to estimate emissions for multiple future years and/or states. The calculator is used to estimate emissions in a future year for each state using the following inputs:

- Base year emissions by SCC and county (for area sources) or by latitude/longitude location (for point sources)
- Oil and gas production forecasts
- Emission control by source category

2.1 Base Year Oil and Gas Emissions

Base year emissions are based on the datasets described below. For datasets in which GHG and/or HAP emissions were not available, these emissions were added according to the methodology described below.

2.1.1 Area (Well Site) Sources

We obtained 2011 oil and gas area source (i.e., well site) emission estimates from the state agencies (OKDEQ, KDHE, and TCEQ). TCEQ has developed 2011 emissions based on a Texas-specific oil and gas emissions calculator (ERG, 2010). OKDEQ and KDHE each referred us to the latest emissions submitted to the 2011 National Emission Inventory (NEI) in the EPA Oil and Gas Tool ACCESS database format (EPA, 2014a). The OKDEQ and KDHE oil and gas emissions from the EPA Oil and Gas Tool are based on the CenSARA oil and gas Emission Inventory Project calculator (ENVIRON, 2012) with state provided updates for certain inputs.

OKDEQ also provided comments that were submitted to EPA in response to the Notice of Availability of the Environmental Protection Agency's Updated Ozone Transport Modeling Data for the 2008 Ozone National Ambient Air Quality Standard (NAAQS)[4] (OKDEQ, 2016). Area source VOC emissions estimates for pneumatic controllers were incorporated into the inventory based on the OKDEQ comment "Proposed Changes to VOC Emissions Totals and Categorization of Emissions from Pneumatic Devices Associated with the Oil and Natural Gas Sector in the 2011 National Emissions Inventory". VOC emissions from pneumatic controllers submitted in OKDEQ (2016) were estimated based on a recent Oklahoma Independent Petroleum Association (OIPA) Study[5] for the following SCCs:

- 2310010300 Oil Production Pneumatic Devices
- 2310021300 On-Shore Gas Production Pneumatic Devices
- 2310023300 On-Shore Coal-Bed Methane (CBM) Production Pneumatic Devices
- 2310021506 On-Shore Gas Production/Fugitives: Other

[4] Published in the Federal Register on August 4, 2015 (80 FR 46271), Docket ID No. EPA-HQ-OAR-2015-0500
[5] Available from the OIPA web page: http://www.oipa.com/page_images/1418911081.pdf

- 2310011506 On-Shore Oil Production/Fugitives: Other (not previously utilized)
- 2310023516 On-Shore CBM Production/Fugitives: Other

Information was not available in OKDEQ (2016) to revise HAP emissions from pneumatic controllers; hence, HAP emissions from pneumatic controllers are based on the EPA Oil and Gas Tool.

2.1.2 Point (Midstream) Sources

Oil and gas point source (i.e., midstream) emissions were taken from EPA's 2011 NEI (version 2)[6]. Oil and gas point sources were extracted from the 2011 NEI (version 2) point source emissions based on the North American Industry Classification System (NAICS) designations in Table 2-1.

OKDEQ comments submitted to EPA in response to the Notice of Availability of the Environmental Protection Agency's Updated Ozone Transport Modeling Data for the 2008 Ozone National Ambient Air Quality Standard (NAAQS)[4] (OKDEQ, 2016) were also used to revise oil and gas point source emissions. Oil and gas point source emissions estimates were updated based on the OKDEQ comment, "Diminished Production at Well Release Point 93974412: Emissions in Projected 2017 National Emissions Inventory Require Correction". For a small natural gas facility (Release Point 93974412) VOC emissions decreased from over 2,000 tons per year (tpy) in 2011 to less than 40 tpy by 2015. VOC emissions in this analysis from Release Point 93974412 were assumed to be less than 40 tpy in all future year emission inventories.

EPA has designated certain point sources as oil and gas compressor stations and gas plants in the 2011 NEI (version 2) emissions database. However, the EPA compressor stations and gas plants assignments do not include all compressor stations and gas plants; the oil and gas point sources extraction based on NAICS designations provides a more comprehensive accounting of oil and gas point source facilities.

Table 2-1. Oil and gas midstream NAICS designations.

NAICS	Description
211111	Crude Petroleum and Natural Gas Extraction
211112	Natural Gas Liquid Extraction
486210	Pipeline Transportation of Natural Gas

2.1.3 Mineral Designation

Base year emissions available by county and SCC were disaggregated to mineral estate designation based on oil and gas activity data by mineral estate provided by BLM (BLM, 2015b). Table 2-2 shows the percent of oil and gas activity by mineral estate for each state. The fraction of oil and gas production that is from Federal mineral estate is less than 1% in all three states except for gas production in Kansas, where Federal mineral estate accounts for 1.5% of gas

[6] http://www.epa.gov/ttnchie1/net/2011inventory.html

production. Indian mineral estate accounts for approximately 8% and 2.5% of oil and gas production in Oklahoma and less than 0.1% in Texas; there is no oil and gas production associated with Indian mineral estate in Kansas. Detailed county-level mineral estate estimates are available in each state's calculator.

Table 2-2. Mineral Estate Designation Fractions by State.

Oil and gas Activity	Federal	Indian		Private / State Fee
Kansas				
Oil Production	0.6%	-		99.4%
Gas Production	1.5%	-		98.5%
Oklahoma				
Oil Production	0.4%	6.2% (Osage)	1.9% (Other)	91.5%
Gas Production	0.6%	0.6% (Osage)	1.9% (Other)	96.9%
Texas				
Oil Production	0.1%	<0.1%		99.9%
Gas Production	0.6%	<0.1%		99.4%

2.1.4 Greenhouse Gases

Comprehensive oil and gas greenhouse gas emissions were not available from the NEI or state databases and were therefore added to the inventory based on GHG to CAP emission ratios. Process specific emission factors from EPA Oil and Gas Tool (EPA, 2014a) and AP-42 Guidance[7] were used to develop GHG to CAP emission ratios for combustion emissions sources as shown in Table 2-3.

For emissions associated with venting and loss source emissions of natural gas, casinghead gas, condensate tanks, and crude oil tanks, GHG to CAP emission ratios were estimated based on EPA Oil and Gas Tool emission factors ratios for these processes by oil and gas basin as shown in Appendix A.

[7] http://www.epa.gov/ttn/chief/ap42/

Table 2-3. Emission factors and GHG to CAP emission ratios for combustion source emissions.

Source	Emission Factors					
	CO_2	CH_4	N_2O	NOx	Units	Reference
Flares	102	0.040	1.44[a]	0.070	lb/MMBTU	EPA Oil and Gas Tool
Drill Rigs	530	0.004	0.013	4.784	g/hp-hr	EPA Oil and Gas Tool
Heaters	120000	2.300	2.200	100.0	lb/MMSCF	EPA Oil and Gas Tool
2-Cycle Lean Burn Engines	399	5.262	0.001	7.040	g/hp-hr	EPA Oil and Gas Tool
4-Cycle Lean Burn Engines	399	4.536	0.001	3.074	g/hp-hr	EPA Oil and Gas Tool
4-Cycle Rich Burn Engines	399	0.830	0.001	8.240	g/hp-hr	EPA Oil and Gas Tool
Gas Turbine Engines	110	0.009	0.003	0.320	lb/MMBTU	AP-42
Source	**Emission Factor Ratios**					
	CO_2/NOx	CH_4/NOx	N_2O/NOx			
Flares	1457	0.571	0.0124			
Drill Rigs	111	0.001	0.0027			
Heaters	1200	0.023	0.0220			
2-Cycle Lean Burn Engines	57	0.747	0.0001			
4-Cycle Lean Burn Engines	130	1.476	0.0002			
4-Cycle Rich Burn Engines	48	0.101	0.0001			
Gas Turbine Engines	344	0.027	0.0094			
Diesel Generators	37	[a]	[a]			

[a] units of lb/MMSCF

2.1.5 Hazardous Air Pollutants

For area sources in Kansas and Oklahoma, HAP emissions were taken directly from the NEI (version 2) emissions. For Texas, ratios of HAP to CAP emissions were developed from the NEI (version 2) emission files and applied to Texas CAP emissions to estimate HAP emissions.

For point sources, HAP emissions were taken directly from the NEI (version 2) point source emission inventory.

2.2 Oil and Gas Production Forecasts

Future year estimates of emissions were forecast from the 2011 base year emission inventory in approximately five-year increments (i.e., 2015, 2020, 2025, and 2030), accounting for both forecasted changes in oil and gas activity and emission control program effects. Oil and gas activity changes were assumed constant across all three states and oil and gas activity forecasting factors were limited to future estimates of changes in oil and gas production. More detailed scaling factors by basin and the expansion of scaling factors to active well count and drilling activity would allow for more refined oil and gas emissions development, however, due to the geographical scale of the analysis (i.e., multiple basins across multiple states) and the longer temporal scale (forecasts to 2032) such detailed forecasts were not applied.

BLM estimates of RFD natural gas and oil production activity forecasts (BLM, 2015a) were used to scale 2011 emissions to future years based on expected change in resource production. Each emission SCC was cross-referenced with the activity surrogate to which it is most closely associated and the estimated change in that activity factor from the base year was used to estimate future year emissions (see Table 2-4). This methodology is similar to the methodology used in the 2011 EPA modelling platform (EPA, 2014b). For sources related to both oil production and gas production, a combined equivalent production was used to forecast emissions. The combined equivalent production was estimated using EPA modelling platform methodology in which oil and natural gas production estimates were combined based on a barrel-of-oil equivalent by energy estimate of 0.178 barrels of crude oil to 1000 cubic feet of natural gas (EPA, 2014b). Figure 2-1 shows the estimated oil and gas activity forecast ratios used to scale emissions from 2011 to future years.

Table 2-4. Emission forecast projection parameter.

Emission Source Category
Activity Projection Parameter: Oil Production
Oil & Gas Expl & Prod /All Processes /Artificial Lift
Oil & Gas Expl & Prod /Crude Petroleum /Oil Well Heaters
Oil & Gas Expl & Prod /Crude Petroleum /Oil Well Pneumatic Devices
Oil & Gas Expl & Prod /Crude Petroleum /Oil Well Tanks - Flashing & Standing/Working/Breathing
On-Shore Oil Exploration /Mud Degassing
On-Shore Oil Exploration /Oil Well Completion: All Processes
On-Shore Oil Exploration /Oil Well Pneumatic Pumps
On-Shore Oil Production /Fugitives: Valves
On-Shore Oil Production /Fugitives: Connectors
On-Shore Oil Production /Fugitives: Flanges
On-Shore Oil Production /Fugitives: Open Ended Lines
On-Shore Oil Production /Tank Truck/Railcar Loading: Crude Oil
On-Shore Oil Production /Total: All Processes
Activity Projection Parameter: Gas Production
On-Shore Gas Exploration /Gas Well Completion: All Processes
On-Shore Gas Exploration /Gas Well Pneumatic Pumps
On-Shore Gas Exploration /Mud Degassing
On-Shore Gas Production
On-Shore Gas Production / Gas Well Venting - Blowdowns
On-Shore Gas Production /Fugitives: Other
On-Shore Gas Production /Fugitives: Valves
On-Shore Gas Production /Fugitives: Connectors
On-Shore Gas Production /Fugitives: Flanges
On-Shore Gas Production /Fugitives: Open Ended Lines
On-Shore Gas Production /Gas Well Dehydrators

Emission Source Category
On-Shore Gas Production /Gas Well Heaters
On-Shore Gas Production /Gas Well Pneumatic Devices
On-Shore Gas Production /Natural Gas Fired 4Cycle Lean Burn Compressor Engines 50 To 499 HP
On-Shore Gas Production /Natural Gas Fired 4Cycle Rich Burn Compressor Engines 50 To 499 HP
On-Shore Gas Production /Storage Tanks: Condensate
On-Shore Gas Production /Tank Truck/Railcar Loading: Condensate
All Midstream Point Sources
Activity Projection Parameter: Combined Equivalent Production
All Processes
Oil & Gas Expl & Prod /All Processes /Drill Rigs
Oil & Gas Expl & Prod /All Processes /Produced Water

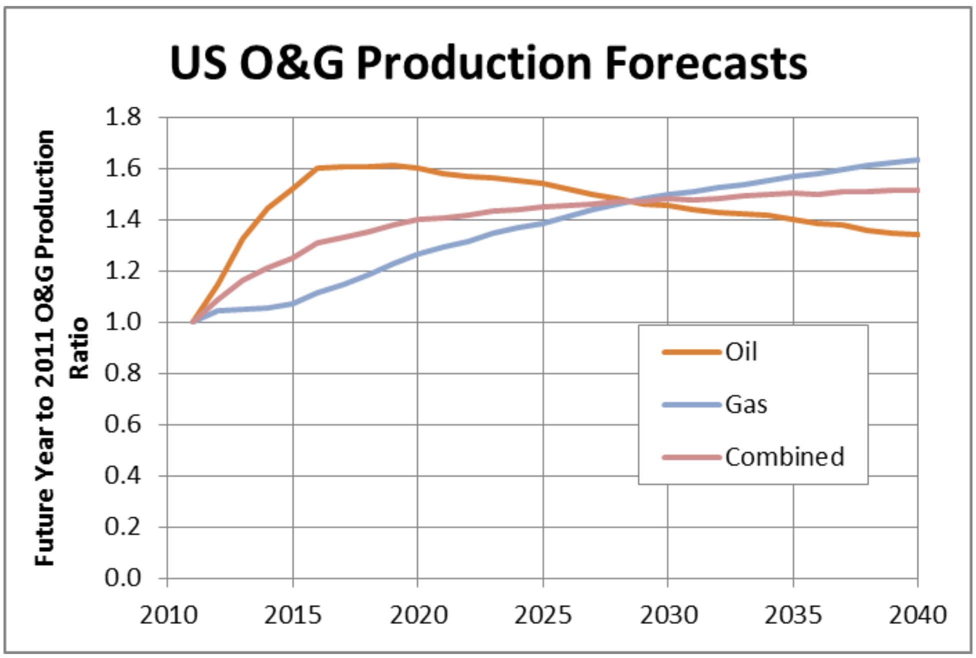

Figure 2-1. Oil and gas activity forecasts (source for production data: USA Crude Oil Production and Gas Production Forecast from Energy Information Administration, provided by BLM, 2015a).

2.3 Oil and Gas Emissions Control

Emissions control resulting from regulatory programs such as EPA's New Source Performance Standards Subpart OOOO[8], EPA's off-road diesel engine tier standards[9], and state specific regulatory programs were incorporated into future year emission estimates. It is important to note that accurate accounting of emission control effects is dependent on a number of factors

[8] http://www.epa.gov/airquality/oilandgas/actions.html
[9] http://www.epa.gov/otaq/nonroad-diesel.htm

including the level of emission control in the base year as well as the expected penetration of the control program in future years. In cases where the emission control applied to new or modified sources only (e.g., NSPS Subpart OOOO), due to the lack of information on the number of modified sources as well as the lack of information about the extent to which wells were or will be taken offline between 2011 and 2030, we applied controls to only added emissions; this methodology is consistent with EPA's latest future year modelling platform emissions (EPA, 2014b). Table 2-5 below lists the "on-the-books" federal and state regulations that affect emissions source categories in the oil and gas industry.

Table 2-5. Summary of federal and state "on-the-books" regulations affecting the oil and gas source categories considered in this inventory.

Source Category	Regulation	Enforcing Agency	Effective Date	Emission Reductions Applied?
Drill Rigs, Fracturing Engines	Nonroad engine Tier standards (1-4)	US EPA	Phase in from 1996 - 2014	Y (see Section 2.3.1)
Drill Rig, Fracing Engines Workover Rigs	Nonroad diesel fuel sulfur standards (EPA, 2006)	US EPA	Phase in beginning in 2010	Y (see Section 2.3.1)
Pneumatic Controllers[10]	NSPS Subpart OOOO: Six cubic-feet per hour limit pneumatic controller at new and modified wells.	US EPA	October 15, 2013	Y (see Section 2.3.2)
Spark-Ignited Stationary Engines	NSPS Subpart JJJJ: Emission standards for new and modified engines.	US EPA	Phase in from 2005 to 2011	Y (see Section 2.3.5)
Spark-Ignited Stationary Engines	East Texas Combustion Rule (Title 30 TAC Chapter 117.3300): Emission standards for stationary, gas-fired reciprocating internal combustion engines at any stationary source of nitrogen oxides in 33 counties in East Texas.	TCEQ	Effective June 14, 2007	N Rule is effective fleet-wide prior to base year 2011.
Condensate Tanks	Subpart OOOO: Storage vessels with VOC emissions equal to or greater than 6 tpy must reduce emissions by at least 95 percent.	US EPA	Phase in from 2012	Y (see Section 2.3.4)
Oil Tanks	Subpart OOOO: Storage vessels with VOC emissions equal to or greater than 6 tpy must reduce emissions by at least 95 percent.	US EPA	Phase in from 2012	Y (see Section 2.3.4)
Gas Well Completions	NSPS Subpart OOOO: 1. Hydraulically fractured wildcat (exploratory), delineation gas wells, low pressure gas wells, non-wildcat and non-delineation gas wells - Standard: Route flowback emissions to completion combustion device by October 15, 2012. 2. All other hydraulically fractured and refractured gas wells - Standard: Route	US EPA	Phase in from October 15, 2012	Y (see Section 2.3.3)

[10] The effects of NSPS Subpart OOOO on pneumatic controller emissions in Oklahoma were not estimated. The effects of NSPS Subpart OOOO were not able to be estimated consistent with the methodology used to estimate pneumatic controller emissions in OKDEQ (2016).

Source Category	Regulation	Enforcing Agency	Effective Date	Emission Reductions Applied?
	flowback emissions to completion combustion device prior to January 1, 2015. Must employ Reduced Emissions Completions (REC) in combination with use of a completion combustion device to control gas not suitable for entering the flow line on or after January 1, 2015.			
Dehydrators	New Source Performance Standards Subpart HH (NSPS) (EPA, 2012)	US EPA	Phase in from Oct. 2012-Oct. 2015	N (Insufficient information to estimate the impact of this regulation. Dehydrators represent less than 1% of VOC emissions.)

