Draft Environmental Assessment

Western Farmers Electric Cooperative
Anadarko Power Plant Combustion Turbine Project

Caddo County, Oklahoma

U.S. Department of Agriculture
Rural Utilities Service (RUS)

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ANADARKO COMBUSTION TURBINE PROJECT
ENVIRONMENTAL ASSESSMENT

Prepared for

United States Department of Agriculture
Rural Utilities Service
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Washington, DC 20250

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ACRONYMS AND ABBREVIATIONS

Acronym/Abbreviation	**Definition**
AAFB	Altus Air Force Base
ADW	Animal Diversity Web
APE	Area of Potential influence
agl	Above ground level
AQD	Air Quality Division
BACT	Best Available Control Technology
BAE	Baseline Actual Emissions
BGEPA	Bald and Golden Eagle Protection Act
BIA	Bureau of Indian Affairs
BLM	Bureau of Land Management
BMP	Best Management Practice
Btu	British Thermal Unit
CAA	Clean Air Act
CEC	Civil & Environmental Consultants
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CH_2O	Formaldehyde
CH_4	Methane
CO	Carbon Monoxide
CO_2	Carbon dioxide
CO_2e	Carbon dioxide equivalent
dBa	Decibel
DFW	Dallas-Fort Worth
DOE	Department of Energy
EA	Environmental Assessment
EDA	Economic Development Administration
EIA	U.S. Energy Information Administration
EIS	Environmental Impact Statement

Draft Environmental Assessment

Acronym/Abbreviation	**Definition**
EO	Executive Order
FEMA	Federal Emergency Management Agency
FIC	Farmland Information Center
FONSI	Finding of No Significant Impact
FPPA	Farmland Protection Policy Act
GE	General Electric
GHG	Greenhouse Gas
GSU	Generator step-up
G&T	Generation and Transmission
HAP	Hazardous Air Pollutant
HHV	Higher Heating Value
HRSG	Heat recovery steam generator
IPaC	Information, Planning, and Consultation
IRP	Integrated Resource Plan
IWG	Interagency Working Group
kW	Kilowatt
kWh	Kilowatt-hour
kV	Kilovolt
Ldn	Day-night average sound level
LHV	Lower heating value
LRE	Load Responsible Entities
MBTA	Migratory Bird Treaty Act
MGD	Millions of gallons per day
MW	Megawatt
MWe	Megawatt electric
N_2O	Nitrous Oxide
NAAQS	National Ambient Air Quality Standard
NASA	National Aeronautics and Space Administration
NCSL	National Council of State Legislatures
NEPA	National Environmental Policy Act
NESHAP	National Emissions Standard for Hazardous Air Pollutants
NFHL	National Flood Hazard Layer

Acronym/Abbreviation	**Definition**
NGCC	Natural Gas-Fired Combined-Cycle
NIEHS	National Institute of Environmental Health Sciences
NO_x	Nitrogen Oxides
NPS	National Parks Service
NREL	National Renewable Energy Laboratory
NSPS	New Source Performance Standards
NWI	National Wetlands Inventory
NWSRS	National Wild and Scenic River System
O_3	Ozone
OBIS	Oklahoma Biodiversity Information System
ODEQ	Oklahoma Department of Environmental Quality
ODOT	Oklahoma Department of Transportation
OK	Oklahoma
OKDAFF	Oklahoma Department of Agriculture, Forestry, and Food
OkIPC	Oklahoma Invasive Plant Council
O&M	Operating and Maintenance
OPDES	Oklahoma Pollutant Discharge Elimination System
OSU	Oklahoma State University
Pb	Lead
PM	Particulate Matter
PPE	Personal Protective Equipment
PRM	Planning Reserve Margin
PSD	Prevention of Significant Deterioration
PV	Photovoltaic
RICE	Reciprocating Internal Combustion Engine
RMI	Rocky Mountain Institute
RMP	Risk Management Plan
RUS	Rural Utilities Service
SCCT	Simple-Cycle Combustion Turbine
SC-GHG	Social Cost of Greenhouse Gas Emissions
SCR	Selective Catalytic Reduction
S&L	Sargent & Lundy, LLC.

Acronym/Abbreviation	**Definition**
SO_2	Sulfur Dioxide
SPP	Southwest Power Pool
TCEQ	Texas Commission on Environmental Quality
™	Trademark
US	United States
USC	US Code
USCB	US Census Bureau
USDA	US Department of Agriculture
USEPA	US Environmental Protection Agency
USFWS	US Fish and Wildlife Service
USGS	United States Geologic Survey
UST	Underground Storage Tank
VOC	Volatile Organic Compound
Western Farmers	Western Farmers Electric Cooperative
WFEC	Western Farmers Electric Cooperative
°F	Fahrenheit

1.0 PURPOSE AND NEED FOR THE PROJECT

Western Farmers Electric Cooperative ("Western Farmers" or "WFEC") is a generation and transmission (G&T) cooperative headquartered in Anadarko, Oklahoma (OK). WFEC provides electric service to 21 member cooperatives, Altus Air Force Base, and other power users. These member cooperatives are located primarily in Oklahoma and New Mexico, with some service areas extending into parts of Texas and Kansas (WFEC, 2022a). WFEC's generating facilities are located in Anadarko, Mooreland, and Hugo, Oklahoma and Lovington, New Mexico. WFEC owns and maintains more than 3,800 miles of transmission line to more than 330 sub and switch stations.