The sections below discuss estimation of each control's effect on area source oil and gas emissions; while it is understood that point source oil and gas emissions may also be subject to additional control per requirements such as NSPS Subpart OOOO, information was not available upon which to estimate the effect of such controls on point source oil and gas emissions. For point source oil and gas emissions, future year emissions do not account for the effects of such control programs.

Control factors were estimates as described below at the basin-level. For each county in that basin, control factors were applied to scale future year emissions. Appendix B provides a table which shows the by year and source category control factors for all three states.

2.3.1 Nonroad Diesel Engine Standards and Fuel Sulfur Standards

The EPA NONROAD2008a (EPA, 2009a) model was run with fuel inputs based on the EPA guidance for NONROAD fuel properties (EPA, 2009b). The model outputs were used to develop county-level emissions per unit population for "other oil field equipment" (SCC 2270010010) for the calendar year 2011, and then separately for future calendar years. These emissions per unit population reflect the predicted fleet mix of engines – for various tier standards from baseline uncontrolled engines through Tier IV engines – and are used as a representation of fleet turnover for drilling rigs, fracing engines, and workover rigs. The ratios of the per unit emissions in each future year to those in the base year for each state of interest were taken to be the control factors accounting for federal non-road tier standards and diesel fuel sulfur standards.

2.3.2 New Source Performance Standards for Pneumatic Devices

Following the requirements of the NSPS Subpart OOOO, it was assumed that all new pneumatic devices installed after September 2011 would be low-bleed (i.e., less than 6 standard cubic-feet per hour bleed rate)[11]. This analysis assumed new pneumatic device installation tracked the increase in oil production for pneumatic devices at oil wells and gas production for pneumatic devices at gas wells. Emission control was estimated separately by basin for Kansas based on the change in emissions from the uncontrolled pneumatic device configuration in the EPA Oil and Gas Tool to the exclusive use of low-bleed devices with an emission rate of 6 standard cubic-feet per hour. Due to lack of by basin information for Texas, EPA (2014b) nationwide estimates of emissions control were applied in Texas. The effects of NSPS Subpart OOOO control on pneumatic devices were conservatively not accounted for in Oklahoma[10].

2.3.3 New Source Performance Standards for Completions

NSPS Subpart OOOO requires controls on hydraulically fractured gas well completions in the form of flaring from August 23, 2011 to December 31, 2014 and green completions from January 1, 2015[11]. Based on the regulatory requirement that green completions be implemented from 2015, it was assumed that all gas well completions make use of green completion technology in all future years with a 95% total control efficiency. Emission control was estimated for Kansas and Oklahoma gas well completions based on the change in emissions from conventional completions in the EPA Oil and Gas Tool to the exclusive use of green completions in future years consistent with EPA (2014b) methodology. Emissions control for the use of green completions in Texas was estimated consistent with ERG (2014b) in which green completion control was assumed for horizontal and directional, but not vertically drilled gas wells.

2.3.4 New Source Performance Standards for Crude Oil and Condensate Tanks

NSPS Subpart OOOO requires controls on condensate and oil tanks that emit over 6 tons per year VOC if the source was constructed after August 23, 2011. The compliance deadline is April 15, 2014 for tanks that come online after April 12, 2013 and April 15, 2015 for tanks constructed between August 23, 2011 and April 12, 2013[12]. For each basin, Ramboll Environ utilized tank flashing emission factors from the EPA Oil and Gas Tool and production data to estimate, for the base year, the fraction of crude oil and condensate tanks that would have emissions greater than 6 tons per year VOC. Due to lack of information on the number of tanks per well site, this analysis assumed that all production at each well site was sent to only one tank (i.e. multi-tank sites were not considered).For oil and condensate production added after the base year, control was assumed by flare at crude oil and condensate tanks for the percent of tanks in the base year that emitted more than 6 tons per year VOC.

2.3.5 New Source Performance Standards for Compressor Engines

NSPS Subpart JJJJ applies to natural gas-fired engines such compressor engines at well sites and midstream facilities and artificial lift engines at well sites. Lack of information in the point sources emissions data and for Texas wellhead compressor engines about engine emission rates and turnover rates prevented calculation of the effect of NSPS for those engines. For

[11] Fact Sheet: Summary of Requirements for Processes and Equipment at Natural Gas Well Sites. http://www.epa.gov/airquality/oilandgas/pdfs/20120417summarywellsites.pdf

[12] Fact Sheet: Final Updates to Requirements for Storage Tanks Used in Oil And Natural Gas Production and Transmission. http://www.epa.gov/airquality/oilandgas/pdfs/20130805fs.pdf

wellhead and lateral area source compressor engines in Kansas and Oklahoma, estimates of emissions control were based on the control of base year emission factors from the EPA Oil and Gas Tool to NSPS requirements for production added after 2011. Artificial lift engines with a horsepower rating less than 25 generally met the less stringent NSPS Subpart JJJJ requirements for that horsepower range while engines with a horsepower rating above 25 emission rates required control to meet the 3.8 g/hp-hr HC+NOx emission standard. In Kansas and Oklahoma, for basins with an average artificial lift engine horsepower greater than 25 in the EPA Oil and Gas Tool, emissions added above 2011 levels were assumed controlled to NSPS requirements; if the basin average artificial lift engine rated horsepower was less than 25, no control was assumed. In Texas, artificial lift engines were assumed distributed across four representative engines, state-wide (ERG, 2010). One out of four representative engines had a horsepower greater than 25 HP and for emissions added over 2011 base year levels, the single representative engine with a horsepower greater than 25 was assumed controlled with the other three representative engines assumed uncontrolled per NSPS Subpart JJJJ requirements.

3.0 COAL MINING EMISSION INVENTORY DEVELOPMENT

Coal mining is an important source of CAP and GHG emissions. Altogether, there are approximately 20 coal mines in the Kansas, Oklahoma, and Texas planning area; there is one underground mine in Oklahoma and all remaining mines are surface mines. There are currently two mines on federal mineral estate that are operating (Bull Hill and Polyanna #8) in Oklahoma with a potential for four additional mines on federal land, all in Oklahoma. There are no mines on federal mineral estate in Kansas and Texas. Emissions were estimated for fugitive dust, methane venting, and off-road equipment associated with mining activities. On-road vehicle emissions were not estimated due to lack of site specific information about the mode of coal transport (e.g., rail versus truck) and travel distances. Windblown dust emissions are also expected to be associated with coal mines, but are not estimated due to lack of mine specific data on the characteristics and extent of exposed surfaces that would allow for estimation of emissions from this source category.

3.1 Base Year Coal Mining Emissions

3.1.1 Fugitive Dust

Fugitive dust emissions from coal mining were estimated based on methodology implemented by EPA in its 2011 NEI[13]. Emission estimates include fugitive dust emitted from the following activities (with associated emission factors based on EPA-AP-42[14]):

- truck loading-overburden (0.015 lb/ton)
- overburden replacement (0.001 lb/ton)
- truck unloading: bottom dump-overburden (0.006 lb/ton)
- open pit overburden removal (0.225 lb/ton)
- drilling/blasting (0.00005 lb/ton)
- truck loading-coal (0.05 lb/ton)
- truck unloading: end dump-coal (0.0035 lb/ton)
- truck unloading: bottom dump-coal (0.033 lb/ton)

Emissions from coal preparation activities (e.g., coal transfers, screening, crushing, etc.) were not included in the emission estimates because they are generally much smaller than the fugitive dust sources listed above.

It was assumed that overburden removal was ten times the mass of coal production and that there is an equivalent split between end dump and bottom dump truck unloading[13]. The ratio of PM_{10} to $PM_{2.5}$ was assumed to be 0.125[13].

[13] ftp://ftp.epa.gov/EmisInventory/2011nei/doc/mining_and_quarrying.zip
[14] AP-42, Fifth Edition, Volume 1, Chapter 11: Mineral Products Industry, Section 11.9: Western Surface Coal Mining, http://www.epa.gov/ttn/chief/ap42/ch11/final/c11s09.pdf

For surface mining, emissions were estimated from all of the activities listed above. For underground mining, emissions were assumed to be limited to truck loading and unloading of coal. Table 3-1 shows coal mining fugitive dust emission factors.

Table 3-1. Coal mining fugitive dust emissions factors.

Mine Type	PM_{10} (lb/ton of coal)	$PM_{2.5}$ (lb/ton of coal)
Surface	0.513	0.064
Underground	0.068	0.009

3.1.2 Methane Venting

Coal mines can be a significant source of methane emissions; during and after mining operations, methane that was previously contained in the subsurface is liberated by the mining process. The methodology used to estimate coal mining methane venting emissions is based on methodology from EPA's GHG Inventory report (1990-2013; EPA, 2015a). Surface mining and underground mining have different associated emissions rates; underground mining methane emission rates are significantly higher due to the potential for extraction of methane rich coal deeper below the surface.

Emissions were estimated for the following venting processes; associated emission factors are provided in Table 3-2:

1. Surface mine, venting: EPA (2015a) surface mine venting emissions factor estimates are available by coal basin. Each surface coal mine's production was multiplied by the emission factor for its associated basin to estimate emissions.
2. Surface mine, post-mining: EPA (2015a) surface mine post-mining emissions factor estimates are available by coal basin. Each surface coal mine's production was multiplied by the emission factor for its associated basin to estimate emissions.
3. Underground mine, post-mining: EPA (2015a) underground mine post-mining emissions factor estimates are available by coal basin. Each underground coal mine's production was multiplied by the emission factor for its associated basin to estimate emissions.
4. Underground mine, ventilation & degasification: Ventilation systems allow for methane concentrations in mines to remain at safe levels while degasification systems are used to remove methane prior to mining. EPA (2015a) estimated ventilation and degasification emissions using mine specific methane emissions data available from the U.S. Mine Safety and Health Administration. Estimates of emissions from underground mine ventilation and degasification were taken from EPA (2015a) by subtracting the 2011 emissions of methane estimated from the three sources listed above from state level total 2011 emissions estimated in EPA (2015a; Table A-125) for Oklahoma, since Oklahoma is the only state in this analysis with an underground mine.

Table 3-2. Coal mining methane emission factors by basin (cubic-feet per short ton of coal; source EPA 2015)

Basin	Surface Average in situ gas Content (ft^3/ton)	Underground Average In situ Content (ft^3/ton)	Surface Mine Factors (ft^3/ton)	Post-Mining Surface Factors (ft^3/ton)	Post Mining Underground (ft^3/ton)
Cherokee	34.3	64.3	51.5	11.1	20.9
Arkoma	74.5	331.2	111.8	24.2	107.6
Gulf coast	11.0	127.9	16.5	3.6	41.6

3.1.3 Off-road Equipment

Off-road equipment is used at coal mines for site preparation, extraction, and handling. Emissions from off-road equipment were estimated for mines in all three states using methodology that is applied in TCEQ's Texas NONROAD (TexN) model. The TexN model coal mining off-road equipment activity estimates are based on surveys of coal mines as described in ERG (2009). Representative coal mine equipment populations (in units of equipment population per ton of coal produced), average rated horsepower, and average annual hours of use from ERG (2009) are shown in Table 3-3. The NONROAD2008a model was used to generate emission rates for each equipment type in the base year and future years with the equipment activity shown in Table 3-3 to estimate off-road emissions per unit of coal production.

Table 3-3. Coal mining off-road equipment activity (source ERG, 2009).

Equipment Type	No. of units/million tons coal production	Average Rated HP	Average Annual Activity (hr/yr)
Crawler Tractor/Dozer	2.3	493	5,800
Excavator	0.7	923	5,273
Grader	0.8	254	5,218
Off-road Truck	2.6	1,047	4,793
Roller	0.05	315	300
Rubber Tire Loader	1.6	438	3,677
Scraper	0.3	629	2,929

3.2 Coal Mining Production

3.2.1 Base Year 2011 Coal Production

Annual coal production by coal mine was obtained for calendar year 2011 from the U.S. Energy Information Administration[15]. Annual 2011 production by coal mine in Kansas, Oklahoma, and Texas is shown in Table 3-4.

[15] U.S. Energy Information Administration. Historical detailed coal production data (1983-2013). http://www.eia.gov/coal/data.cfm#production

Table 3-4. 2011 coal production for mines in Kansas, Oklahoma, and Texas[15].

MSHA ID	Mine Name	Location		Mine Type	Coal Basin	2011 Annual Production (short tons)
		State	County			
Private Mineral Estate						
1401626	Garland Mine	Kansas	Bourbon	Surface	Cherokee	37,257
3401062	Joshua Coal Company	Oklahoma	Okmulgee	Surface	Cherokee	2,987
3402081	H & H	Oklahoma	Nowata	Surface	Cherokee	254,087
3402094	Culver Mine	Oklahoma	Craig	Surface	Cherokee	75,074
3402108	Taloka Creek Mine	Oklahoma	Haskell	Surface	Arkoma	203,607
4101192	Big Brown Strip	Texas	Freestone	Surface	Gulf Coast	1,837,202
4102632	Beckville Strip	Texas	Panola	Surface	Gulf Coast	4,517,856
4102776	Sulphur Springs Strip	Texas	Hopkins	Surface	Gulf Coast	1,267,357
4102840	San Miguel Lignite Mine	Texas	Atascosa	Surface	Gulf Coast	3,204,153
4103101	South Hallsville No 1 Mine	Texas	Harrison	Surface	Gulf Coast	4,041,305
4103164	Jewett Mine	Texas	Leon	Surface	Gulf Coast	4,221,546
4103428	Calvert Mine	Texas	Robertson	Surface	Gulf Coast	1,826,445
4103658	Winfield South Strip	Texas	Titus	Surface	Gulf Coast	1,584,019
4103659	Tatum Strip Mine	Texas	Panola	Surface	Gulf Coast	2,537,285
4103660	Oak Hill Strip	Texas	Rusk	Surface	Gulf Coast	3,227,650
4104085	Three Oaks	Texas	Lee	Surface	Gulf Coast	7,192,404
4104586	Kosse Strip	Texas	Limestone	Surface	Gulf Coast	8,630,793
4104802	Turlington Strip Mine	Texas	Freestone	Surface	Gulf Coast	1,815,582
Federal Mineral Estate						
3402076	Bull Hill	Oklahoma	Le Flore	Surface	Arkoma	200,552
3402080	Polyanna #8	Oklahoma	Le Flore	Undergrnd	Arkoma	408,358
3401728	Liberty Mine	Oklahoma	Haskell	Surface	Arkoma	[a]
N/A	McCurtain	Oklahoma	Le Flore	Undergrnd	Arkoma	[a]
N/A	Red Bank	Oklahoma	Le Flore	Undergrnd	Arkoma	[a]

[a] No activity in base year

3.2.2 Future Years Coal Production

Future year coal mining activity was estimated based on (1) information provided by BLM staff (BLM, 2015c), for mines on federal mineral estate and (2) U.S. Energy Information Administration nationwide future coal mining activity forecasts based on the analysis of EPA's proposed Clean Power Plan (EIA, 2015), base case policy forecasts were assumed. Table 3-5 shows estimates of future production for federal coal mines and Figure 3-1 shows U.S. Energy Information Administration estimates of nationwide coal production trends.

Table 3-5. Annual production from mines on Federal mineral estate (note, all mines on federal mineral estate are located in Oklahoma).

Year	Surface Mines		Underground Mines			Source
	Liberty Mine	Bull Hill	Polyanna #8	McCurtain	Red Bank	
2011	0	200,552	408,358	0	0	U.S. EIA[15]
2015	0	210,000	400,000	0	0	BLM (2015c)
2020	240,000	210,000	400,000	0	300,000	
2025	240,000	210,000	0	400,000	300,000	
2030	240,000	0	0	400,000	300,000	

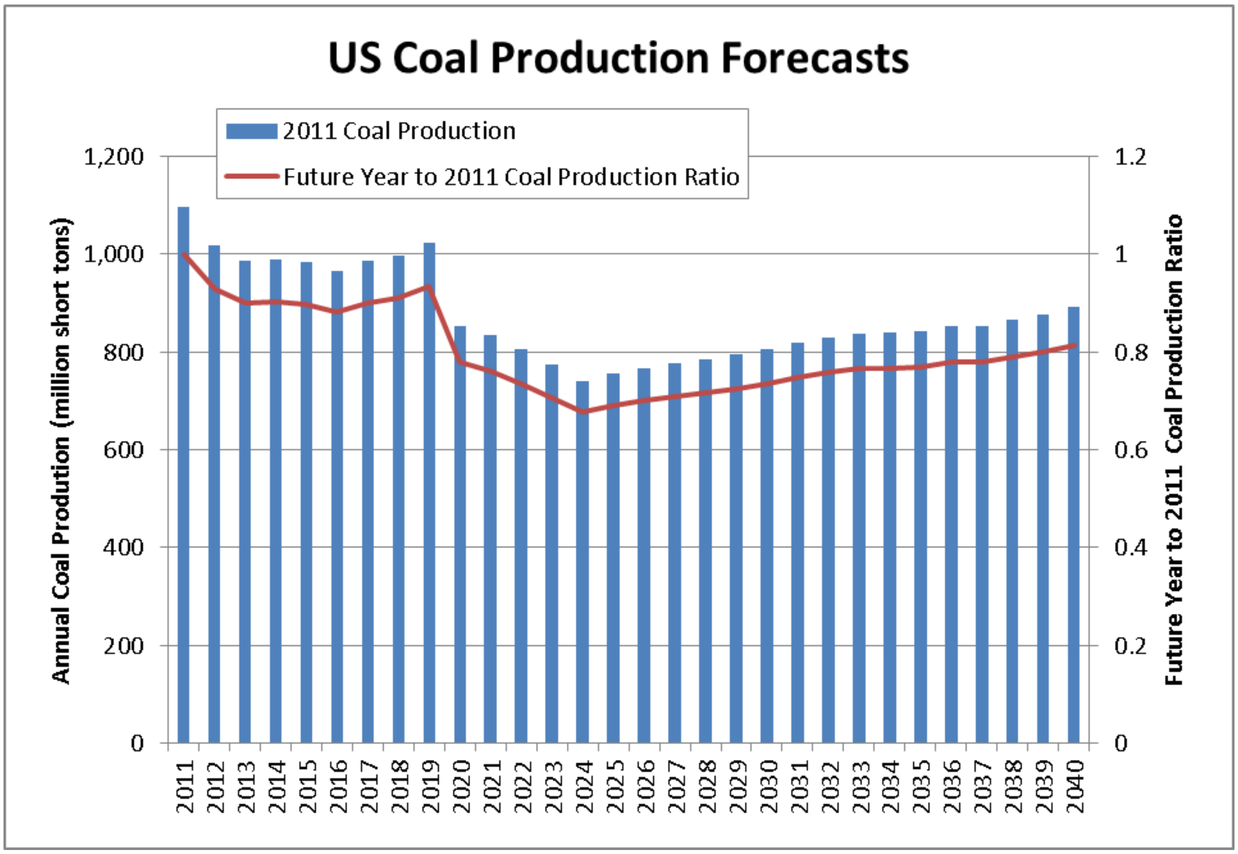

Figure 3-1. Annual U.S.-wide coal production estimates for 2011-2040 with future year forecasting scalars (source: U.S. Energy Information Administration, Analysis of the Impacts of the Clean Power Plan, Base Case (EIA, 2015)).

4.0 SUMMARY RESULTS

4.1 Oil and gas Emissions

Oil and gas emission inventory results are presented below in a series of pie charts, bar graphs, and emission tables. The quantitative emissions summaries are presented in Table 4-1 through Table 4-3. It should be noted that all pie charts showing emission by source category only include data labels for source categories that constitute 1% or greater of the emission inventory. A complete list of emissions by county and SCC are included in the emission spreadsheets that accompany this report.

Pie charts in Figure 4-1 to Figure 4-6 show NOx and VOC emission contributions by source for Kansas, Oklahoma, and Texas for the year 2015. Similar pie charts for each year are available in the emission inventory spreadsheets that accompany this report. Figure 4-1 shows that for 2015 in Kansas, the three largest contributors to NOx emissions account for 97% of emissions with contributions of 65% from compressor engines, 18% from artificial lift engines, and 14% from heaters. Figure 4-2 shows that for 2015 in Kansas, 77% of VOC emissions are from three source categories, pneumatic devices (41%), tanks (22%), and fugitives (14%). Figure 4-3 shows that for 2015 in Oklahoma, compressor engines account for 75% of NOx emissions in 2015, with smaller contributions from heaters (9%), dehydrators (7%), and artificial lift engines (6%). Figure 4-4 shows that for 2015 in Oklahoma, a majority of VOC emissions (55%) are from two source categories: fugitive components (31%) and tanks (24%). Figure 4-5 shows that for 2015 in Texas, compressor engines account for 72% of NOx emissions in 2015, with smaller contributions from artificial lift engines (12%), drill rigs (9%), and heaters (4%). Figure 4-6 shows that for 2015 in Texas, 49% of VOC emissions are from tanks, 16% are from well venting, with the remaining 35% distributed across multiple source categories.

Figure 4-7 and Figure 4-8 show total oil and gas emissions by state for all emission inventory years for NOx and VOC, respectively. Emissions increase monotonically from 2011 to 2020 in each state. Over the 2011 to 2030 time period NOx emissions increases by 42% in Oklahoma, 41% in Kansas, and 39% in Texas while VOC emissions increased by 41% in Oklahoma, 38% in Kansas, and 27% in Texas. Over the same time period, oil production increased by 44% and gas production increased by 51%. Emissions control from regulatory programs such as NSPS Subparts OOOO and JJJJ caused percent increases in emissions to be less than percent increases in oil and gas production.

Table 4-1 to Table 4-3 show emissions totals for each state by mineral estate. In Kansas (Table 4-1), there are no emissions from Indian mineral estate, 1% of the emissions from any pollutant are from Federal mineral estate, with 99% or more of emissions from private/state fee mineral estate. In Oklahoma (Table 4-2), 94% to 98% of emissions are from private/state fee mineral estate, with contributions of 4% or less from Osage Indian mineral estate, 2% or less from other Indian mineral estimate, and 1% or less from Federal mineral estate. In Texas (Table 4-3) close to 100% of emissions are from private/state fee land with very small contributions from Federal and Indian mineral estate.

CO_2 emissions were estimated based on methodology described in Chapter 2.0, primarily by using GHG to CAP emission factor ratios for combustion sources and based on natural gas composition GHG to VOC ratios for venting and loss sources. This CO_2 inventory cannot be directly compared to EPA's subpart W reporting program or the EPA Greenhouse Gas Sinks Emission Inventory because the applied methodology differs considerably from these two sources.

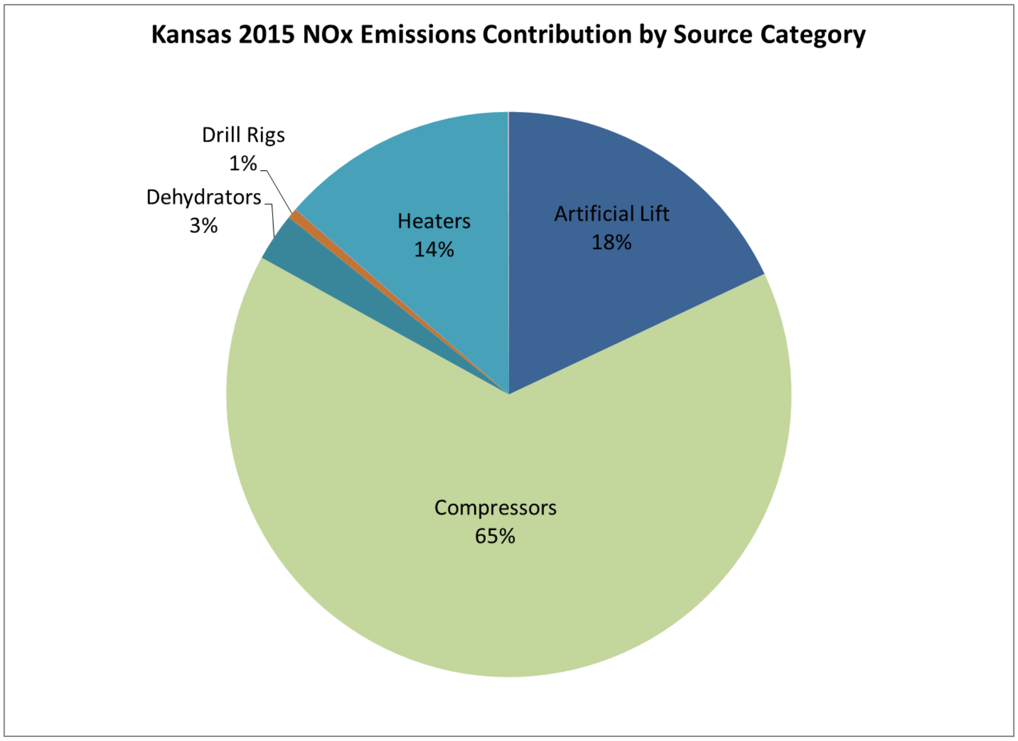

Figure 4-1. Kansas state-wide 2015 oil and gas NOx emissions by source category from point and area sources.

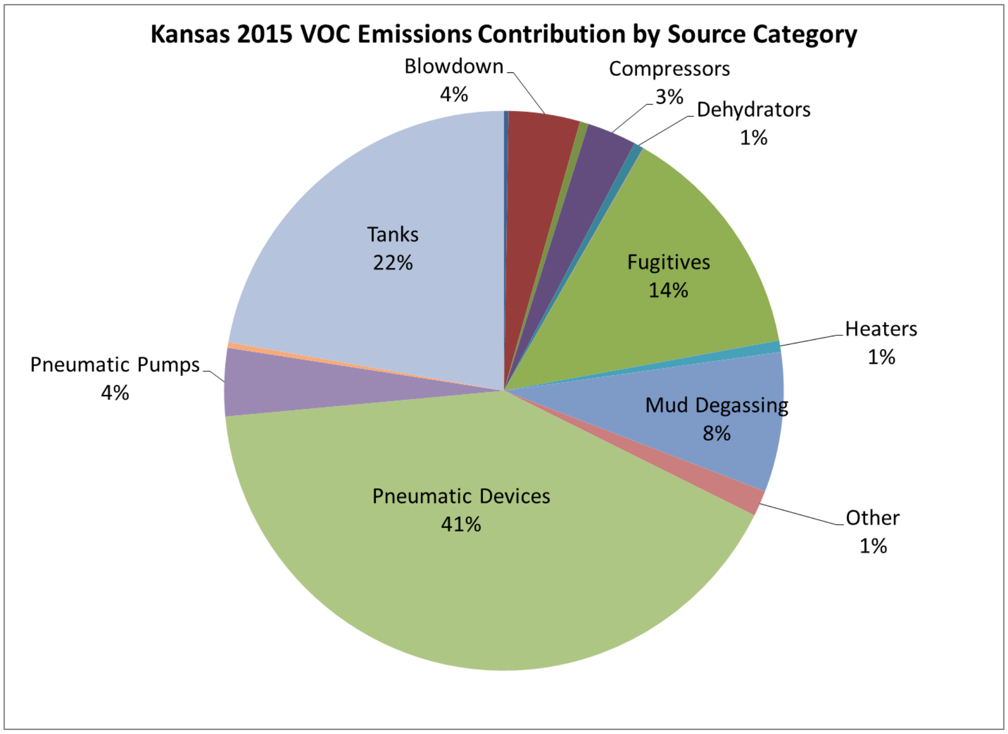

Figure 4-2. Kansas state-wide 2015 oil and gas VOC emissions by source category from point and area sources.

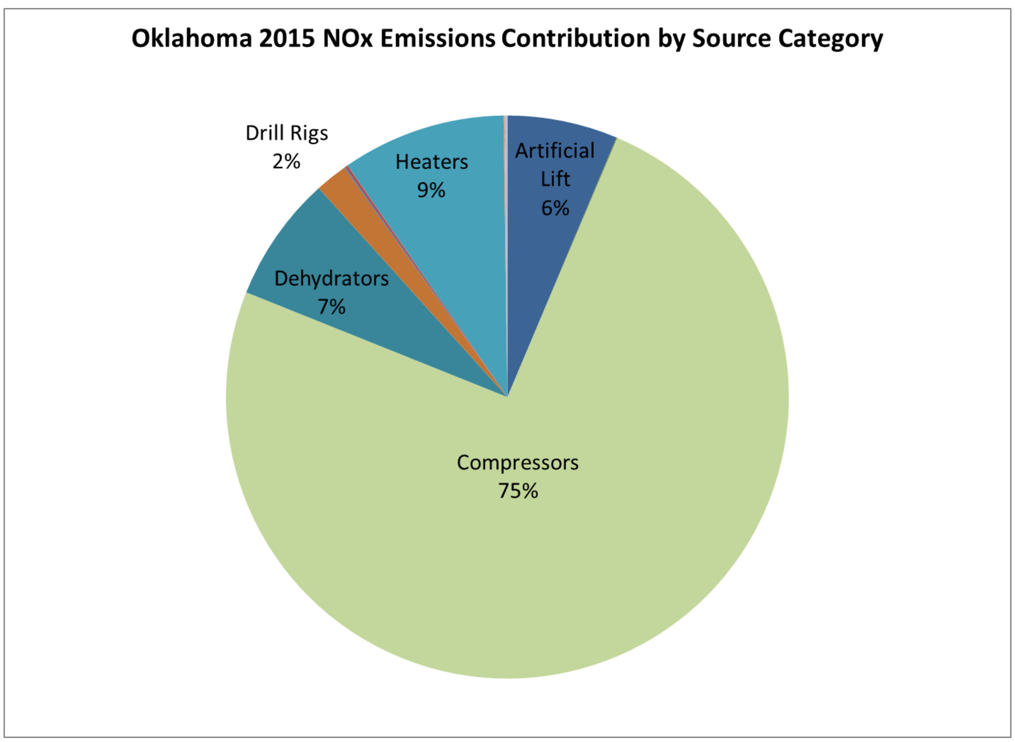

Figure 4-3. Oklahoma state-wide 2015 oil and gas NOx emissions by source category from point and area sources.

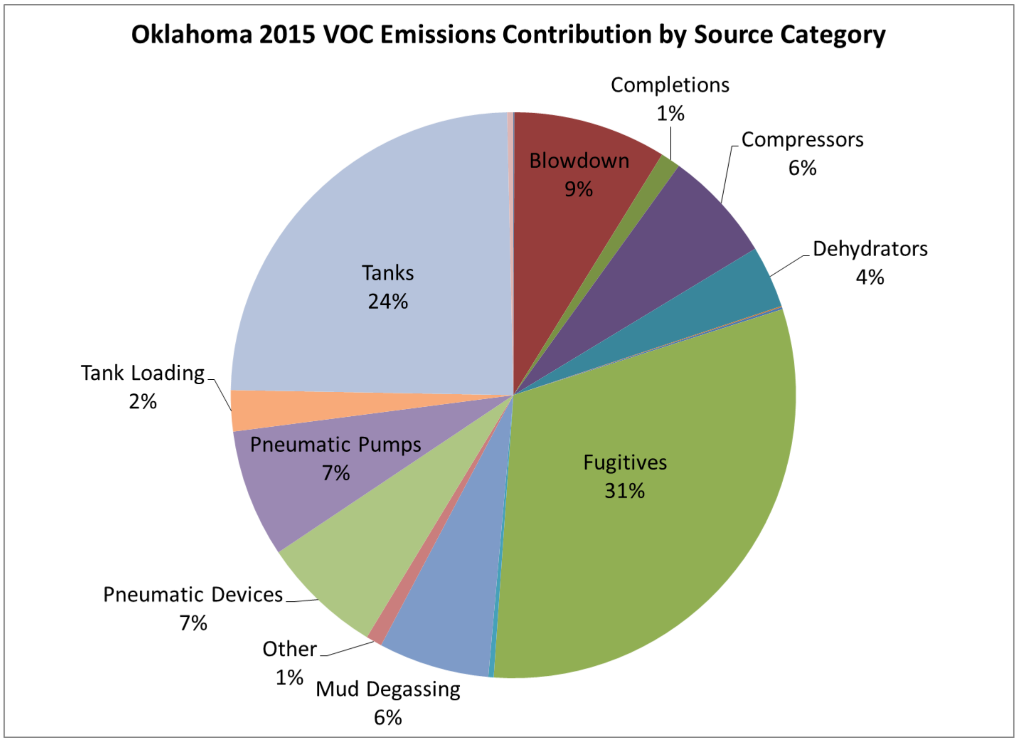

Figure 4-4. Oklahoma state-wide 2015 oil and gas VOC emissions by source category from point and area sources.

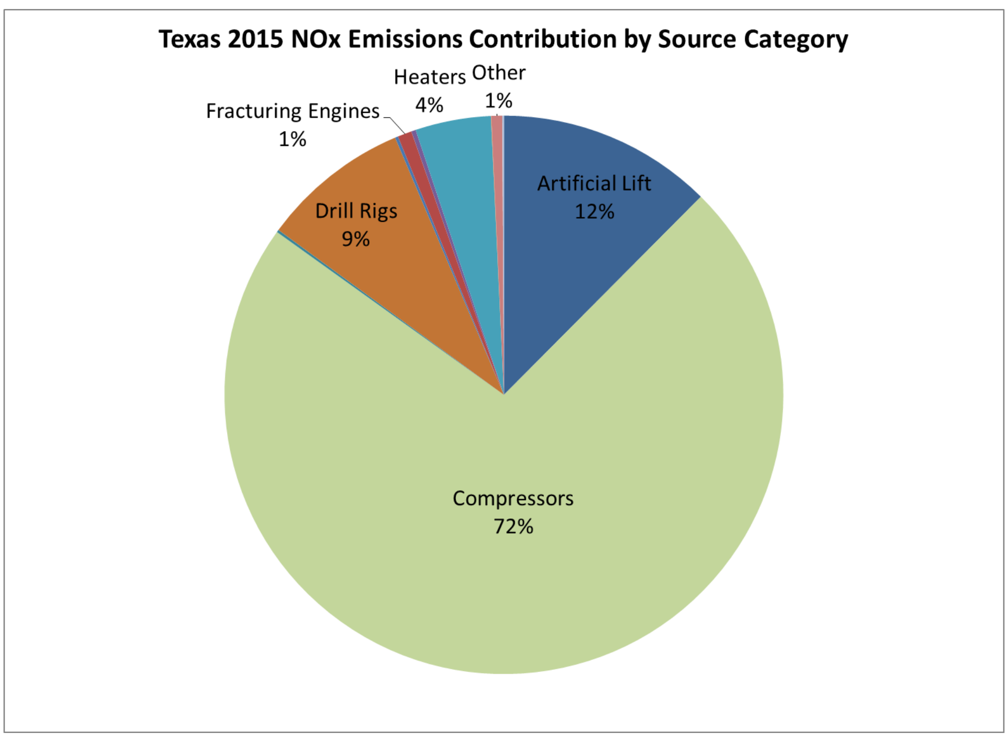

Figure 4-5. Texas state-wide 2015 oil and gas NOx emissions by source category from point and area sources.