Western Farmers is proposing to construct two (2) new natural gas-fired simple-cycle combustion turbines at its existing Anadarko Power Plant (the "Combustion Turbine Project" or the "Project"). The new combustion turbines will be installed as replacement generating capacity following the retirement of three less efficient gas-fired boilers. WFEC intends to request financing for the Project from the U.S. Department of Agriculture (USDA) Rural Utilities Service (RUS) under the RUS Electric Loan Program. Under the Rural Electrification Act, as amended, the Secretary of Agriculture is authorized and empowered to make loans to nonprofit cooperatives and others for rural electrification "for the purpose of financing the construction and operation of generating plants, electric transmission and distribution lines, or systems for the furnishing and improving of electric service to persons in rural areas" (7 U.S. Code [USC] § 904). A primary function of RUS is to implement the loan program (7 USC § 6942). RUS funding of the Project represents a federal action subject to review under the National Environmental Policy Act (NEPA) of 1969.

WFEC prepared this Environmental Assessment (EA) to support RUS's NEPA review of the Combustion Turbine Project. The purpose of the EA is to identify and assess potential direct, indirect, and cumulative effects of building and operating the Project. The EA was prepared in accordance with NEPA implementing regulations at 40 Code of Federal Regulations (CFR) 1500–1508 and RUS's NEPA guidance at 7 CFR Part 1970-Subpart C – *NEPA Environmental Assessments*. The purpose of the EA is to inform the RUS of any significant effects to environmental and social resources in its review of the Project, and its decision to issue a Finding of No Significant Impact (FONSI) or require preparation of an Environmental Impact Statement (EIS).

This EA was prepared in accordance with 40 CFR Parts 1500-1508 and 7 CFR Part 1794. In addition, this EA addresses, as applicable, other environmental laws, regulations, and executive orders promulgated to protect and enhance environmental quality. Environmental laws, statutes, and regulations of particular relevance in preparation of this EA include:

- National Environmental Policy Act (42 U.S.C. §4321 et seq.)
- Endangered Species Act of 1973 (16 U.S.C §1531 et seq.)
- Migratory Bird Treaty Act of 1918 (16 U.S,C, §703-712)

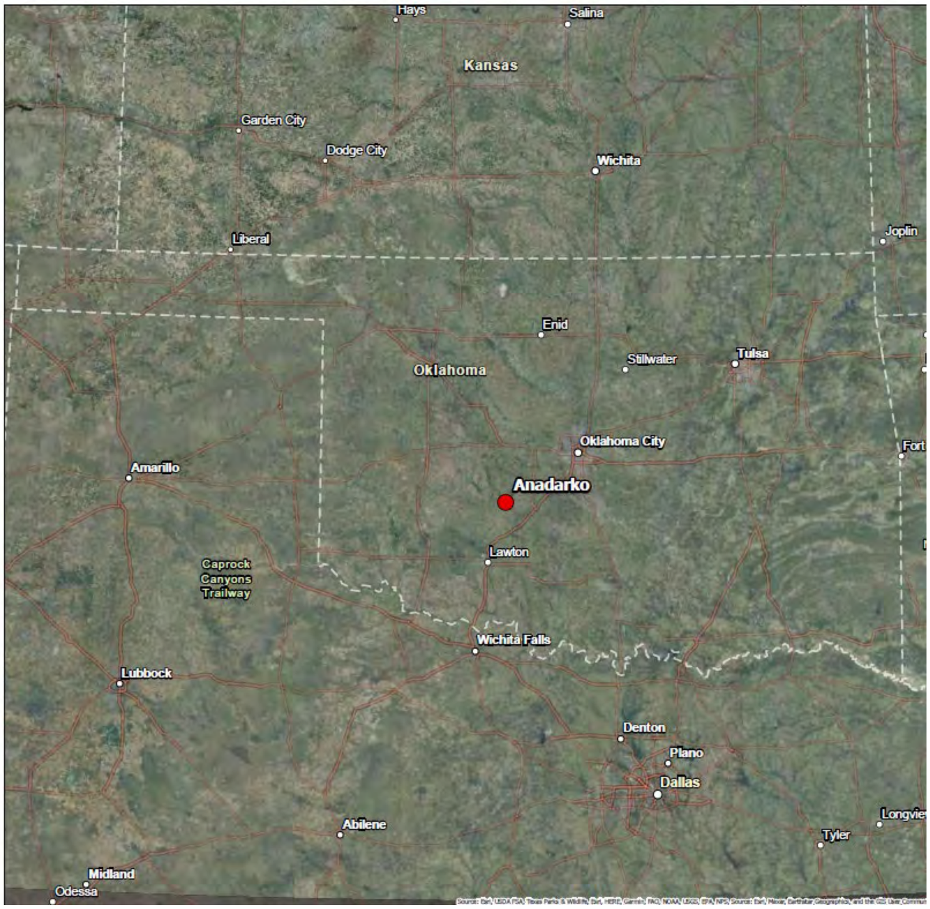
- National Historic Preservation Act (16 U.S.C. §470)
- Clean Air Act of 1977 (43 U.S.C. §7401 et seq.)
- Clean Water Act of 1977 (33 U.S.C. §1251 et seq.)
- Archaeological Resources Protection Act of 1979 (16 U.S.C. §470)
- Native American Graves Protection and Repatriation Act of 1990 (25 U.S.C. §3001–3013)
- Farmland Protection Policy Act (7 U.S.C. §4201 et seq).