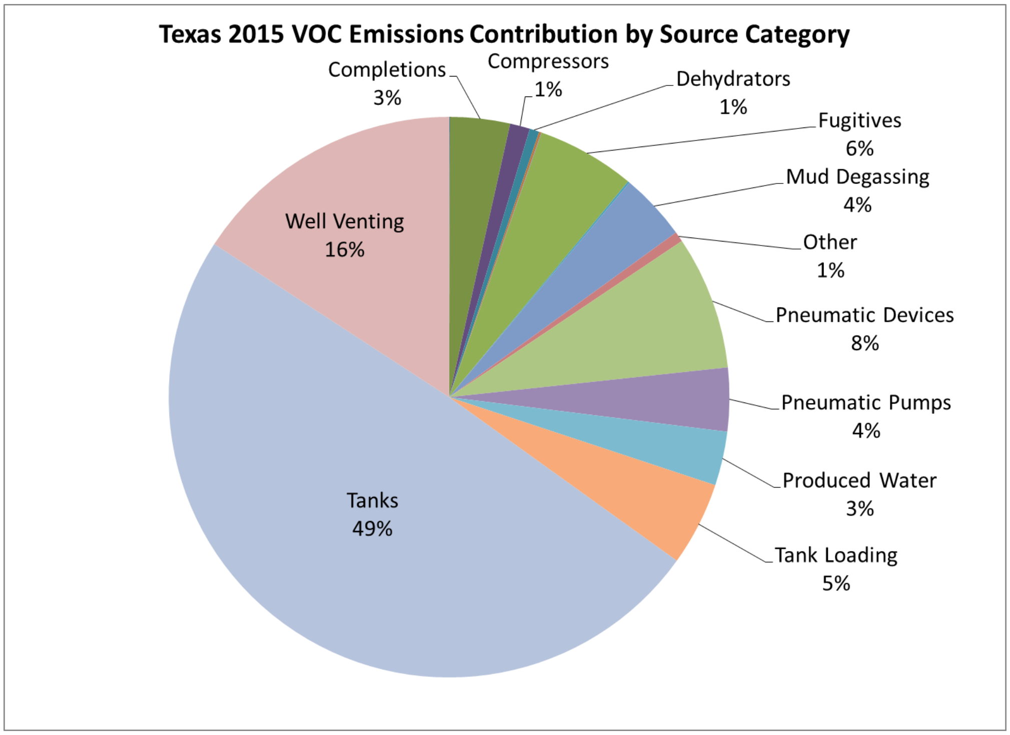

Figure 4-6. Texas state-wide 2015 oil and gas VOC emissions by source category from point and area sources.

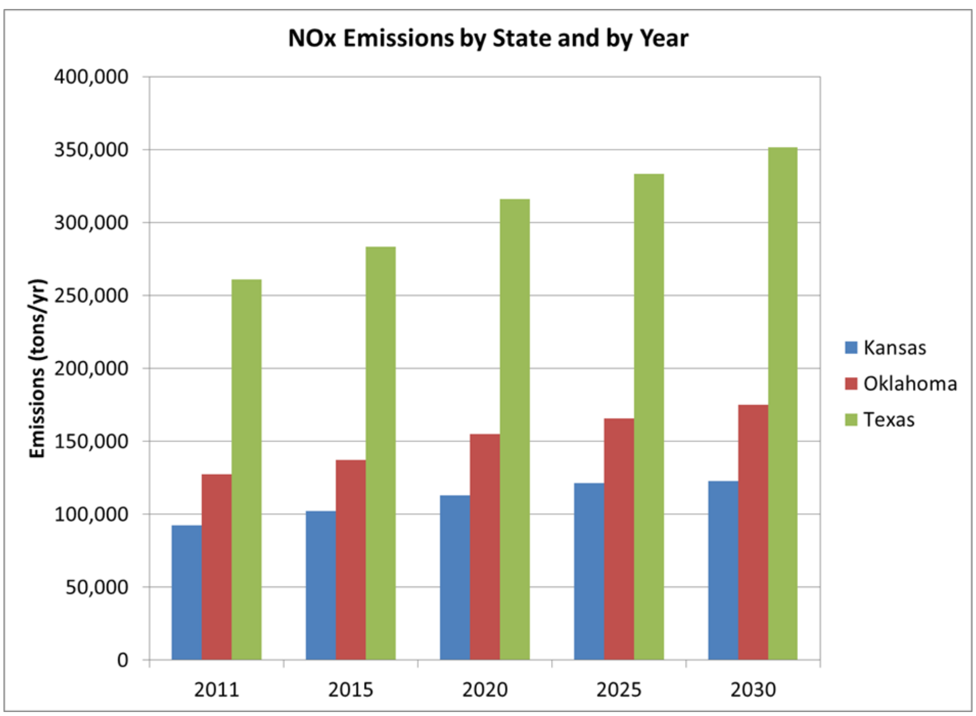

Figure 4-7. Oil and gas NOx emissions by year from point and area sources.

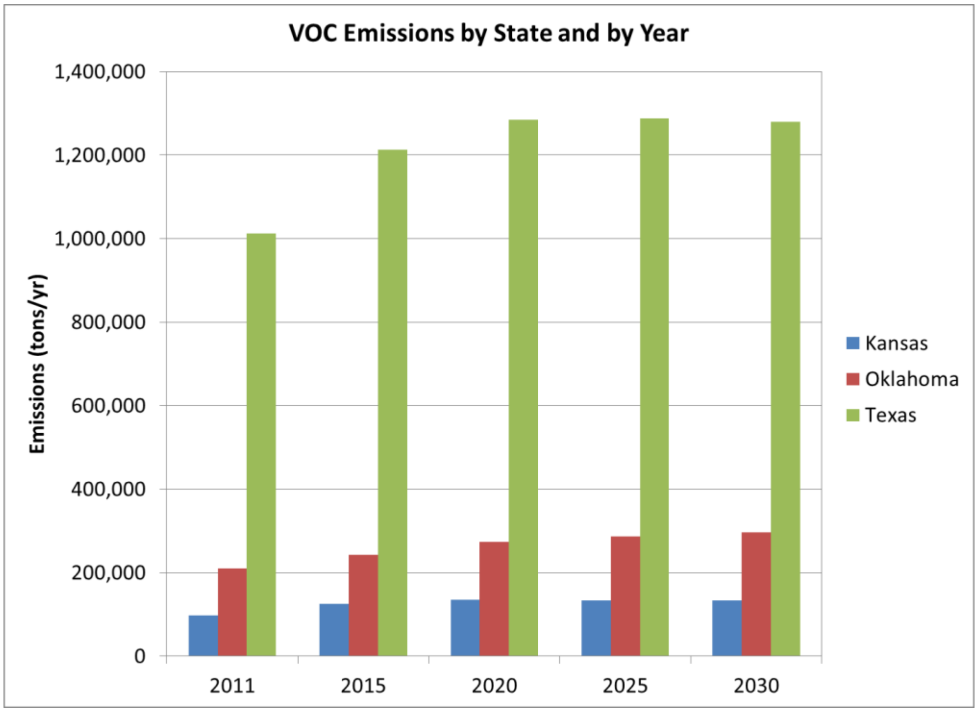

Figure 4-8. oil and gas VOC emissions by year from point and area sources.

Table 4-1. Kansas oil and gas emissions by state and mineral estate (summation of area and point sources).

Mineral Designation	Emissions (tons/year)							Emissions (million metric tonnes/year)
	NOx	VOC	CO	PM_{10}	$PM_{2.5}$	SO_2	HAPs	CO_2e
2011								
Totals State-wide	**92,271**	**97,011**	**87,120**	**2,097**	**2,088**	**211**	**2,360**	**30.0**
Federal	721	485	684	22	21	1	20	0.2
State & Private	91,549	96,526	86,436	2,075	2,067	210	2,341	29.8
Indian	-	-	-	-	-	-	-	-
2015								
Totals State-wide	**102,032**	**126,085**	**97,603**	**2,491**	**2,482**	**258**	**3,011**	**36.2**
Federal	781	577	744	24	24	1	25	0.3
State & Private	101,251	125,507	96,859	2,467	2,458	258	2,986	35.9
Indian	-	-	-	-	-	-	-	-
2020								
Totals State-wide	**112,775**	**135,201**	**105,472**	**2,822**	**2,811**	**283**	**4,091**	**40.6**
Federal	890	651	846	28	27	1	37	0.3
State & Private	111,885	134,550	104,626	2,794	2,783	283	4,053	40.3
Indian	-	-	-	-	-	-	-	-
2025								
Totals State-wide	**121,423**	**133,732**	**126,193**	**2,965**	**2,953**	**290**	**3,600**	**42.2**
Federal	977	663	1,042	30	30	1	31	0.3
State & Private	120,446	133,069	125,151	2,934	2,923	289	3,569	41.9
Indian	-	-	-	-	-	-	-	-
2030								
Totals State-wide	**122,770**	**133,232**	**111,091**	**3,081**	**3,068**	**294**	**5,255**	**43.7**
Federal	1,012	706	956	32	32	1	52	0.3
State & Private	121,758	132,527	110,134	3,048	3,036	293	5,203	43.4
Indian	-	-	-	-	-	-	-	-

Table 4-2. Oklahoma oil and gas emissions by state and mineral estate (summation of are and point sources).

Mineral Designation	Emissions							
	(tons/year)							(million metric tonnes/year)
	NOx	VOC	CO	PM_{10}	$PM_{2.5}$	SO_2	HAPs	CO2e
2011								
Totals State-wide	**127,550**	**210,798**	**122,246**	**3,488**	**3,483**	**930**	**8,107**	**46.0**
Federal	577	872	552	18	18	3	39	0.2
State & Private	123,070	201,092	117,224	3,370	3,365	916	7,782	44.3
Osage Indian	2,238	5,859	2,758	52	52	5	164	0.8
Other Indian	1,664	2,975	1,712	48	48	6	122	0.6
2015								
Totals State-wide	**137,203**	**243,343**	**132,748**	**3,818**	**3,814**	**1,000**	**9,158**	**51.2**
Federal	612	966	589	19	19	3	44	0.3
State & Private	132,247	230,897	127,146	3,680	3,675	985	8,772	49.2
Osage Indian	2,534	7,955	3,133	66	66	6	204	1.0
Other Indian	1,810	3,525	1,879	54	53	7	139	0.7
2020								
Totals State-wide	**155,074**	**273,007**	**149,984**	**4,405**	**4,402**	**1,174**	**11,363**	**59.7**
Federal	696	1,116	675	22	22	3	56	0.3
State & Private	149,614	259,425	143,841	4,248	4,245	1,157	10,901	57.4
Osage Indian	2,729	8,510	3,351	73	73	6	235	1.1
Other Indian	2,034		2,117	61	61	8		0.8

Mineral Designation	Emissions (tons/year) NOx	VOC	CO	PM$_{10}$	PM$_{2.5}$	SO$_2$	HAPs	(million metric tonnes/year) CO2e
		3,956					172	
2025								
Totals State-wide	**165,420**	**286,201**	**159,671**	**4,732**	**4,730**	**1,279**	**12,685**	**64.4**
Federal	748	1,199	727	24	24	4	63	0.3
State & Private	159,713	272,426	153,277	4,567	4,565	1,261	12,183	62.0
Osage Indian	2,801	8,438	3,422	75	75	6	248	1.2
Other Indian	2,158	4,138	2,245	65	65	9	191	0.9
2030								
Totals State-wide	**175,084**	**296,646**	**168,416**	**5,045**	**5,043**	**1,375**	**13,891**	**68.6**
Federal	797	1,273	775	26	26	4	70	0.4
State & Private	169,163	282,864	161,817	4,874	4,871	1,356	13,354	66.2
Osage Indian	2,851	8,232	3,466	76	76	6	258	1.2
Other Indian	2,273	4,278	2,359	69	69	9	209	0.9

Table 4-3. Texas oil and gas emissions by state and mineral estate (summation of are and point sources).

Mineral Designation	Emissions (tons/year)							Emissions (million metric tonnes/year)
	NOx	VOC	CO	PM_{10}	$PM_{2.5}$	SO_2	HAPs	CO_2e
2011								
Totals State-wide	**260,138**	**1,013,266**	**165,886**	**5,770**	**5,711**	**18,523**	**13,556**	**63.2**
Federal	714	1,507	396	13	13	10	42	0.2
State & Private	259,390	1,011,509	165,468	5,757	5,698	18,512	13,506	63.0
Indian	33	248	21	1	1	1	5	0.0
2015								
Totals State-wide	**282,508**	**1,212,416**	**374,393**	**6,299**	**6,241**	**23,474**	**15,456**	**72.3**
Federal	749	1,625	549	13	13	15	45	0.2
State & Private	281,723	1,210,532	373,817	6,286	6,228	23,457	15,406	72.2
Indian	35	259	27	1	1	2	5	0.0
2020								
Totals State-wide	**315,167**	**1,284,474**	**425,777**	**6,893**	**6,835**	**26,144**	**17,326**	**82.2**
Federal	830	1,782	630	13	13	16	52	0.2
State & Private	314,297	1,282,416	425,115	6,879	6,821	26,126	17,268	81.9
Indian	40	276	32	1	1	2	6	0.0
2025								
Totals State-wide	**332,415**	**1,288,670**	**415,250**	**7,102**	**7,047**	**26,922**	**18,202**	**86.6**
Federal	875	1,847	650	13	13	16	56	0.2
State & Private	331,496	1,286,539	414,565	7,088	7,033	26,904	18,140	86.4
Indian	43	285	34	1	1	2	6	0.0
2030								
Totals State-wide	**350,842**	**1,279,632**	**392,441**	**7,411**	**7,353**	**27,347**	**18,930**	**90.2**
Federal	930	1,901	664	14	14	15	59	0.2
State & Private	349,865	1,277,439	391,741	7,395	7,338	27,330	18,864	90.0
Indian	47	293	36	1	1	2	7	0.0

4.1.1 Comparison to EPA Inventories for Area Source oil and gas

Table 4-4 shows 2011 area source emissions from the BLM calculator, the EPA Modelling Platform (version 6.2), and the 2011 NEI (version 2). Area source emissions for Kansas agree across all inventories. Oklahoma emissions for the BLM calculator and the 2011 NEI (version 2) agree to within 5%; EPA modelling platform emissions agree with the exception of VOCs, which are smaller in the BLM calculator due to the update of pneumatic device emissions per OKDEQ (2016). Texas emissions are comparable, but lower in the BLM calculator relative to both the EPA modelling platform and the 2011 NEI (version 2) based on the use of emissions provided directly by TCEQ.

Table 4-4. 2011 oil and gas area source emissions by state comparison.

State	2011 Emissions (tons)		
	BLM Calculator[1,2]	EPA Modeling Platform (v6.2)	2011 NEI (v2.0)
KANSAS			
NOx	56,387	56,387	56,387
VOC	93,310	93,310	93,310
CO	74,716	74,716	74,716
PM_{10}	1,625	1,627	1,625
$PM_{2.5}$	1,622	1,622	1,622
SO_2	151	151	151
OKLAHOMA			
NOx	66,436	66,436	63,314
VOC	182,577	231,250	226,492
CO	76,998	76,998	73,638
PM_{10}	2,414	2,414	2,304
$PM_{2.5}$	2,410	2,410	2,301
SO_2	127	127	121
TEXAS			
NOx	184,158	197,238	197,238
VOC	989,410	996,215	996,215
CO	120,651	130,436	130,436
PM_{10}	2,856	3,334	3,334
$PM_{2.5}$	2,832	3,307	3,307
SO_2	8,205	8,210	8,210

Table 4-5 compares 2025 area source emissions estimated in the BLM calculator with 2025 emissions estimated in the EPA modelling platform (version 6.2; EPA, 2015b). oil and gas2025 Kansas BLM calculator area source emissions are 70% to 219% higher than the EPA modelling platform estimates due to the application of higher oil and gas activity growth factors in the BLM calculator relative to the EPA modelling platform. EPA modeling platform emissions were developed based on a regional analysis of growth forecasts in which growth within a census division was conserved; high oil and gas growth rates in the West North Central census division outside of Kansas led to oil and gas growth rates in Kansas that were low (EPA, 2016). 2025 BLM calculator Oklahoma area source emissions are 8% smaller to 17% higher than the EPA modelling platform estimates; differences are explained by (1) the application of different oil and gas activity growth factors in the BLM calculator and the EPA modelling platform, and (2) 2011 base year EPA modelling platform emissions did not include the OKDEQ (2016) revised pneumatic devices emissions. 2025 BLM calculator Texas area source emissions are 47% smaller to 79% higher than the EPA modelling platform estimates due to (1) the application of different growth factors in the BLM calculator and the EPA modelling platform, and (2) differences in 2011 base year EPA modelling platform emissions and 2011 base year BLM calculator emissions.

Table 4-5. 2025 oil and gas area source emissions by state comparison.

State	2025 Emissions (tons)		
	BLM Calculator	EPA Modeling Platform (v6.2)	Percentage Difference
KANSAS			
NOx	71,710	25,386	182%
VOC	128,605	65,253	97%
CO	109,008	34,179	219%
PM_{10}	2,311	730	217%
$PM_{2.5}$	2,307	729	216%
SO_2	208	122	70%
OKLAHOMA			
NOx	80,753	71,726	13%
VOC	250,045	269,558	-7%
CO	96,982	83,077	17%
PM_{10}	3,244	3,526	-8%
$PM_{2.5}$	3,243	3,523	-8%
SO_2	166	178	-7%
TEXAS			
NOx	227,154	243,534	-7%
VOC	1,255,623	1,535,778	-18%
CO	352,598	197,082	79%
PM_{10}	3,065	5,768	-47%
$PM_{2.5}$	3,058	5,723	-47%
SO_2	12,627	19,097	-34%

oil and gas

4.2 Coal Mining Emissions

Coal mining emission inventory estimates are presented below in a series of bar graphs (Figure 4-9 through Figure 4-11) and an emission table (Table 4-7). A complete list of emissions by county and SCC are included in the emission spreadsheets that accompany this report.

2011 coal mining emissions contributions by source category (see Figure 4-9) show that PM_{10} and $PM_{2.5}$ emissions are dominated by surface mining fugitive dust with small contributions from surface mining off-road equipment, indicative of high fugitive dust contributions from surface mining. 78% of methane emissions are from surface mine venting, indicative of the vast majority of coal production from surface mines, and 22% from underground mine venting, indicative of the higher emissions per unit of production for underground mining relative to surface mining. 100% of NOx, VOC, CO, SO_2, HAP, CO_2, and N_2O emissions are from surface mining off-road equipment.

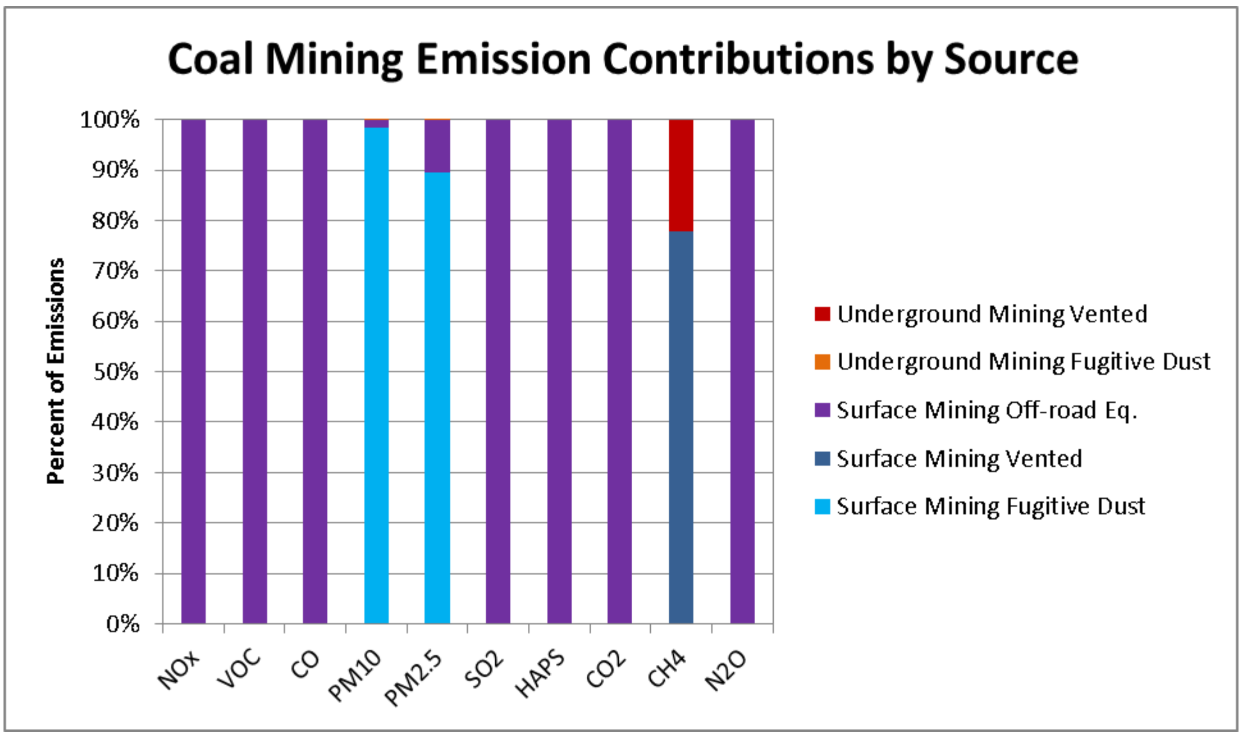

Figure 4-9. 2011 coal mining emissions contributions by mine type and source.

State-level contributions to emissions are generally indicative of coal mining activity by state. 98% of emissions across all pollutants except methane are from Texas (all private mineral estate), which is consistent with coal production by state (in 2011, 97% of all coal production was from Texas). 72% of methane emissions are from Texas, 28% are from Oklahoma, and <1% are from Kansas; while Oklahoma represents less than 3% of the mining activity across the three states it is the only state with an underground mine, hence a larger contribution to methane emissions.

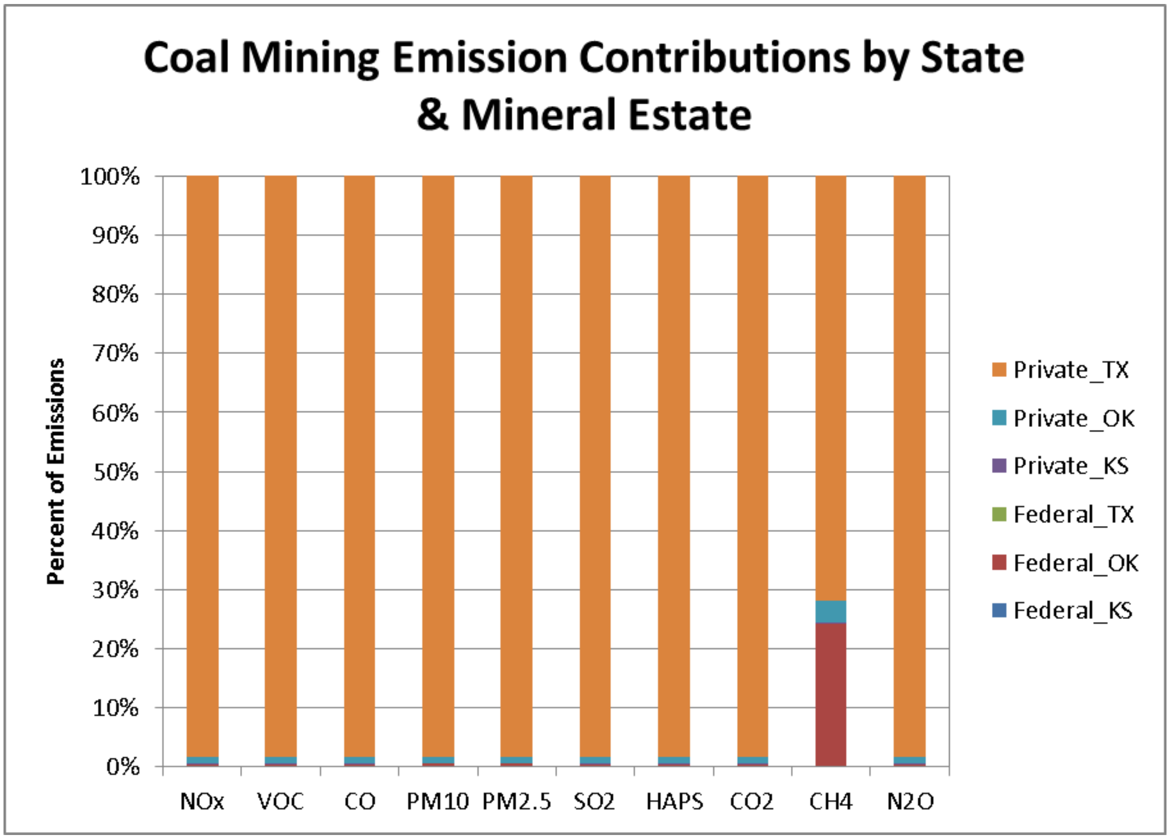

Figure 4-10. Coal mining emissions contributions by mineral estate and state.

Figure 4-11 shows emission trends for various pollutants. Coal mining NOx emission trends reflect the combination of both trends in surface coal mining activity and fleet turnover to newer diesel engines meeting more stringent standards over time. Methane emissions reflect trends in both surface coal mining and underground coal mining activity; increased underground mining activity on Federal mineral estate contributes to increasing methane emissions in future years. PM_{10} and $PM_{2.5}$ emissions primarily reflect the change in surface mining activity and to a much lesser degree off-road equipment fleet turnover to newer, cleaner engines. Table 4-7 presents by year, state, and mineral designation emissions for all pollutants.

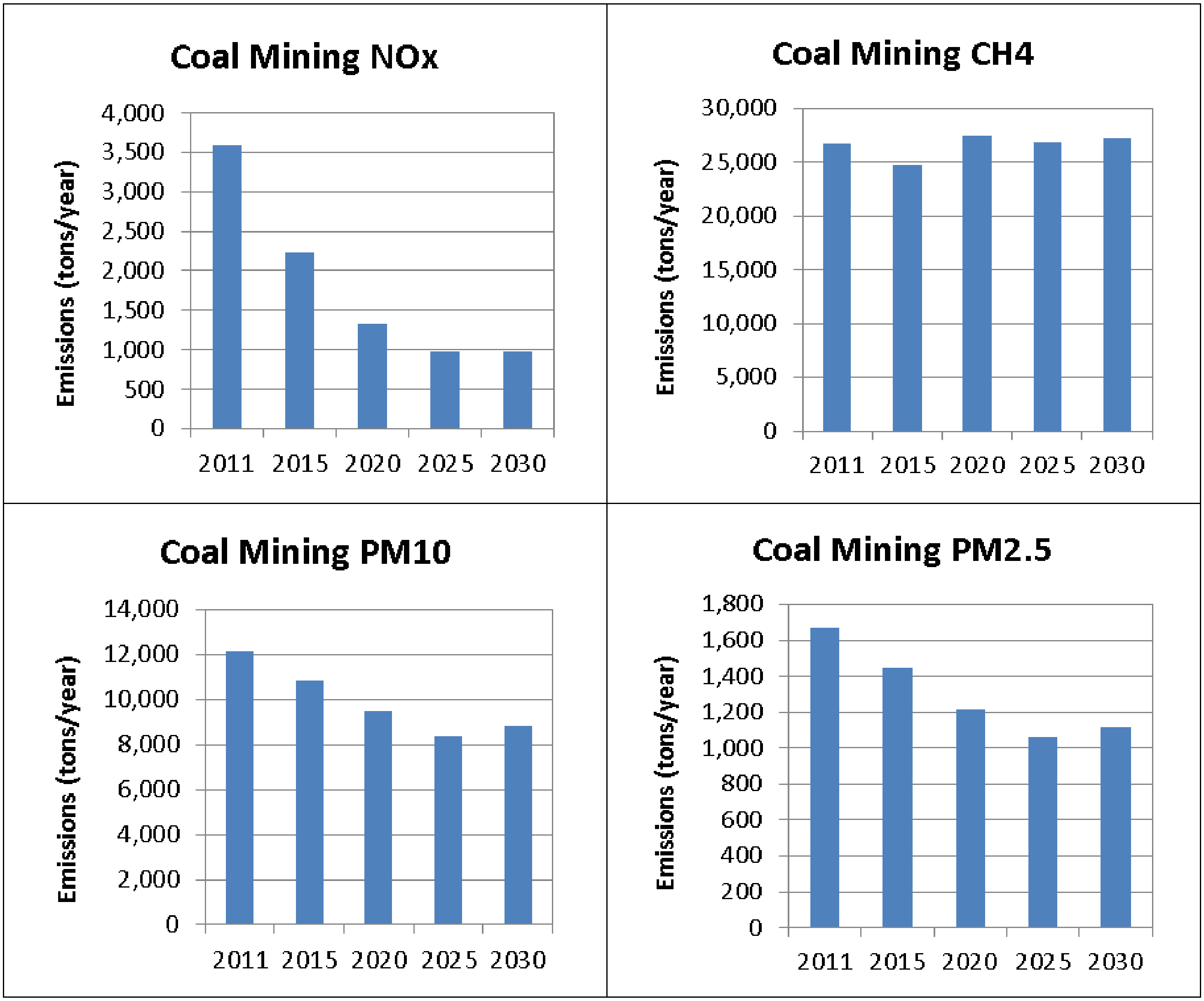

Figure 4-11. Coal mining emissions trends for NOx (upper left panel), methane (upper right panel), PM_{10} (lower left panel), and $PM_{2.5}$ (lower right panel).

Table 4-7. Coal mining emissions for base and future years by state and mineral designation (short tons/year).

Mineral Estate	Year	NOx	VOC	CO	PM_{10}	$PM_{2.5}$	SO_2	HAPS	CO_2	CH_4	N_2O
Kansas											
Federal	*no emissions*										
Private	2011	3	0.2	1.0	10	1	0.007	0.021	354	49	0.01
	2015	2	0.1	0.6	9	1	0.002	0.017	317	44	0.01
	2020	1	0.1	0.3	7	1	0.001	0.011	275	38	0.01
	2025	1	0.1	0.1	7	1	0.001	0.008	244	33	0.01
	2030	1	0.1	0.1	7	1	0.001	0.008	260	36	0.01
Private Subtotal		7	0.5	2.0	39	5	0.012	0.065	1,451	199	0.04
Kansas Total		**7**	**0.5**	**2.0**	**39**	**5**	**0.012**	**0.065**	**1,451**	**199**	**0.04**
Oklahoma											
Federal	2011	15	0.9	5.1	66	9	0.036	0.112	1,904	6,487	0.05
	2015	11	0.8	4.1	68	9	0.011	0.104	1,994	6,514	0.05
	2020	16	1.4	4.1	140	18	0.022	0.171	4,273	11,633	0.11
	2025	14	1.2	1.7	140	18	0.021	0.143	4,274	12,884	0.11
	2030	7	0.6	0.6	86	11	0.011	0.074	2,279	12,289	0.06
Federal Subtotal		63	4.9	15.6	499	64	0.101	0.604	14,724	49,807	0.37
Private	2011	41	2.4	13.7	139	19	0.097	0.300	5,085	1,010	0.13
	2015	26	1.9	9.3	125	17	0.026	0.238	4,565	906	0.12
	2020	15	1.3	3.8	107	14	0.020	0.158	3,961	786	0.10
	2025	11	0.9	1.4	95	12	0.017	0.118	3,509	696	0.09
	2030	11	1.0	1.1	101	13	0.018	0.122	3,742	742	0.09
Private Subtotal		104	7.5	29.3	568	74	0.178	0.935	20,862	4,141	0.53
Oklahoma Total		**167**	**12.4**	**44.9**	**1067**	**139**	**0.280**	**1.539**	**35,586**	**53,947**	**0.90**
Texas											
Federal	2011	*no emissions*									
Private	2011	3,532	206.2	1177.6	11,950	1,640	8.269	25.681	435,718	19,217	11.04
	2015	2,188	163.4	799.3	10,673	1,420	2.247	20.355	391,147	17,248	9.91
	2020	1,296	108.8	324.3	9,209	1,185	1.734	13.557	339,338	14,959	8.60
	2025	955	81.0	118.0	8,138	1,032	1.471	10.090	300,632	13,250	7.61
	2030	955	83.7	90.4	8,675	1,096	1.553	10.421	320,616	14,131	8.12
Private Subtotal		8,926	643.0	2509.6	48,645	6,372	15.274	80.103	1,787,452	78,804	45.3
Texas Total		**8,926**	**643.0**	**2509.6**	**48,645**	**6,372**	**15.274**	**80.103**	**1,787,452**	**78,804**	**45.3**

5.0 REFERENCES

BLM, 2014. Air Resources Technical Report for Oil and Gas Development. New Mexico, Oklahoma, Texas and Kansas. Prepared by New Mexico State Office. February

BLM, 2015a. Oil and gas activity geodatabases and spreadsheets provided by Patrick Stong. BLM Oklahoma Field Office, February 23, 2015.

BLM, 2015b. Oil and gas activity by mineral designation spreadsheets provided by Patrick Stong. BLM Oklahoma Field Office, March 19, 2015.

BLM, 2015c. Estimates of coal mining activity on federal mineral estate provided by Allen Hollubec. June 5, 2015.

BLM and BIA, 2014. Resource Management Plan Revision and Environmental Impact Statement. Final Scoping Summary Report. Prepared by Oklahoma Field Office. US Department of the Interior, Bureau of Land Management and Bureau of Indian Affairs. July.

EIA, 2015. Analysis of the Impacts of the Clean Power Plan. United States Energy Information Administration. May. Available Online: http://www.eia.gov/analysis/requests/powerplants/cleanplan/pdf/powerplant.pdf

EPA, 2009a. NONROAD2008a Model. United States Environmental Protection Agency Assessment and Standards Division, Office of Transportation and Air Quality. Available Online: http://www.epa.gov/otaq/nonrdmdl.htm

EPA, 2009b. Suggested Nationwide Average Fuel Properties. United States Environmental Protection Agency Assessment and Standards Division, Office of Transportation and Air Quality. Available Online: http://www.epa.gov/otaq/models/nonrdmdl/nonrdmdl2008/420b09018.pdf

ERG, 2014a. Oil & Gas Emission Estimation Tool. Eastern Research Group, Inc. Available online: ftp://ftp.epa.gov/EmisInventory/2011nei/doc/Tool_and_Report112614.zip

EPA, 2014b. Technical Support Document (TSD) Preparation of Emissions Inventories for the Version 6.1, 2011 Emissions Modeling Platform. United States Environmental Protection Agency Office of Air and Radiation, Office of Air Quality Planning and Standards, Air Quality Assessment Division. Available Online: http://www.epa.gov/ttn/chief/emch/index.html#2011

EPA, 2015. Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2013. U.S. Environmental Protection Agency. April. Available Online: http://www.epa.gov/climatechange/ghgemissions/usinventoryreport.html

EPA, 2015b. Technical Support Document (TSD) Preparation of Emissions Inventories for the Version 6.2, 2011 Emissions Modeling Platform. United States Environmental Protection Agency Office of Air and Radiation, Office of Air Quality Planning and Standards, Air Quality Assessment Division. Available Online:

https://www.epa.gov/sites/production/files/2015-10/documents/2011v6_2_2017_2025_emismod_tsd_aug2015.pdf

EPA. 2016. Email communication from EPA staff (Alison Eyth). United States Environmental Protection Agency. January 22, 2016.

ENVIRON, 2012. 2011 Oil and Gas Emission Inventory Enhancement Project for CenSARA States. Prepared by ENVIRON International Corporation and Eastern Research Group, Inc. December.

ERG. 2009. Update of Diesel Construction Equipment Emission Estimates for the State of Texas – Phase I and II: Final Report. Prepared by Eastern Research Group, Inc. July.

ERG. 2010. Characterization of Oil and Gas Production Equipment and Develop a Methodology to Estimate Statewide Emissions: Final Report. Eastern Research Group, Inc. Prepared for the Texas Commission on Environmental Quality. November. http://www.tceq.texas.gov/assets/public/implementation/air/am/contracts/reports/ei/5820784003FY1026-20101124-ergi-oilGasEmissionsInventory.pdf

ERG, 2014a. Oil & Gas Emission Estimation Tool. Eastern Research Group, Inc. Available online: ftp://ftp.epa.gov/EmisInventory/2011nei/doc/Tool_and_Report112614.zip

ERG. 2014b. Specified Oil & Gas Well Activities Emissions Inventory Update: Final Report. Eastern Research Group, Inc. Prepared for the Texas Commission on Environmental Quality. August. https://www.tceq.texas.gov/assets/public/implementation/air/am/contracts/reports/ei/5821199776FY1426-20140801-erg-oil_gas_ei_update.pdf

OKDEQ, 2016. Oklahoma Department of Environmental Quality Response to Comments on Docket ID No. EPA–HQ-OAR-2015-0500. Provided by Thomas Richardson. Oklahoma Department of Environmental Quality, Air Quality Division. April 1, 2016.