Chapter 1 of the EA describes the purpose of and need for the proposed Project, applicable laws and regulations, and the agency decision to be made. Chapter 2 describes alternatives to the proposed action that were evaluated, including the no action alternative, and describes the proposed action in detail. Chapter 3 describes the affected environment, including environmental, cultural, and social resources, and identifies and evaluates potential effects of the proposed and alternative actions. Chapter 4 evaluates the potential cumulative effects that the proposed action and alternatives would have on the affected environment, including the effects of past, present, and reasonably foreseeable future actions. Chapter 5 summarizes all mitigation measures proposed for the proposed action and alternatives. Chapter 6 describes the agency and Tribal consultations that have taken place to date.

1.1 Project Description

WFEC is proposing to install two (2) new natural gas-fired simple-cycle combustion turbines (SCCTs) at its existing Anadarko Power Plant. The proposed Project will be constructed at WFEC's existing Anadarko Power Plant, located on the Washita River in Anadarko, Caddo County, Oklahoma (the "Project Site"). The Anadarko Power Plant occupies approximately 420 acres of land, of which approximately 28.5 acres will be disturbed to construct the Project, including construction of the SCCTs, ancillary equipment, equipment laydown and construction parking. The general location of the Project Site is shown in Figure 1-1 and the proposed site layout of the Project is shown in Figure 1-2.

Figure 1-1. Anadarko Power Plant Location



Source: Esri, USDA FSA, Texas Parks & Wildlife, Esri, HERE, Garmin, FAO, NOAA, USGS, EPA, NPS, Source: Esri, Maxar, Earthstar Geographics, and the GIS User Commun

Figure 1-2: Preliminary Project Layout

As currently planned, the Project will consist of two General Electric (GE) LM6000PC-Sprint SCCTs with a nominal gross generating capacity of 50.2 megawatts (MW) per combustion turbine and a heat rate of approximately 8,947 British Thermal Units (Btu) per gross kilowatt-hour (Btu/kWh-gross). The proposed SCCTs will be designed to burn natural gas exclusively as the primary fuel. Total net output from the SCCTs will be 98.4 MW. An evaporative cooling or wet compression system will be used to increase the efficiency of the combustion turbines. Water injection will be used to reduce the formation of nitrogen oxide (NOx) emissions and an oxidation catalyst system will be used to reduce carbon monoxide (CO) emissions from the combustion turbines.

Fuel for the SCCTs will be provided by the existing natural gas infrastructure at the Anadarko Power Plant. Natural gas is provided to the plant by two suppliers, Enable Oklahoma Intrastate Transmission, LLC and ONEOK. Natural gas will be supplied via the existing natural gas infrastructure at the Anadarko Power Plant with the addition of two (2) new gas compressor stations. No new off-site natural gas pipelines will be constructed as part of the Project, and an adequate supply of natural gas is currently available at the plant as the proposed new SCCT units will replace three less efficient existing gas-fired boilers that are slated for permanent retirement.

A new 0.94-mile transmission line, consisting of a single-circuit 69 kilovolt (kV) line, will be constructed to connect the combustion turbines to the existing 69 kV substation located at the Anadarko Power Plant. The transmission line will travel east from the SCCTs approximately 0.15 miles before turning north following an existing on-site roadway for approximately 0.30 miles, and then back west to the existing substation. The transmission line will be located entirely within the existing boundaries of the Anadarko Power Plant.

The SCCTs will employ inlet chilling and a spray intercooling system to reduce NOx formation and to optimize power output. The Sprint™ spray inter-cooling system for the LM6000 gas turbine injects water into the low- and high-pressure compression inlets which increases mass flow through the combustion turbine resulting in increased output and efficiency of the unit. The system is designed to use an atomized water spray injected through spray nozzles. Injection points are based on turbine inlet temperature and automatically controlled (GE, 2023).

Other equipment that will be installed as part of the Project include two (2) new electric natural gas compressor stations, a closed-loop water chiller or cooling tower to provide chilled water to the inlet air chilling system, and auxiliary electrical systems. Raw water for the Project will be obtained from the Fort Cobb Reservoir located approximately five miles north of Ft. Cobb, Oklahoma. The reservoir currently provides raw water to the Anadarko Power Plant, and existing raw water storage and treatment system will be used to supply water to the new SCCTs. Similarly, wastewater treatment and discharge will be provided by existing operations at the plant. An aqueous ammonia storage tank and ammonia handling system will be included if selective catalytic reduction (SCR) is required for additional NOx control. The SCCT stacks will be approximately 80 feet above ground level (agl) with a diameter of approximately 120 inches.

The proposed Project includes the following major new components:

1. Two LM6000PC Sprint SCCTs
2. Air cooled generator and auxiliary equipment
3. Generator step-up (GSU) and auxiliary transformers
4. Two (2) new electric gas compressors
5. One (1) water chiller (or cooling tower) to support the inlet air chilling system
6. Transmission line to connect the SCCTs to the existing switchyard

The Project will be constructed over a period of approximately 17-months, with construction scheduled to commence in the fall of 2024. The footprint for the construction project, including areas disturbed by site preparation and grading, equipment laydown, temporary offices, and construction parking is approximately

28.5 acres. All construction activities will take place within the existing boundary of the Anadarko Power Plant. Areas potentially impacted by the construction project are shown in Figure 1-2.

1.2 Purpose and Need

1.2.1 Rural Development Mission Statement

USDA, Rural Development is a mission area that includes three federal agencies – Rural Business-Cooperative Service, Rural Housing Service, and Rural Utilities Service. The agencies have in excess of 50 programs that provide financial assistance and a variety of technical and educational assistance to eligible rural and tribal populations, eligible communities, individuals, cooperatives, and other entities with a goal of improving the quality of life, sustainability, infrastructure, economic opportunity, development, and security in rural America. Financial assistance can include direct loans, guaranteed loans, and grants in order to accomplish program objectives.