TCEQ, 2014. 2014 Five-year Regional Haze State Implementation Plan Revision.

Appendix A

Oil and gas GHG to CAP Ratios for Venting and Loss Sources

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Table A1. Oil and gas GHG to CAP ratios for venting and loss sources.

Type	Basin	GHG Weight Fractions Ratio to VOC		
		CO_2	CH_4	N_2O
Kansas				
Gas	Anadarko Basin	0.04	4.19	0.00
Gas	Cambridge Arch-Central Kansas Uplift	0.19	15.79	0.00
Gas	Cherokee Platform	6.24	335.86	0.00
Gas	Forest City Basin	0.30	32.01	0.00
Gas	Nemaha Uplift	0.03	3.02	0.00
Gas	Salina Basin	0.25	19.07	0.00
Gas	Sedgwick Basin	0.02	4.13	0.00
Oil	Anadarko Basin	0.26	4.01	0.00
Oil	Cambridge Arch-Central Kansas Uplift	0.01	1.91	0.00
Oil	Cherokee Platform	0.11	1.77	0.00
Oil	Forest City Basin	0.01	2.22	0.00
Oil	Nemaha Uplift	0.01	2.22	0.00
Oil	Salina Basin	0.01	1.91	0.00
Oil	Sedgwick Basin	0.01	2.57	0.00
Condensate Tank	Anadarko Basin	0.00	0.66	0.00
Condensate Tank	Cambridge Arch-Central Kansas Uplift	0.00	0.23	0.00
Condensate Tank	Cherokee Platform	0.00	0.40	0.00
Condensate Tank	Forest City Basin	0.00	0.23	0.00
Condensate Tank	Nemaha Uplift	0.00	0.23	0.00
Condensate Tank	Salina Basin	0.00	0.23	0.00
Condensate Tank	Sedgwick Basin	0.00	0.23	0.00
Crude Tank	Anadarko Basin	0.00	0.01	0.00
Crude Tank	Cambridge Arch-Central Kansas Uplift	0.00	0.14	0.00
Crude Tank	Cherokee Platform	0.00	0.14	0.00
Crude Tank	Forest City Basin	0.00	0.14	0.00
Crude Tank	Nemaha Uplift	0.00	0.14	0.00
Crude Tank	Salina Basin	0.00	0.14	0.00
Crude Tank	Sedgwick Basin	0.00	0.14	0.00
Oklahoma				
Gas	Anadarko Basin	0.03	2.56	0.00
Gas	Arkoma Basin	1.00	25.40	0.00
Gas	Bend Arch-Fort Worth Basin	0.17	4.92	0.00
Gas	Cherokee Platform	0.17	4.92	0.00
Gas	Nemaha Uplift	0.03	5.12	0.00
Gas	Palo Duro Basin	0.17	4.92	0.00
Gas	Southern Oklahoma	0.15	5.51	0.00
Oil	Anadarko Basin	0.26	4.01	0.00
Oil	Arkoma Basin	0.02	0.38	0.00

Type	Basin	GHG Weight Fractions Ratio to VOC		
		CO_2	CH_4	N_2O
Oil	Bend Arch-Fort Worth Basin	0.11	1.77	0.00
Oil	Cherokee Platform	0.11	1.77	0.00
Oil	Nemaha Uplift	0.01	2.22	0.00
Oil	Palo Duro Basin	0.11	1.77	0.00
Oil	Southern Oklahoma	0.07	1.13	0.00
CBM	Anadarko Basin	0.03	2.56	0.00
CBM	Arkoma Basin	1.00	25.40	0.00
CBM	Bend Arch-Fort Worth Basin	0.17	4.92	0.00
CBM	Cherokee Platform	0.17	4.92	0.00
CBM	Nemaha Uplift	0.03	5.12	0.00
CBM	Palo Duro Basin	0.17	4.92	0.00
CBM	Southern Oklahoma	0.15	5.51	0.00
Condensate Tank	Anadarko Basin	0.00	0.66	0.00
Condensate Tank	Arkoma Basin	0.00	1.51	0.00
Condensate Tank	Bend Arch-Fort Worth Basin	0.00	0.40	0.00
Condensate Tank	Cherokee Platform	0.00	0.40	0.00
Condensate Tank	Nemaha Uplift	0.00	0.23	0.00
Condensate Tank	Palo Duro Basin	0.00	0.40	0.00
Condensate Tank	Southern Oklahoma	0.00	0.97	0.00
Crude Tank	Anadarko Basin	0.00	0.01	0.00
Crude Tank	Arkoma Basin	0.00	0.13	0.00
Crude Tank	Bend Arch-Fort Worth Basin	0.00	0.14	0.00
Crude Tank	Cherokee Platform	0.00	0.14	0.00
Crude Tank	Nemaha Uplift	0.00	0.14	0.00
Crude Tank	Palo Duro Basin	0.00	0.14	0.00
Crude Tank	Southern Oklahoma	0.00	0.09	0.00
Texas				
Gas	Anadarko Basin	0.04	3.62	0.00
Gas	Bend Arch-Fort Worth Basin	0.38	10.73	0.00
Gas	East Texas Basin	0.31	8.83	0.00
Gas	Marathon Thrust Belt	0.27	3.42	0.00
Gas	Palo Duro Basin	0.23	6.63	0.00
Gas	Permian Basin	0.27	3.42	0.00
Gas	Western Gulf	0.26	7.34	0.00
Oil	Anadarko Basin	0.12	1.81	0.00
Oil	Bend Arch-Fort Worth Basin	0.09	1.41	0.00
Oil	East Texas Basin	0.09	1.41	0.00
Oil	Marathon Thrust Belt	0.12	1.72	0.00
Oil	Palo Duro Basin	0.09	1.41	0.00
Oil	Permian Basin	0.12	1.68	0.00

Type	Basin	GHG Weight Fractions Ratio to VOC		
		CO_2	CH_4	N_2O
Oil	Western Gulf	0.09	1.41	0.00
CBM	Anadarko Basin	0.04	3.62	0.00
CBM	Bend Arch-Fort Worth Basin	0.38	10.73	0.00
CBM	East Texas Basin	0.31	8.83	0.00
CBM	Marathon Thrust Belt	0.27	3.42	0.00
CBM	Palo Duro Basin	0.23	6.63	0.00
CBM	Permian Basin	0.27	3.42	0.00
CBM	Western Gulf	0.26	7.34	0.00
Condensate Tank	Anadarko Basin	0.00	0.66	0.00
Condensate Tank	Bend Arch-Fort Worth Basin	0.00	0.40	0.00
Condensate Tank	East Texas Basin	0.00	0.40	0.00
Condensate Tank	Marathon Thrust Belt	0.00	0.40	0.00
Condensate Tank	Palo Duro Basin	0.00	0.40	0.00
Condensate Tank	Permian Basin	0.00	0.40	0.00
Condensate Tank	Western Gulf	0.00	0.40	0.00
Crude Tank	Anadarko Basin	0.00	0.01	0.00
Crude Tank	Bend Arch-Fort Worth Basin	0.00	0.14	0.00
Crude Tank	East Texas Basin	0.00	0.14	0.00
Crude Tank	Marathon Thrust Belt	0.00	0.14	0.00
Crude Tank	Palo Duro Basin	0.00	0.14	0.00
Crude Tank	Permian Basin	0.00	0.14	0.00
Crude Tank	Western Gulf	0.00	0.14	0.00

Appendix B

oil and gas Control Factors

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Table B1. Oil and gas control factors.

Location	Source Category	NOX	VOC	CO	SO_2	PM	CO_2	CH_4	N_2O	All HAPs	Applicability
		Percentage Decrease from 2011									
Kansas											
All	Drill rigs	28%	20%	31%	68%	32%	0%	20%	0%	20%	calendar year 2015
All	Drill rigs	55%	36%	61%	72%	61%	0%	36%	0%	36%	calendar year 2020
All	Drill rigs	70%	45%	81%	74%	81%	0%	45%	0%	45%	calendar year 2025
All	Drill rigs	75%	49%	89%	75%	87%	0%	49%	0%	49%	calendar year 2030
All	Hydraulic Fracturing Engines	28%	20%	31%	68%	32%	0%	20%	0%	20%	calendar year 2015
All	Hydraulic Fracturing Engines	55%	36%	61%	72%	61%	0%	36%	0%	36%	calendar year 2020
All	Hydraulic Fracturing Engines	70%	45%	81%	74%	81%	0%	45%	0%	45%	calendar year 2025
All	Hydraulic Fracturing Engines	75%	49%	89%	75%	87%	0%	49%	0%	49%	calendar year 2030
Anadarko Basin	Gas Well Pneumatic Devices	0%	56%	0%	0%	0%	56%	56%	56%	56%	all emissions added after 2011
Cambridge Arch-Central Kansas Uplift	Gas Well Pneumatic Devices	0%	65%	0%	0%	0%	65%	65%	65%	65%	all emissions added after 2011
Cherokee Platform	Gas Well Pneumatic Devices	0%	71%	0%	0%	0%	71%	71%	71%	71%	all emissions added after 2011
Forest City Basin	Gas Well Pneumatic Devices	0%	65%	0%	0%	0%	65%	65%	65%	65%	all emissions added after 2011
Nemaha Uplift	Gas Well Pneumatic Devices	0%	65%	0%	0%	0%	65%	65%	65%	65%	all emissions added after 2011
Salina Basin	Gas Well Pneumatic Devices	0%	65%	0%	0%	0%	65%	65%	65%	65%	all emissions added after 2011
Sedgwick Basin	Gas Well Pneumatic Devices	0%	65%	0%	0%	0%	65%	65%	65%	65%	all emissions added after 2011
Anadarko Basin	Oil Well Pneumatic Devices	0%	43%	0%	0%	0%	43%	43%	43%	43%	all emissions added after 2011
Cambridge Arch-Central Kansas Uplift	Oil Well Pneumatic Devices	0%	17%	0%	0%	0%	17%	17%	17%	17%	all emissions added after 2011
Cherokee Platform	Oil Well Pneumatic Devices	0%	0%	0%	0%	0%	0%	0%	0%	0%	all emissions added after 2011
Forest City Basin	Oil Well Pneumatic Devices	0%	17%	0%	0%	0%	17%	17%	17%	17%	all emissions added after 2011
Nemaha Uplift	Oil Well Pneumatic Devices	0%	17%	0%	0%	0%	17%	17%	17%	17%	all emissions added after 2011
Salina Basin	Oil Well Pneumatic Devices	0%	17%	0%	0%	0%	17%	17%	17%	17%	all emissions added after 2011
Sedgwick Basin	Oil Well Pneumatic Devices	0%	17%	0%	0%	0%	17%	17%	17%	17%	all emissions added after 2011
Anadarko Basin	Artificial Lift	0%	0%	0%	0%	0%	0%	0%	0%	0%	all emissions added after 2011
Cambridge Arch-Central Kansas Uplift	Artificial Lift	0%	0%	0%	0%	0%	0%	0%	0%	0%	all emissions added after 2011
Cherokee Platform	Artificial Lift	68%	-37%	62%	0%	0%	0%	-37%	0%	-37%	all emissions added after 2011
Forest City Basin	Artificial Lift	68%	-37%	62%	0%	0%	0%	-37%	0%	-37%	all emissions added after 2011
Nemaha Uplift	Artificial Lift	68%	-37%	62%	0%	0%	0%	-37%	0%	-37%	all emissions added after 2011
Salina Basin	Artificial Lift	0%	0%	0%	0%	0%	0%	0%	0%	0%	all emissions added after 2011
Sedgwick Basin	Artificial Lift	68%	-37%	62%	0%	0%	0%	-37%	0%	-37%	all emissions added after 2011
Anadarko Basin	Lateral Compressors - Rich Burn	59%	-967%	48%	0%	0%	0%	-967%	0%	-967%	all emissions added after 2011
Cambridge Arch-Central Kansas Uplift	Lateral Compressors - Rich Burn	88%	-552%	84%	0%	0%	0%	-552%	0%	-552%	all emissions added after 2011
Cherokee Platform	Lateral Compressors - Rich Burn	85%	-625%	81%	0%	0%	0%	-625%	0%	-625%	all emissions added after 2011
Forest City Basin	Lateral Compressors - Rich Burn	88%	-552%	84%	0%	0%	0%	-552%	0%	-552%	all emissions added after 2011
Nemaha Uplift	Lateral Compressors - Rich Burn	88%	-552%	84%	0%	0%	0%	-552%	0%	-552%	all emissions added after 2011
Salina Basin	Lateral Compressors - Rich Burn	88%	-552%	84%	0%	0%	0%	-552%	0%	-552%	all emissions added after 2011
Sedgwick Basin	Lateral Compressors - Rich Burn	88%	-552%	84%	0%	0%	0%	-552%	0%	-552%	all emissions added after 2011

Location	Source Category	Percentage Decrease from 2011									Applicability
		NOX	VOC	CO	SO_2	PM	CO_2	CH_4	N_2O	All HAPs	
Anadarko Basin	Lateral Compressors - Lean Burn	13%	66%	-137%	0%	0%	0%	66%	0%	66%	all emissions added after 2011
Cambridge Arch-Central Kansas Uplift	Lateral Compressors - Lean Burn	67%	-64%	1%	0%	0%	0%	-64%	0%	-64%	all emissions added after 2011
Cherokee Platform	Lateral Compressors - Lean Burn	67%	-64%	1%	0%	0%	0%	-64%	0%	-64%	all emissions added after 2011
Forest City Basin	Lateral Compressors - Lean Burn	67%	-64%	1%	0%	0%	0%	-64%	0%	-64%	all emissions added after 2011
Nemaha Uplift	Lateral Compressors - Lean Burn	67%	-64%	1%	0%	0%	0%	-64%	0%	-64%	all emissions added after 2011
Salina Basin	Lateral Compressors - Lean Burn	67%	-64%	1%	0%	0%	0%	-64%	0%	-64%	all emissions added after 2011
Sedgwick Basin	Lateral Compressors - Lean Burn	67%	-64%	1%	0%	0%	0%	-64%	0%	-64%	all emissions added after 2011
Anadarko Basin	Gas Well Completions	100%	0%	100%	0%	100%	0%	0%	100%	0%	all years
Cambridge Arch-Central Kansas Uplift	Gas Well Completions	0%	95%	0%	95%	0%	95%	95%	0%	95%	all years
Cherokee Platform	Gas Well Completions	100%	87%	100%	87%	100%	87%	87%	100%	87%	all years
Forest City Basin	Gas Well Completions	0%	95%	0%	95%	0%	95%	95%	0%	95%	all years
Nemaha Uplift	Gas Well Completions	0%	95%	0%	95%	0%	95%	95%	0%	95%	all years
Salina Basin	Gas Well Completions	0%	95%	0%	95%	0%	95%	95%	0%	95%	all years
Sedgwick Basin	Gas Well Completions	0%	95%	0%	95%	0%	95%	95%	0%	95%	all years
Anadarko Basin	Condensate Tank Venting	0%	89%	0%	0%	0%	0%	89%	0%	89%	all emissions added after 2011
Cambridge Arch-Central Kansas Uplift	Condensate Tank Venting	0%	78%	0%	0%	0%	0%	78%	0%	78%	all emissions added after 2011
Cherokee Platform	Condensate Tank Venting	0%	53%	0%	0%	0%	0%	53%	0%	53%	all emissions added after 2011
Forest City Basin	Condensate Tank Venting	0%	0%	0%	0%	0%	0%	0%	0%	0%	all emissions added after 2011
Nemaha Uplift	Condensate Tank Venting	0%	88%	0%	0%	0%	0%	88%	0%	88%	all emissions added after 2011
Sedgwick Basin	Condensate Tank Venting	0%	87%	0%	0%	0%	0%	87%	0%	87%	all emissions added after 2011
Anadarko Basin	Crude Oil Tank Venting	0%	35%	0%	0%	0%	0%	35%	0%	35%	all emissions added after 2011
Cambridge Arch-Central Kansas Uplift	Crude Oil Tank Venting	0%	5%	0%	0%	0%	0%	5%	0%	5%	all emissions added after 2011
Cherokee Platform	Crude Oil Tank Venting	0%	10%	0%	0%	0%	0%	10%	0%	10%	all emissions added after 2011
Forest City Basin	Crude Oil Tank Venting	0%	0%	0%	0%	0%	0%	0%	0%	0%	all emissions added after 2011
Nemaha Uplift	Crude Oil Tank Venting	0%	9%	0%	0%	0%	0%	9%	0%	9%	all emissions added after 2011
Salina Basin	Crude Oil Tank Venting	0%	0%	0%	0%	0%	0%	0%	0%	0%	all emissions added after 2011
Sedgwick Basin	Crude Oil Tank Venting	0%	0%	0%	0%	0%	0%	0%	0%	0%	all emissions added after 2011
Oklahoma											
All	Drill rigs	28%	20%	31%	68%	32%	0%	20%	0%	20%	calendar year 2015
All	Drill rigs	55%	36%	61%	72%	61%	0%	36%	0%	36%	calendar year 2020
All	Drill rigs	70%	45%	81%	74%	81%	0%	45%	0%	45%	calendar year 2025
All	Drill rigs	75%	49%	89%	75%	87%	0%	49%	0%	49%	calendar year 2030
All	Hydraulic Fracturing Engines	28%	20%	31%	68%	32%	0%	20%	0%	20%	calendar year 2015
All	Hydraulic Fracturing Engines	55%	36%	61%	72%	61%	0%	36%	0%	36%	calendar year 2020
All	Hydraulic Fracturing Engines	70%	45%	81%	74%	81%	0%	45%	0%	45%	calendar year 2025
All	Hydraulic Fracturing Engines	75%	49%	89%	75%	87%	0%	49%	0%	49%	calendar year 2030
Anadarko Basin	Artificial Lift	0%	0%	0%	0%	0%	0%	0%	0%	0%	all emissions added after 2011
Arkoma Basin	Artificial Lift	68%	-37%	62%	0%	0%	0%	-37%	0%	-37%	all emissions added after 2011