WFEC intends to request financing for the Project from the U.S. Department of Agriculture (USDA) Rural Utilities Service (RUS) under the RUS Electric Loan Program. Under the Rural Electrification Act, as amended, the Secretary of Agriculture is authorized and empowered to make loans to nonprofit cooperatives and others for rural electrification "for the purpose of financing the construction and operation of generating plants, electric transmission and distribution lines, or systems for the furnishing and improving of electric service to persons in rural areas" (7 U.S. Code [USC] § 904).

1.2.2 Western Farmers Electric Cooperative - Profile

WFEC is a G&T cooperative organized in 1941 that provides electric service to 21 member cooperatives and the Altus Air Force Base. Member cooperatives are primarily located in Oklahoma and New Mexico, with some service areas extending into parts of Texas and Kansas. Today, WFEC's system delivers electricity to an estimated 340,000 consumer meters, serving a member population of approximately 717,000 (WFEC, 2022). WFEC's member cooperatives primarily serve electricity users who live in rural parts of the four-state system. More populous urban and suburban areas of the WFEC service territory are served by municipal or investor-owned electric utilities. WFEC is a member of the Southwest Power Pool (SPP). SPP is a Regional Transmission Organization (RTO) mandated by the Federal Energy Regulatory Commission to ensure reliable supplies of power, adequate transmission infrastructure, and competitive wholesale prices of electricity. WFEC's service territory is depicted in Attachment 1a.

1.2.3 Integrated Resource Planning and Project Need

WFEC is obligated to provide generating capacity that is needed to meet the aggregate member load requirements and satisfy SPP reserve requirements. To inform its decision-making process and identify the need for additional generating resources, WFEC completes and updates an Integrated Resource Plan (IRP) on an annual basis. The IRP planning process evaluates the full range of alternative generating resources, including new generating capacity, power purchase agreements, energy conservation and efficiency, and renewable energy resources to provide reliable service to WFEC's member cooperatives. The IRP process implemented by WFEC is designed to assess demand and supply resources on a consistent and integrated basis and take into account system operating features such as fuel diversity, resource reliability, and dispatchability. The IRP process is designed to leverage annual demand forecasts provided by member cooperatives to optimize resource dispatch and identify the need for new generating resources.

WFEC owns and operates a diverse power generation fleet consisting of six steam and gas turbine power generation sites, five utility-scale solar farms, and 13 community solar farms. WFEC's generating facilities, and nominal generating capacities, include (WFEC, 2022):

• Anadarko Power Plant	Anadarko, OK	3 units (40 MW) gas steam 3 units (289 MW) combined-cycle
o Orme Plant	Anadarko, OK	3 units (142 MW) gas combustion turbine
o Genco Plant	Anadarko, OK	2 units (92 MW) gas combustion turbine
Total Generation at Anadarko		11 units (563 MW total)
• Mooreland Power Plant	Mooreland, OK	3 units (329 MW) gas steam
• Hugo Power Plant	Hugo, OK	1 unit (400 MW) coal
• LCEC Generation Plant	Lovington, NM	5 units (42 MW) gas

WFEC also has a large renewable energy presence, with approximately 956 MW of wind energy from 14 sites, and 53 MW of solar from 21 sites, including both utility-scale, community, and power purchase agreements (WFEC, 2022). Attachment 1b provides a figure depicting WFEC's existing fuel diversity.

Load forecasting prepared as part of the IRP process integrates demand forecasts provided by WFEC's member cooperatives, including projected demand growth and capacity saved through energy efficiency and direct load control programs. Load forecasts, which are updated on an annual basis, are used by WFEC as a basis for dispatch modeling, engineering studies, and financial forecasting. In addition, WFEC closely checks load forecasts against actual demand, including periods of peak demand and SPP Advisories. To ensure adequate capacity during periods of peak demand, SPP requires Load Responsible Entities (LREs) such as WFEC to maintain a Planning Reserve Margin (PRM) of 15 percent (SPP, 2023).

Based on information available from the most recent load forecast and information published by SPP, WFEC member cooperatives forecast 2023 peak demand of 2,083 MW. Excluding 325 MW of internal firm power purchases (which includes reserves) and including the SPP 15% capacity reserve requirement, results in an SPP resource adequacy requirement of 2,021 MW (SPP, 2023). Attachment 1c shows the near-term and long-term load forecast compared to existing and planned generating resources from the 2022 WFEC IRP.

A capacity surplus or deficit is calculated as the difference between existing generating capacity and the total of the demand requirements and required system reserves. WFEC’s IRP shows that WFEC currently has the capacity to respond to the near-term projected peak demand with adequate SPP reserve margins; however, an updated load forecast shows that WFEC needs additional capacity in 2024 which will be covered by a capacity purchase. It is also important to note that the 2022 IRP is based on the assumption that the existing high-pressure steam units at the Anadarko Power Plant (AN-UNIT1R, AN-UNIT2R, and AN-UNIT3, designated as “Anadarko 1-3” in Attachment 1c) will be replaced.

The Anadarko Power Plant generates wholesale electricity which is transmitted over WFEC's electrical distribution system. As described above, the Anadarko facility currently consists of eleven (11) generating units with a total capacity of approximately 563 MW. Two of the three gas-fired high-pressure boilers at the Anadarko Power Plant originally went on-line in 1953, with the third commencing operation in 1958. Two of the units (AN-UNIT2 and AN-UNIT3) were subsequently upgraded in 1997 and 1998. Dispatch of the high-pressure gas-fired boilers has declined significantly over the past several years due to declines in boiler efficiencies and operating and maintenance (O&M) costs. The three high-pressure boilers are currently only used as needed during periods of peak demand and are slated for permanent retirement. The three gas-fired boilers are listed in the facility’s Title V Operating Permit (Permit No. 2015-1968-TVR3(M-4)) with the following generating capacities:

- Three (3) natural gas-fired high-pressure boilers:
    - AN-UNITlR: 15 MW
    - AN-UNIT2R: 15 MW
    - AN-UNIT3: 44 MW

WFEC’s 2022 IRP indicates that WFEC has adequate capacity to respond to member cooperative load requirements with adequate SPP capacity margin when capacity from the three high-pressure steam boilers is included. However, WFEC will have a capacity deficit if this capacity is not replaced. The determination of need for replacement power at the Anadarko Power Plant was established based on near-term load requirements, projected load growth, and SPP capacity reserve requirements. Replacement power is needed at the Anadarko Power Plant to provide reliable capacity with the ability to respond to fluctuations associated with power supplied from renewable resources, as a necessary bridge to support a larger renewables portfolio in the future, and for continued compliance with the SPP capacity reserve requirements. The proposed Project is intended to replace capacity lost due to the retirement of Anadarko 1-3 by providing reliable, cost-effective, and dispatchable replacement power.

2.0 ALTERNATIVES EVALUATED INCLUDING THE PROPOSED ACTION

In order to continue to meet member cooperative load demand and SPP capacity margin requirements, WFEC is proposing to install replacement power at the Anadarko Power Plant. Goals and objectives of the proposed capacity replacement project include the installation of reliable, cost-effective, and dispatchable replacement power with load following capabilities to provide capacity and support the continued utilization of intermittent renewable resources.

2.1 Proposed Action

Based on a review of available options, WFEC determined that two (2) GE LM6000PC Sprint simple-cycle combustion turbines with a nominal generating gross output of approximately 100 MW represented the best fit generating technology for the replacement power project at the Anadarko Power Plant (the "Proposed Action"). The Proposed Action meets all Project goals and objectives, including reliable, cost-effective, dispatchable replacement power. Other equipment expected to be installed as part of the Proposed Action includes two (2) new electric natural gas compressor stations, a closed-loop water chiller or cooling tower to provide chilled water to the inlet air chilling system, auxiliary electrical systems, and construction of a new, on-site transmission line to connect the combustion turbines to the existing on-site 69 kV substation. An aqueous ammonia storage tank and ammonia handling system will be included if SCR is required for additional NOx control.

The Proposed Action will be constructed using standard construction techniques and sequencing. Overall, approximately 28.5 acres of land will be disturbed for construction of the Proposed Action, including installation of the combustion turbines, ancillary equipment, and transmission line, as well as equipment laydown areas and construction parking. All construction activities will occur within the existing boundary of the Anadarko Power Plant.

2.2 Other Alternatives Evaluated

2.2.1 Alternatives Assessment Methodology

Several alternatives for replacement power at the Anadarko Power Plant were considered. Alternatives considered to meet demand and capacity margin requirements following the closure of the three high-pressure boilers included:

a. Load Management
b. Distributed Generation
c. Added Renewable Energy Resources
    a. Wind Generation
    b. Solar Generation
    c. Energy Storage Systems

    d. Biomass Co-firing
    e. Hydrogen Combustion
d. Replacement Fossil-Based Generation
    a. Natural Gas Combined-Cycle
    b. Natural Gas Simple-Cycle Combustion Turbines
    c. Natural Gas Reciprocating Internal Combustion Engines

WFEC evaluated each alternative with respect to the Project goals of providing reliable, cost-effective, and dispatchable replacement power at the Anadarko Power Plant.

2.2.2 Load Management

As an electric power G&T, WFEC's primary purpose is to provide reliable, low-cost wholesale energy to meet the needs of its member cooperatives, including energy requirements during periods of peak demand. Electricity demand during peak times has a direct impact on the available power supply and infrastructure/transmission costs and is consequently more expensive. As such, WFEC's rate structure for power has both a base demand component and peak demand billing component. This type of billing structure encourages member cooperatives to implement cost-effective actions to reduce peak demand during the summer and winter peak seasons.

To support these programs, WFEC has implemented a Peak Days notification program. WFEC issues Peak Day notifications when conditions warrant an increase in energy load. In turn, some of WFEC's member distribution cooperatives have programs to notify their respective members, encouraging them to conserve energy during periods of peak demand. Member cooperatives may encourage voluntary conservation efforts by their customers to help decrease the anticipated loads, typically focused on residential customers. Other cooperatives have more formal programs that appeal directly to commercial and industrial customers, irrigation accounts, and other business entities. These programs, which are driven by a specific rate structure or are directly controlled, also encourage reducing usage during the hottest times of a called Peak Day (WFEC, 2022b).