Location	Source Category	Percentage Decrease from 2011									Applicability
		NOX	VOC	CO	SO_2	PM	CO_2	CH_4	N_2O	All HAPs	
Bend Arch-Fort Worth Basin	Artificial Lift	0%	0%	0%	0%	0%	0%	0%	0%	0%	all emissions added after 2011
Cherokee Platform	Artificial Lift	68%	-37%	62%	0%	0%	0%	-37%	0%	-37%	all emissions added after 2011
Nemaha Uplift	Artificial Lift	68%	-37%	62%	0%	0%	0%	-37%	0%	-37%	all emissions added after 2011
Palo Duro Basin	Artificial Lift	0%	0%	0%	0%	0%	0%	0%	0%	0%	all emissions added after 2011
Southern Oklahoma	Artificial Lift	0%	0%	0%	0%	0%	0%	0%	0%	0%	all emissions added after 2011
Anadarko Basin	Lateral Compressors - Rich Burn	59%	-967%	48%	0%	0%	0%	-967%	0%	-967%	all emissions added after 2011
Arkoma Basin	Lateral Compressors - Rich Burn	80%	-735%	74%	0%	0%	0%	-735%	0%	-735%	all emissions added after 2011
Bend Arch-Fort Worth Basin	Lateral Compressors - Rich Burn	85%	-625%	81%	0%	0%	0%	-625%	0%	-625%	all emissions added after 2011
Cherokee Platform	Lateral Compressors - Rich Burn	85%	-625%	81%	0%	0%	0%	-625%	0%	-625%	all emissions added after 2011
Nemaha Uplift	Lateral Compressors - Rich Burn	88%	-552%	84%	0%	0%	0%	-552%	0%	-552%	all emissions added after 2011
Palo Duro Basin	Lateral Compressors - Rich Burn	85%	-625%	81%	0%	0%	0%	-625%	0%	-625%	all emissions added after 2011
Southern Oklahoma	Lateral Compressors - Rich Burn	73%	-837%	65%	0%	0%	0%	-837%	0%	-837%	all emissions added after 2011
Anadarko Basin	Lateral Compressors - Lean Burn	13%	66%	-137%	0%	0%	0%	66%	0%	66%	all emissions added after 2011
Arkoma Basin	Lateral Compressors - Lean Burn	67%	-64%	1%	0%	0%	0%	-64%	0%	-64%	all emissions added after 2011
Bend Arch-Fort Worth Basin	Lateral Compressors - Lean Burn	67%	-64%	1%	0%	0%	0%	-64%	0%	-64%	all emissions added after 2011
Cherokee Platform	Lateral Compressors - Lean Burn	67%	-64%	1%	0%	0%	0%	-64%	0%	-64%	all emissions added after 2011
Nemaha Uplift	Lateral Compressors - Lean Burn	67%	-64%	1%	0%	0%	0%	-64%	0%	-64%	all emissions added after 2011
Palo Duro Basin	Lateral Compressors - Lean Burn	67%	-64%	1%	0%	0%	0%	-64%	0%	-64%	all emissions added after 2011
Southern Oklahoma	Lateral Compressors - Lean Burn	67%	-64%	1%	0%	0%	0%	-64%	0%	-64%	all emissions added after 2011
Anadarko Basin	Wellhead Compressors - Rich Burn	59%	-968%	47%	0%	0%	0%	-968%	0%	-968%	all emissions added after 2011
Arkoma Basin	Wellhead Compressors - Rich Burn	80%	-736%	74%	0%	0%	0%	-736%	0%	-736%	all emissions added after 2011
Bend Arch-Fort Worth Basin	Wellhead Compressors - Rich Burn	83%	-671%	78%	0%	0%	0%	-671%	0%	-671%	all emissions added after 2011
Cherokee Platform	Wellhead Compressors - Rich Burn	83%	-671%	78%	0%	0%	0%	-671%	0%	-671%	all emissions added after 2011
Nemaha Uplift	Wellhead Compressors - Rich Burn	88%	-552%	84%	0%	0%	0%	-552%	0%	-552%	all emissions added after 2011
Palo Duro Basin	Wellhead Compressors - Rich Burn	83%	-671%	78%	0%	0%	0%	-671%	0%	-671%	all emissions added after 2011
Southern Oklahoma	Wellhead Compressors - Rich Burn	73%	-838%	65%	0%	0%	0%	-838%	0%	-838%	all emissions added after 2011
Anadarko Basin	Wellhead Compressors - Lean Burn	13%	66%	-137%	0%	0%	0%	66%	0%	66%	all emissions added after 2011
Arkoma Basin	Wellhead Compressors - Lean Burn	67%	-64%	1%	0%	0%	0%	-64%	0%	-64%	all emissions added after 2011
Bend Arch-Fort Worth Basin	Wellhead Compressors - Lean Burn	67%	-64%	1%	0%	0%	0%	-64%	0%	-64%	all emissions added after 2011
Cherokee Platform	Wellhead Compressors - Lean Burn	67%	-64%	1%	0%	0%	0%	-64%	0%	-64%	all emissions added after 2011
Nemaha Uplift	Wellhead Compressors - Lean Burn	13%	66%	-137%	0%	0%	0%	66%	0%	66%	all emissions added after 2011
Palo Duro Basin	Wellhead Compressors - Lean Burn	67%	-64%	1%	0%	0%	0%	-64%	0%	-64%	all emissions added after 2011
Southern Oklahoma	Wellhead Compressors - Lean Burn	67%	-64%	1%	0%	0%	0%	-64%	0%	-64%	all emissions added after 2011
Anadarko Basin	Gas Well Completions	100%	-150%	100%	100%	100%		-150%	100%	-150%	all years
Arkoma Basin	Gas Well Completions	100%	26%	100%	100%	100%		26%	100%	26%	all years
Bend Arch-Fort Worth Basin	Gas Well Completions	100%	87%	100%	100%	100%		87%	100%	87%	all years

Location	Source Category	*Percentage Decrease from 2011*									Applicability
		NOX	VOC	CO	SO_2	PM	CO_2	CH_4	N_2O	All HAPs	
Cherokee Platform	Gas Well Completions	100%	87%	100%	100%	100%		87%	100%	87%	all years
Nemaha Uplift	Gas Well Completions	0%	95%	0%	0%	0%		95%	0%	95%	all years
Palo Duro Basin	Gas Well Completions	100%	87%	100%	100%	100%		87%	100%	87%	all years
Southern Oklahoma	Gas Well Completions	100%	26%	100%	100%	100%		26%	100%	26%	all years
Anadarko Basin	Condensate Tank Venting	0%	77%	0%	0%	0%	0%	77%	0%	77%	all emissions added after 2011
Cherokee Platform	Condensate Tank Venting	0%	79%	0%	0%	0%	0%	79%	0%	79%	all emissions added after 2011
Nemaha Uplift	Condensate Tank Venting	0%	87%	0%	0%	0%	0%	87%	0%	87%	all emissions added after 2011
Arkoma Basin	Condensate Tank Venting	0%	22%	0%	0%	0%	0%	22%	0%	22%	all emissions added after 2011
Southern Oklahoma	Condensate Tank Venting	0%	77%	0%	0%	0%	0%	77%	0%	77%	all emissions added after 2011
Palo Duro Basin	Condensate Tank Venting	0%	90%	0%	0%	0%	0%	90%	0%	90%	all emissions added after 2011
Anadarko Basin	Crude Oil Tank Venting	0%	59%	0%	0%	0%	0%	59%	0%	59%	all emissions added after 2011
Cherokee Platform	Crude Oil Tank Venting	0%	34%	0%	0%	0%	0%	34%	0%	34%	all emissions added after 2011
Nemaha Uplift	Crude Oil Tank Venting	0%	21%	0%	0%	0%	0%	21%	0%	21%	all emissions added after 2011
Arkoma Basin	Crude Oil Tank Venting	0%	79%	0%	0%	0%	0%	79%	0%	79%	all emissions added after 2011
Southern Oklahoma	Crude Oil Tank Venting	0%	74%	0%	0%	0%	0%	74%	0%	74%	all emissions added after 2011
Palo Duro Basin	Crude Oil Tank Venting	0%	0%	0%	0%	0%	0%	0%	0%	0%	all emissions added after 2011
Bend Arch-Fort Worth Basin	Crude Oil Tank Venting	0%	48%	0%	0%	0%	0%	48%	0%	48%	all emissions added after 2011
Texas											
All	Drill rigs	28%	20%	31%	68%	32%	0%	20%	0%	20%	calendar year 2015
All	Drill rigs	55%	36%	61%	72%	61%	0%	36%	0%	36%	calendar year 2020
All	Drill rigs	70%	45%	81%	74%	81%	0%	45%	0%	45%	calendar year 2025
All	Drill rigs	75%	49%	89%	75%	87%	0%	49%	0%	49%	calendar year 2030
All	Hydraulic Fracturing Engines	28%	20%	31%	68%	32%	0%	20%	0%	20%	calendar year 2015
All	Hydraulic Fracturing Engines	55%	36%	61%	72%	61%	0%	36%	0%	36%	calendar year 2020
All	Hydraulic Fracturing Engines	70%	45%	81%	74%	81%	0%	45%	0%	45%	calendar year 2025
All	Hydraulic Fracturing Engines	75%	49%	89%	75%	87%	0%	49%	0%	49%	calendar year 2030
All	Artificial Lift	35%	0%	-820%	0%	0%	0%	0%	0%	0%	all emissions added after 2011
All	Artificial Lift	35%	0%	-820%	0%	0%	0%	0%	0%	0%	all emissions added after 2011
All	Artificial Lift	35%	0%	-820%	0%	0%	0%	0%	0%	0%	all emissions added after 2011
All	Artificial Lift	35%	0%	-820%	0%	0%	0%	0%	0%	0%	all emissions added after 2011
Anadarko Basin	Gas Well Pneumatic Devices	0%	77%	0%	0%	0%	77%	77%	77%	77%	all emissions added after 2011
Bend Arch-Fort Worth Basin	Gas Well Pneumatic Devices	0%	77%	0%	0%	0%	77%	77%	77%	77%	all emissions added after 2011
East Texas Basin	Gas Well Pneumatic Devices	0%	77%	0%	0%	0%	77%	77%	77%	77%	all emissions added after 2011
Marathon Thrust Belt	Gas Well Pneumatic Devices	0%	77%	0%	0%	0%	77%	77%	77%	77%	all emissions added after 2011
Palo Duro Basin	Gas Well Pneumatic Devices	0%	77%	0%	0%	0%	77%	77%	77%	77%	all emissions added after 2011
Permian Basin	Gas Well Pneumatic Devices	0%	77%	0%	0%	0%	77%	77%	77%	77%	all emissions added after 2011
Western Gulf	Gas Well Pneumatic Devices	0%	77%	0%	0%	0%	77%	77%	77%	77%	all emissions added after 2011
Anadarko Basin	Oil Well Pneumatic Devices	0%	77%	0%	0%	0%	77%	77%	77%	77%	all emissions added after 2011
Bend Arch-Fort Worth Basin	Oil Well Pneumatic Devices	0%	77%	0%	0%	0%	77%	77%	77%	77%	all emissions added after 2011

Location	Source Category	*Percentage Decrease from 2011*									Applicability
		NOX	VOC	CO	SO_2	PM	CO_2	CH_4	N_2O	All HAPs	
East Texas Basin	Oil Well Pneumatic Devices	0%	77%	0%	0%	0%	77%	77%	77%	77%	all emissions added after 2011
Marathon Thrust Belt	Oil Well Pneumatic Devices	0%	77%	0%	0%	0%	77%	77%	77%	77%	all emissions added after 2011
Palo Duro Basin	Oil Well Pneumatic Devices	0%	77%	0%	0%	0%	77%	77%	77%	77%	all emissions added after 2011
Permian Basin	Oil Well Pneumatic Devices	0%	77%	0%	0%	0%	77%	77%	77%	77%	all emissions added after 2011
Western Gulf	Oil Well Pneumatic Devices	0%	77%	0%	0%	0%	77%	77%	77%	77%	all emissions added after 2011
Anadarko Basin	Condensate Tank Venting	0%	70%	0%	0%	0%	0%	70%	0%	70%	all emissions added after 2011
Bend Arch-Fort Worth Basin	Condensate Tank Venting	0%	70%	0%	0%	0%	0%	70%	0%	70%	all emissions added after 2011
East Texas Basin	Condensate Tank Venting	0%	70%	0%	0%	0%	0%	70%	0%	70%	all emissions added after 2011
Marathon Thrust Belt	Condensate Tank Venting	0%	70%	0%	0%	0%	0%	70%	0%	70%	all emissions added after 2011
Palo Duro Basin	Condensate Tank Venting	0%	70%	0%	0%	0%	0%	70%	0%	70%	all emissions added after 2011
Permian Basin	Condensate Tank Venting	0%	70%	0%	0%	0%	0%	70%	0%	70%	all emissions added after 2011
Western Gulf	Condensate Tank Venting	0%	70%	0%	0%	0%	0%	70%	0%	70%	all emissions added after 2011
Anadarko Basin	Crude Oil Tank Venting	0%	70%	0%	0%	0%	0%	70%	0%	70%	all emissions added after 2011
Bend Arch-Fort Worth Basin	Crude Oil Tank Venting	0%	70%	0%	0%	0%	0%	70%	0%	70%	all emissions added after 2011
East Texas Basin	Crude Oil Tank Venting	0%	70%	0%	0%	0%	0%	70%	0%	70%	all emissions added after 2011
Marathon Thrust Belt	Crude Oil Tank Venting	0%	70%	0%	0%	0%	0%	70%	0%	70%	all emissions added after 2011
Palo Duro Basin	Crude Oil Tank Venting	0%	70%	0%	0%	0%	0%	70%	0%	70%	all emissions added after 2011
Permian Basin	Crude Oil Tank Venting	0%	70%	0%	0%	0%	0%	70%	0%	70%	all emissions added after 2011
Western Gulf	Crude Oil Tank Venting	0%	70%	0%	0%	0%	0%	70%	0%	70%	all emissions added after 2011
Anderson County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Andrews County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Angelina County	Horizontal Gas Well Completions	0%	95%	0%	0%	0%	0%	95%	0%	95%	all years
Aransas County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Archer County	Horizontal Gas Well Completions	0%	95%	0%	0%	0%	0%	95%	0%	95%	all years
Armstrong County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Atascosa County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Austin County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Bailey County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Bandera County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Bastrop County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Baylor County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Bee County	Horizontal Gas Well Completions	0%	68%	0%	0%	0%	0%	68%	0%	68%	all years
Bell County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Bexar County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Blanco County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Borden County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Bosque County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Bowie County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Brazoria County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Brazos County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years

Location	Source Category	*Percentage Decrease from 2011*									Applicability
		NOX	VOC	CO	SO_2	PM	CO_2	CH_4	N_2O	All HAPs	
Brewster County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Briscoe County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Brooks County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Brown County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Burleson County	Horizontal Gas Well Completions	0%	95%	0%	0%	0%	0%	95%	0%	95%	all years
Burnet County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Caldwell County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Calhoun County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Callahan County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Cameron County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Camp County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Carson County	Horizontal Gas Well Completions	0%	95%	0%	0%	0%	0%	95%	0%	95%	all years
Cass County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Castro County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Chambers County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Cherokee County	Horizontal Gas Well Completions	0%	95%	0%	0%	0%	0%	95%	0%	95%	all years
Childress County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Clay County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Cochran County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Coke County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Coleman County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Collin County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Collingsworth County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Colorado County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Comal County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Comanche County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Concho County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Cooke County	Horizontal Gas Well Completions	0%	95%	0%	0%	0%	0%	95%	0%	95%	all years
Coryell County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Cottle County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Crane County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Crockett County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Crosby County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Culberson County	Horizontal Gas Well Completions	0%	95%	0%	0%	0%	0%	95%	0%	95%	all years
Dallam County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Dallas County	Horizontal Gas Well Completions	0%	95%	0%	0%	0%	0%	95%	0%	95%	all years
Dawson County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Deaf Smith County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Delta County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Denton County	Horizontal Gas Well Completions	0%	95%	0%	0%	0%	0%	95%	0%	95%	all years
Dewitt County	Horizontal Gas Well Completions	0%	95%	0%	0%	0%	0%	95%	0%	95%	all years
Dickens County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years

Location	Source Category	Percentage Decrease from 2011									Applicability
		NOX	VOC	CO	SO_2	PM	CO_2	CH_4	N_2O	All HAPs	
Dimmit County	Horizontal Gas Well Completions	0%	95%	0%	0%	0%	0%	95%	0%	95%	all years
Donley County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Duval County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Eastland County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Ector County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Edwards County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Ellis County	Horizontal Gas Well Completions	0%	95%	0%	0%	0%	0%	95%	0%	95%	all years
El Paso County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Erath County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Falls County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Fannin County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Fayette County	Horizontal Gas Well Completions	0%	95%	0%	0%	0%	0%	95%	0%	95%	all years
Fisher County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Floyd County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Foard County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Fort Bend County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Franklin County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Freestone County	Horizontal Gas Well Completions	0%	15%	0%	0%	0%	0%	15%	0%	15%	all years
Frio County	Horizontal Gas Well Completions	0%	95%	0%	0%	0%	0%	95%	0%	95%	all years
Gaines County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Galveston County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Garza County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Gillespie County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Glasscock County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Goliad County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Gonzales County	Horizontal Gas Well Completions	0%	95%	0%	0%	0%	0%	95%	0%	95%	all years
Gray County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Grayson County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Gregg County	Horizontal Gas Well Completions	0%	95%	0%	0%	0%	0%	95%	0%	95%	all years
Grimes County	Horizontal Gas Well Completions	0%	95%	0%	0%	0%	0%	95%	0%	95%	all years
Guadalupe County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Hale County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Hall County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Hamilton County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Hansford County	Horizontal Gas Well Completions	0%	95%	0%	0%	0%	0%	95%	0%	95%	all years
Hardeman County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Hardin County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Harris County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Harrison County	Horizontal Gas Well Completions	0%	91%	0%	0%	0%	0%	91%	0%	91%	all years
Hartley County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Haskell County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Hays County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years

Location	Source Category	Percentage Decrease from 2011									Applicability
		NOX	VOC	CO	SO_2	PM	CO_2	CH_4	N_2O	All HAPs	
Hemphill County	Horizontal Gas Well Completions	0%	94%	0%	0%	0%	0%	94%	0%	94%	all years
Henderson County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Hidalgo County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Hill County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Hockley County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Hood County	Horizontal Gas Well Completions	0%	95%	0%	0%	0%	0%	95%	0%	95%	all years
Hopkins County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Houston County	Horizontal Gas Well Completions	0%	95%	0%	0%	0%	0%	95%	0%	95%	all years
Howard County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Hudspeth County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Hunt County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Hutchinson County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Irion County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Jack County	Horizontal Gas Well Completions	0%	95%	0%	0%	0%	0%	95%	0%	95%	all years
Jackson County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Jasper County	Horizontal Gas Well Completions	0%	63%	0%	0%	0%	0%	63%	0%	63%	all years
Jeff Davis County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Jefferson County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Jim Hogg County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Jim Wells County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Johnson County	Horizontal Gas Well Completions	0%	95%	0%	0%	0%	0%	95%	0%	95%	all years
Jones County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Karnes County	Horizontal Gas Well Completions	0%	95%	0%	0%	0%	0%	95%	0%	95%	all years
Kaufman County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Kendall County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Kenedy County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Kent County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Kerr County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Kimble County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
King County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Kinney County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Kleberg County	Horizontal Gas Well Completions	0%	32%	0%	0%	0%	0%	32%	0%	32%	all years
Knox County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Lamar County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Lamb County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Lampasas County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
La Salle County	Horizontal Gas Well Completions	0%	95%	0%	0%	0%	0%	95%	0%	95%	all years
Lavaca County	Horizontal Gas Well Completions	0%	95%	0%	0%	0%	0%	95%	0%	95%	all years
Lee County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Leon County	Horizontal Gas Well Completions	0%	63%	0%	0%	0%	0%	63%	0%	63%	all years
Liberty County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Limestone County	Horizontal Gas Well Completions	0%	37%	0%	0%	0%	0%	37%	0%	37%	all years

Location	Source Category	Percentage Decrease from 2011									Applicability
		NOX	VOC	CO	SO_2	PM	CO_2	CH_4	N_2O	All HAPs	
Lipscomb County	Horizontal Gas Well Completions	0%	95%	0%	0%	0%	0%	95%	0%	95%	all years
Live Oak County	Horizontal Gas Well Completions	0%	88%	0%	0%	0%	0%	88%	0%	88%	all years
Llano County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Loving County	Horizontal Gas Well Completions	0%	95%	0%	0%	0%	0%	95%	0%	95%	all years
Lubbock County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Lynn County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Mcculloch County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Mclennan County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Mcmullen County	Horizontal Gas Well Completions	0%	95%	0%	0%	0%	0%	95%	0%	95%	all years
Madison County	Horizontal Gas Well Completions	0%	95%	0%	0%	0%	0%	95%	0%	95%	all years
Marion County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Martin County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Mason County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Matagorda County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Maverick County	Horizontal Gas Well Completions	0%	95%	0%	0%	0%	0%	95%	0%	95%	all years
Medina County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Menard County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Midland County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Milam County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Mills County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Mitchell County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Montague County	Horizontal Gas Well Completions	0%	95%	0%	0%	0%	0%	95%	0%	95%	all years
Montgomery County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Moore County	Horizontal Gas Well Completions	0%	95%	0%	0%	0%	0%	95%	0%	95%	all years
Morris County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Motley County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Nacogdoches County	Horizontal Gas Well Completions	0%	95%	0%	0%	0%	0%	95%	0%	95%	all years
Navarro County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Newton County	Horizontal Gas Well Completions	0%	68%	0%	0%	0%	0%	68%	0%	68%	all years
Nolan County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Nueces County	Horizontal Gas Well Completions	0%	68%	0%	0%	0%	0%	68%	0%	68%	all years
Ochiltree County	Horizontal Gas Well Completions	0%	95%	0%	0%	0%	0%	95%	0%	95%	all years
Oldham County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Orange County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Palo Pinto County	Horizontal Gas Well Completions	0%	68%	0%	0%	0%	0%	68%	0%	68%	all years
Panola County	Horizontal Gas Well Completions	0%	69%	0%	0%	0%	0%	69%	0%	69%	all years
Parker County	Horizontal Gas Well Completions	0%	95%	0%	0%	0%	0%	95%	0%	95%	all years
Parmer County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Pecos County	Horizontal Gas Well Completions	0%	95%	0%	0%	0%	0%	95%	0%	95%	all years
Polk County	Horizontal Gas Well Completions	0%	95%	0%	0%	0%	0%	95%	0%	95%	all years
Potter County	Horizontal Gas Well Completions	0%	95%	0%	0%	0%	0%	95%	0%	95%	all years
Presidio County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years

Location	Source Category	Percentage Decrease from 2011									Applicability
		NOX	VOC	CO	SO_2	PM	CO_2	CH_4	N_2O	All HAPs	
Rains County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Randall County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Reagan County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Real County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Red River County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Reeves County	Horizontal Gas Well Completions	0%	95%	0%	0%	0%	0%	95%	0%	95%	all years
Refugio County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Roberts County	Horizontal Gas Well Completions	0%	95%	0%	0%	0%	0%	95%	0%	95%	all years
Robertson County	Horizontal Gas Well Completions	0%	13%	0%	0%	0%	0%	13%	0%	13%	all years
Rockwall County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Runnels County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Rusk County	Horizontal Gas Well Completions	0%	95%	0%	0%	0%	0%	95%	0%	95%	all years
Sabine County	Horizontal Gas Well Completions	0%	95%	0%	0%	0%	0%	95%	0%	95%	all years
San Augustine County	Horizontal Gas Well Completions	0%	95%	0%	0%	0%	0%	95%	0%	95%	all years
San Jacinto County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
San Patricio County	Horizontal Gas Well Completions	0%	32%	0%	0%	0%	0%	32%	0%	32%	all years
San Saba County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Schleicher County	Horizontal Gas Well Completions	0%	95%	0%	0%	0%	0%	95%	0%	95%	all years
Scurry County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Shackelford County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Shelby County	Horizontal Gas Well Completions	0%	92%	0%	0%	0%	0%	92%	0%	92%	all years
Sherman County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Smith County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Somervell County	Horizontal Gas Well Completions	0%	95%	0%	0%	0%	0%	95%	0%	95%	all years
Starr County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Stephens County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Sterling County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Stonewall County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Sutton County	Horizontal Gas Well Completions	0%	95%	0%	0%	0%	0%	95%	0%	95%	all years
Swisher County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Tarrant County	Horizontal Gas Well Completions	0%	95%	0%	0%	0%	0%	95%	0%	95%	all years
Taylor County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Terrell County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Terry County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Throckmorton County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Titus County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Tom Green County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Travis County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Trinity County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Tyler County	Horizontal Gas Well Completions	0%	95%	0%	0%	0%	0%	95%	0%	95%	all years
Upshur County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Upton County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years

Location	Source Category	Percentage Decrease from 2011									Applicability
		NOX	VOC	CO	SO_2	PM	CO_2	CH_4	N_2O	All HAPs	
Uvalde County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Val Verde County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Van Zandt County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Victoria County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Walker County	Horizontal Gas Well Completions	0%	95%	0%	0%	0%	0%	95%	0%	95%	all years
Waller County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Ward County	Horizontal Gas Well Completions	0%	95%	0%	0%	0%	0%	95%	0%	95%	all years
Washington County	Horizontal Gas Well Completions	0%	95%	0%	0%	0%	0%	95%	0%	95%	all years
Webb County	Horizontal Gas Well Completions	0%	92%	0%	0%	0%	0%	92%	0%	92%	all years
Wharton County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Wheeler County	Horizontal Gas Well Completions	0%	94%	0%	0%	0%	0%	94%	0%	94%	all years
Wichita County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Wilbarger County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Willacy County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Williamson County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Wilson County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Winkler County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Wise County	Horizontal Gas Well Completions	0%	95%	0%	0%	0%	0%	95%	0%	95%	all years
Wood County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Yoakum County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Young County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years
Zapata County	Horizontal Gas Well Completions	0%	32%	0%	0%	0%	0%	32%	0%	32%	all years
Zavala County	Horizontal Gas Well Completions	0%	0%	0%	0%	0%	0%	0%	0%	0%	all years

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May 11, 2016

MEMORANDUM (ADDENDUM)

To:	Craig Nicholls, BLM
From:	John Grant, Krish Vijayaraghavan, Ralph Morris, Ramboll Environ
CC:	Amy Cordle, Holly Prohaska, David Batts, EMPSi
Subject:	Year 2030 Emissions Inventory for Kansas, Oklahoma, and Texas Oil and Gas and Mining Sector Emissions for Air Quality Modeling

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Annual emission inventories for 2011, 2015, 2020, 2025, and 2030 from oil and gas and mining sectors were developed as described in the inventory memorandum[1]. Emission inventories in the inventory memorandum were developed in early 2015 (with limited revisions in 2016) based on base year emissions and future growth and control estimates available in early 2015. In this addendum we update the 2030 oil and gas emissions inventory to be used in air quality modeling; updates were not made to any other emission inventory year. The revised 2030 modeling inventory utilizes oil and gas growth forecasts for private/state fee mineral estate based on forecasts available from the Energy Information Administration (EIA) 2015 Annual Energy Outlook (AEO)[2] that account for the summer 2014 downturn in oil prices. The previous oil and gas growth forecasts relied on the 2014 AEO, which was estimated prior to the oil price downturn. Federal and Indian mineral estimate growth factors have not been updated to be consistent with Bureau of Land Management (BLM) Reasonable Foreseeable Development (RFD) estimates for the Oklahoma, Kansas, and Texas Joint Environmental Impact Statement (EIS) and BLM Resource Management Plan (RMP)/BIA Integrated RMP, which are based on 2014 AEO growth factors.

Growth Factor Update

Oil and gas activity growth factors (see Table 1) for the 2030 modeling emission inventory were taken from AEO 2015 oil and gas reference case forecasts. The 2015 AEO forecasts were applied by Oil and Gas Supply Region (see Figure 1); Kansas and Oklahoma both are within the Midcontinent region, while Texas lies within the Gulf Coast, Midcontinent, and Southwest regions. The oil and gas activity growth factors applied to the emission inventories described in the inventory memorandum[1] were taken from the 2014 AEO; singular nationwide estimates were used. Relative to the 2014 AEO crude oil forecasts, the 2015 AEO Midcontinent region forecasts were lower and the AEO 2015 Gulf Coast and Southwest region forecasts were higher. For natural gas, all regions showed lower growth

[1] Memorandum: Kansas, Oklahoma, and Texas Oil and Gas and Mining Sector Emissions. To: Craig Nicholls (BLM), From John Grant, Rajashi Parikh, Krish Vijayaraghavan, Ralph Morris (Ramboll Environ). May 11, 2016.
[2] 2015 Annual Energy Outlook. Energy Information Administration. April 14, 2015. (http://www.eia.gov/forecasts/aeo/pdf/0383(2015).pdf)

in the 2015 AEO relative to the 2014 AEO, with the Midcontinent region showing the largest decrease.

Table 1. Oil and gas activity growth forecasts for 2030 relative to base year 2011.

Area	2011 to 2030 Oil and gas Growth Factors	
	Crude Oil	Natural Gas
2015 AEO (basis of oil and gas growth forecasts in the 2030 modeling emission inventory)		
Gulf Coast[a]	2.11	1.38
Midcontinent[a]	1.34	0.69
Southwest[a]	2.10	1.21
2014 AEO (basis of oil and gas growth forecasts in the previous 2030 emission inventory[1])		
National[b]	1.45	1.50

[a] Applied consistent with EIA Oil and Gas Supply Regions
[b] Applied to all states

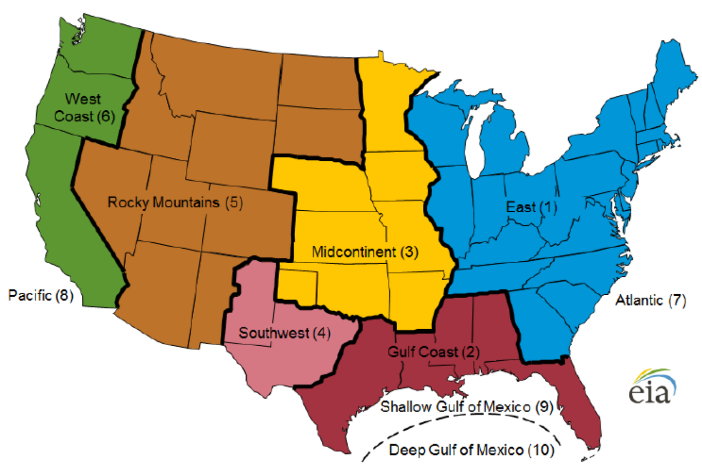

Figure 1. Energy Information Administration Annual Energy Outlook Oil and Gas Supply Module Regions[3].

2030 Emission Inventory Updates

Table 2, Table 3, and Table 4 show state-wide 2030 oil and gas emissions by mineral designation for Kansas, Oklahoma, and Texas, respectively. Federal and Indian 2030 oil and gas emissions remain unchanged from the previous memorandum in all three states. Private/state fee oil and gas emissions decreased by 22% to 42% in Kansas, consistent with decreases in Kansas oil and gas growth factors as described above. Private/state fee oil and gas emissions decreased by 39% to 52% in Oklahoma. Private/state fee oil and gas emissions are forecast in Kansas and Oklahoma based on

[3] Source: Figure 8 of EIA AEO 2015 Oil and Gas Supply Module Description (http://www.eia.gov/forecasts/aeo/assumptions/pdf/oilgas.pdf)

the same Midcontinent region growth factors; there are larger decreases in emissions for Oklahoma relative to Kansas because a greater fraction of emissions in Oklahoma are from sources forecast based on a natural gas (0.69 growth factor) rather than a crude oil (1.34 growth factor) growth factor. Private/state fee emissions forecasts in Texas were estimated based on three separate sets of growth factors representing each of the three Oil and Gas Supply Model Regions in Texas (see Figure 1). Emissions changes from the previous inventory varied from -14% to 51% by pollutant due to differences in the geographical distribution of each pollutant's emissions by Oil and Gas Supply Region.

Table 2. Comparison of Kansas 2030 modeling emission inventory to estimates from the reference memorandum[1].

Designation	Emissions (tons per year; tpy)					
	NOx	VOC	CO	PM_{10}	$PM_{2.5}$	SO_2
2030 Modeling Emission Inventory Estimates						
Federal	1,012	706	956	32	32	1
Private/state fee	73,441	102,809	73,638	1,781	1,776	207
Indian	0	0	0	0	0	0
Totals	**74,453**	**103,514**	**74,595**	**1,814**	**1,808**	**208**
Previous 2030 Emission Inventory Estimates[1]						
Federal	1,012	706	956	32	32	1
Private/state fee	121,758	132,527	110,134	3,048	3,036	293
Indian	0	0	0	0	0	0
Totals	**122,770**	**133,232**	**111,091**	**3,081**	**3,068**	**294**
Percent Difference						
Federal	0%	0%	0%	0%	0%	0%
Private/state fee	-40%	-22%	-33%	-42%	-42%	-29%
Indian	0%	0%	0%	0%	0%	0%
Totals	**-39%**	**-22%**	**-33%**	**-41%**	**-41%**	**-29%**

Table 3. Comparison of Oklahoma 2030 modeling emission inventory to estimates from the reference memorandum[1].

Designation	Emissions (tpy)					
	NOx	VOC	CO	PM_{10}	$PM_{2.5}$	SO_2
2030 Modeling Emission Inventory Estimates						
Federal	797	1,260	775	26	26	4
Private/state fee	88,249	170,537	86,959	2,402	2,400	648
Osage	2,851	8,210	3,466	76	76	6
Indian (except Osage)	2,273	4,247	2,359	69	69	9
Totals	**94,170**	**184,255**	**93,558**	**2,573**	**2,572**	**667**
Previous 2030 Emission Inventory Estimates[1]						
Federal	797	1,260	775	26	26	4
Private/state fee	169,163	280,662	161,817	4,874	4,871	1,356
Osage	2,851	8,210	3,466	76	76	6
Indian (except Osage)	2,273	4,247	2,359	69	69	9
Totals	**175,084**	**294,380**	**168,416**	**5,045**	**5,043**	**1,375**
Percent Difference						
Federal	0%	0%	0%	0%	0%	0%
Private/state fee	-48%	-39%	-46%	-51%	-51%	-52%
Osage	0%	0%	0%	0%	0%	0%
Indian (except Osage)	0%	0%	0%	0%	0%	0%
Totals	**-46%**	**-37%**	**-44%**	**-49%**	**-49%**	**-52%**

Table 4. Comparison of Texas 2030 modeling emission inventory to estimates from the reference memorandum[1].

Designation	Emissions (tpy)					
	NOx	VOC	CO	PM_{10}	$PM_{2.5}$	SO_2
2030 Modeling Emission Inventory Estimates						
Federal	930	1,901	664	14	14	15
Private/state fee	302,230	1,442,351	589,981	6,506	6,465	28,996
Indian	47	293	36	1	1	2
Totals	**303,207**	**1,444,544**	**590,681**	**6,521**	**6,480**	**29,012**
Previous 2030 Emission Inventory Estimates[1]						
Federal	930	1,901	664	14	14	15
Private/state fee	349,865	1,277,439	391,741	7,395	7,338	27,330
Indian	47	293	36	1	1	2
Totals	**350,842**	**1,279,632**	**392,441**	**7,411**	**7,353**	**27,347**
Percent Difference						
Federal	0%	0%	0%	0%	0%	0%
Private/state fee	-14%	13%	51%	-12%	-12%	6%
Indian	0%	0%	0%	0%	0%	0%
Totals	**-14%**	**13%**	**51%**	**-12%**	**-12%**	**6%**