Load management is an important component of energy management to reduce peak demand. However, current energy conservation measures are often voluntary and may not provide the demand reductions needed to avoid the need for replacement capacity. For example, during the extreme heat of July 2022 and cold blast of Winter Storm Elliott in December 2022, WFEC recorded a summer peak demand of 2,188 MW and an all-time winter peak demand of 2,252 MW, respectively (WFEC, 2022a), and in 2023, WFEC recorded an all-time summer peak demand of 2,200 MW. Nevertheless, one of the primary goals of calling Peak Days is to avoid purchasing high-priced peaking power due to the demand for electricity, as any reduction from a called Peak Day will help reduce capacity requirements. Existing load management programs have effectively reduced demand on called Peak Days, but have not reduced demand to a point where replacement power at the Anadarko Power Plant would not be needed. As such, load management programs alone would not achieve the stated goals and objectives of the proposed Project.

2.2.3 Distributed Generation

Distributed generation refers to a variety of technologies that generate electricity at or near where it will be used. Distributed generation may serve a single structure, such as a home or business, or it may be part of a microgrid, such as at a major industrial facility, a military base, or a large college campus (USEPA, 2023c). Distributed generation systems are often designed for use when the utility supply has been interrupted for relatively short periods of time. Common distributed generation systems include (USEPA, 2023c):

- Solar photovoltaic panels
- Small wind turbines
- Emergency backup generators
- Emergency generators and reciprocating internal combustion engines
- Municipal solid waste incineration

When renewable technologies, such as solar panels and small wind turbines are used, distributed generation can provide environmental benefits by reducing the amount of electricity that must be generated at a centralized power plant. However, distributed generation can also lead to negative environmental impacts. For example, because distributed generation systems require space and are located closer to the end-user, some systems may cause land-use concerns. Distributed generation technologies that involve combustion can produce many of the same types of impacts as larger centralized fossil-fuel-fired power plants, and combustion-based distributed generation systems (e.g., diesel and gas fired generators and engines) may be less efficient than centralized power plants due to efficiencies of scale. Although these impacts may be smaller in scale, they may also be closer to populated areas and sensitive receptors (USEPA, 2023c).

Distributed generation systems can be integrated into the overall power grid to provide source-specific generation. When connected to the electric utility's lower voltage distribution line, using local distributed energy sources can also help support reliable power delivery and reduce electricity losses along transmission and distribution lines. WFEC has integrated distribution generation into its overall system where conditions warrant. For example, WFEC and its member Altus Air Force Base (AAFB) entered into an interactive distributed generation services agreement, which provides full backup electric service to AAFB during outage situations and provides WFEC accredited reserve capacity from SPP. WFEC's community solar farms, ranging from 0.125 MW to 0.250 MW at 13 sites, also qualifies as distributed generation. WFEC will continue to work with its member distribution cooperatives to integrate distributed generation opportunities into the overall system; however, distributed generation systems would not fulfill the proposed Project goals and objectives, primarily because distributed generation systems are typically small (e.g., residential scale generation), typically do not provide baseload or reserve capacity, and are not dispatchable in response to intermittent power generation from renewables. For these reasons, WFEC determined that increased distributed generation is not a viable alternative for replacement power at the Anadarko Power Plant.

2.2.4 Renewable Energy Resources

WFEC's mission is to honorably serve its member distribution cooperatives with reliable, competitively priced energy and related services. As such, absent specific renewable portfolio standards or member-specific requirements, renewable energy resources are incorporated into WFEC's generation mix when they are competitively priced, meet member needs, and as directed by its Board. WFEC has a large renewable energy presence, with some 956 MW of wind energy from 14 sites, 53 MW of solar from 21 sites, including both utility-scale and community-scale projects. Many of the renewable energy resources are available to WFEC from power purchase agreements for wind and solar generation. In addition to those, on September 2022, WFEC authorized a 10-year 100 MW Capacity Purchase Agreement beginning June 1, 2026, to be sourced from multiple wind farms. Renewable resources evaluated to provide replacement power at the Anadarko Power Plant included increased wind and solar opportunities and biomass co-firing.

2.2.4.1 Wind Generation

Given the need for replacement capacity at the Anadarko Power Plant, and the intermittent nature of wind energy, WFEC determined that additional wind capacity would not achieve the Project goals and objectives. Wind generation is intermittent, and although Oklahoma has favorable climate conditions for wind power generation, existing wind resources in the state, including those owned and operated by WFEC, typically achieve annual capacity factors in the range of 35-40% (DOE, 2023a). However, wind generation is not a dispatchable energy resource able to respond to demand fluctuations, which is needed at the Anadarko Power Plant. This limitation was demonstrated in late June, July, and early August of 2022, when Oklahoma experienced an extended period of high temperatures, which included several periods of time when very little renewable energy was available (WFEC, 2022a). During the 2022 summer period, and during Winter Storm Elliot in December 2022, WFEC relied on its fossil fleet to provide baseline generation. Further, to produce 100 MW-gross power would require approximately 5,000 acres of land (i.e., 50 acres per MW) and some 70 wind turbines would be required. Given these limitations, WFEC determined that additional wind generation was not a viable alternative for replacement power at the Anadarko Power Plant.

2.2.4.2 Solar Generation

WFEC owns and operates five (5) utility-scale solar farms and 13 community solar farms in Oklahoma with a total solar generation of 23 MW (WFEC, 2022a). In addition, WFEC has a power purchase agreement (PPA) for 25 MW of solar power with the Caprock Solar Facility, and 30 MW of solar power with the Chaves County Solar II facility, both located in New Mexico. The Caprock Solar Facility, a 25 MW utility-scale photovoltaic (PV) facility, was commissioned in December 2016 and power generated from the facility is sold to WFEC. Chaves County Solar II, a 30 MW PV facility located near Roswell, NM, commenced commercial operation in the Summer of 2023 and power generated from the facility is sold to WFEC. Although Oklahoma and New Mexico have generally favorable climates for solar PV, the average capacity factor of U.S. solar projects operating all 12 months in 2021 was 24.4%, with New Mexico-based utility-scale solar projects averaging a 27.3% capacity factor (EIA, 2023a). It is also worth noting that solar projects have much lower capacity factors in the winter and cannot provide power during winter high load hours at night. Furthermore, like wind energy, solar is intermittent, does not provide baseload capacity, and is not a dispatchable energy resource able to respond to demand fluctuations. Given these limitations, WFEC determined that solar generation was not a viable alternative for replacement power at the Anadarko Power Plant.

2.2.4.3 Energy Storage Systems

WFEC also evaluated the potential of combining renewable resources with energy storage systems to achieve the Project goals and objectives. Energy storage systems are being developed as an alternative to more conventional electric power generating facilities to reduce reliance on fossil-based resources. Five types of energy storage systems are in commercial use in the United States, including pumped-storage hydroelectric; battery energy storage systems (BESS); solar electric with thermal energy storage; compressed-air storage; and flywheels. Other types of energy storage systems, including capacitors and super-conducting magnetic storage, are in various stages of research and development (EIA, 2023b).

BESS would be the only energy storage system available to WFEC. BESS is an electrochemical device that charges (or collects energy) from the grid or a power plant and then discharges that energy at a later time to provide electricity or other grid services when needed. Several battery chemistries are available or under investigation for grid-scale applications, including lithium-ion, lead-acid, redox flow, and molten salt (NERL, 2019). Key characteristics of battery storage systems include the rated power capacity of the battery (i.e., the maximum rate of discharge that the BESS can achieve starting from a fully charged state in kilowatt [kW] or megawatt electric [MWe]); energy capacity (i.e., the maximum amount of stored energy in kilowatt-hours [kWh] or megawatt-hours [MWh]); and storage duration which refers to the amount of time stored energy can be discharged at its power capacity before depleting its energy capacity.

Battery energy storage systems have been designed to provide short-term peaking power during relatively short periods (i.e., 2 to 4 hours) of high demand to off-set the need for increased conventional power generation. Pairing or co-locating BESS with wind or solar energy power plants can allow those power plants to respond to supply requests (i.e., dispatch calls) from electric grid operators when direct generation from renewable resources is not available. BESS also offers “price arbitrage” opportunities by charging the batteries during periods of lower electricity demand and discharging the batteries during higher demand periods.

BESS is an emerging technology that continues to be developed for various electricity grid applications; however, BESS has not been used for extended periods of firm capacity. Based on a review of information available from the U.S. Energy Information Agency (EIA), most commercially deployed BESS have storage durations of two to four hours and are used for short-duration applications such as responding to periods of peak demand (EIA, 2023b). Furthermore, energy storage systems are not primary electricity generation sources in that they must use electricity supplied by a separate generating resource to charge the storage system. As such, energy storage systems use more electricity for charging than they can provide when discharging and supplying electricity.

Based on a review of commercially available BESS technologies, WFEC concluded that BESS, as well as other energy storage systems, are not currently capable of meeting the Project goal of providing reliable and cost-effective replacement capacity at the Anadarko Power Plant. Storage duration and energy capacity limitations preclude BESS from consideration as the duration of energy availability from commercially available BESS would be insufficient to replace the functionality and utility of the natural gas-fired combustion turbines. Furthermore, designing the proposed Project as an energy storage system would fundamentally change the proposed Project. For these reasons, WFEC determined that energy storage systems, including BESS, were not a viable alternative for replacement power at the Anadarko Power Plant.

2.2.4.4 Biomass Co-Firing

Conventional steam electric generation is capable of using biomass fuels to provide some or all of the energy requirements. However, availability of biomass fuels is resource dependent, seasonal, and subject to frequent interruptions and variability in both quality and quantity. As such, biomass resources are generally co-fired with fossil fuels (e.g., coal, oil, or natural gas) to provide a portion of the energy in a steam generating unit. The combustion process in a biomass co-fired unit is typically designed as a circulating fluidized bed or stoker fired unit. The existing steam gas-fired high-pressure boilers at Anadarko, which are scheduled to be retired, would require significant modification and retrofit to support biomass co-firing, and, following conversion, have lower efficiencies than other available combustion processes. Therefore, WFEC determined that biomass co-firing is not a viable alternative for replacement power at the Anadarko Power Plant.

2.2.4.5 Hydrogen Combustion

Hydrogen combustion is being studied as an alternative to natural gas combustion as a method of reducing CO_2 emissions from power generation. On May 23, 2023, the U.S. Environmental Protection Agency (USEPA) published a proposed New Source Performance Standard for GHG emissions from new, modified, and reconstructed fossil fuel-fired electric generating units (the "Proposed GHG Rule").[1] In the Proposed GHG Rule, the USEPA proposed co-firing 30 percent by volume low-GHG hydrogen as the best system of emissions reduction for the control of CO_2 emission from intermediate and base load combustion turbines beginning in 2032.

As part of its rulemaking process, the USEPA evaluated the technical feasibility of hydrogen co-firing in combustion turbine electric generating units (USEPA, 2023d). EPA's Technical Support Document (TSD) included several examples of hydrogen co-firing demonstration projects that have been conducted on utility-sized gas turbines over the past several years, including one example that involved a demonstration test to assess burning various hydrogen/natural gas fuel blends in a nominal 45 MW gas turbine (USEPA, 2023d). The USEPA concluded that co-firing low-GHG hydrogen has been demonstrated as technically feasible for new combustion turbines; however, due to limitations associated with the current availability of hydrogen, as well as hydrogen transportation, distribution, and storage infrastructure limitations, USEPA did not propose implementing the standards until 2032.

Based on a review of available information, WFEC concluded that hydrogen co-firing would not be a technically feasible option available to meet all Project goals and objectives. In addition to hydrogen supply limitations, combusting high volumes of hydrogen is currently limited due to inadequate hydrogen transportation, distribution, and storage infrastructure. A viable hydrogen infrastructure requires that hydrogen be able to be delivered from where it is produced to the point of end use. That infrastructure also must be able to deliver hydrogen to the point of use at the times needed, requiring storage infrastructure. Infrastructure includes the pipelines, liquefaction plants, trucks, storage facilities, compressors, and dispensers involved in the process of delivering the fuel. These limitations, and the fact that building the infrastructure required to support hydrogen co-firing in the power sector will take place on a multi-year time scale, eliminated hydrogen combustion from further consideration.

2.2.5 Replacement Fossil-Based Generation

Natural gas-fired combustion turbine and reciprocating engine generating options were evaluated and determined to be the preferred options available to achieve the Project goals of cost-effective, reliable, dispatchable replacement power at the Anadarko Power Plant. Gas-fired combustion turbines and reciprocating internal combustion engines (RICE) were determined to be cost-effective, efficient, and reliable replacement power options.

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[1] The proposed NSPS published on May 23, 2023, and, as of the date of this submittal, has not been published as a final rule. In fact, in the Proposed GHG Rule the USEPA solicited comment on numerous aspects of the rule, including, but not limited to, the percentage of hydrogen co-firing with natural gas, the availability of low-GHG hydrogen, and the build out of the hydrogen production, distribution, and storage infrastructure. As such, several aspects of the Proposed Rule, and conclusions therein regarding the feasibility and commercial availability of co-firing low-GHG hydrogen may change as USEPA receives and evaluates public comment on the proposed rule.

Gas turbines have been in use for stationary electric power generation for many years, and are available in sizes ranging from 500 kilowatts to more than 300 MW (USEPA, 2015). The most efficient commercial technology for utility-scale power plants is the gas turbine-steam turbine combined-cycle plant that has efficiencies in the range of 60 percent measured at lower heating value (LHV). Simple-cycle gas turbines used in power plants are available with efficiencies of over 40 percent LHV, and have long been used by utilities for peaking capacity. However, with changes in the power industry and advancements in the technology, the gas turbine is now being increasingly used for baseload power (USEPA, 2015). Gas turbines have low emissions compared to other fossil-powered generation technologies. Because of their relatively high efficiency and the reliance on natural gas as a primary fuel, gas turbines emit substantially less carbon dioxide (CO_2) per kilowatt-hour generated than other fossil-based power generating technologies (USEPA, 2015).

Natural gas-fired generation, including natural gas-fired combined-cycle (NGCC), SCCT, and gas-fired RICE were evaluated as alternatives to provide replacement power at the Anadarko Power Plant.

2.2.5.1 Natural Gas Combined-Cycle

NGCC plants include a power block consisting of a simple-cycle combustion turbine in combination with a second steam turbine. Electricity is generated in the gas-fired combustion turbine/generator, and waste heat from the gas turbine exhaust is used to produce steam in a heat recovery steam generator (HRSG). Steam from the HRSG is expanded through a steam turbine generator generating more electricity and increasing the plant’s overall efficiency. The use of both gas and steam turbine cycles in a single plant to produce electricity results in higher conversion efficiencies.

In the electric power generating industry, NGCC units are typically designed as larger, baseload generating units. Based on information available from the EIA, the average size of a NGCC power block installed between 2002 and 2014 was about 500 MW. After 2014, the NGCC power block capacity increased, reaching an average of 820 MW in 2017 (EIA, 2023b). The EIA notes that the general trend toward larger combined-cycle power blocks can largely be explained by the efficiency gains (i.e., lower heat rates measured as MMBtu heat input per kW output) available from larger power blocks, and lower capital costs (on a $/kW basis) for larger units. As an example, the capacity-weighted average heat rate of power blocks less than 500 MW is 6% higher (or less efficient) than that of power blocks larger than 1,000 MW (EIA, 2023c).

In addition to the larger size, the initial capital cost of a NGCC unit is typically greater than that of a similarly sized simple-cycle combustion turbine. Based on EIA information, the capital costs of a nominal 237 MW industrial frame simple-cycle unit is approximately $785/kW compared to $1,201/kW for a 418 MW single-shaft combined-cycle unit. Finally, NGCC units tend to have slower dispatch times than simple-cycle units and do not respond as quickly to demand fluctuations.

Based on a review of available technologies, size, capital costs, annual O&M costs, and dispatchability, WFEC determined that a NGCC unit was not the best fit generating technology available to meet Project goals and provide replacement power at the Anadarko Power Plant.

2.2.5.2 Natural Gas Simple-Cycle

In a simple-cycle combustion turbine, natural gas is generally used to power a combustion turbine that is connected to a generator to produce electricity. The process begins with drawing air through an intake structure, where it is conditioned (i.e., filtered and/or cooled) before entering the combustion turbine. The combustion turbine first compresses the air and then mixes it with natural gas (or other fuel source). The air/fuel mixture is then ignited which causes volumetric expansion. Pressure created by this expansion spins the turbine blades, which are attached to a drive shaft and generator, generating electricity. Simple-cycle combustion turbines differ from NGCC units in that waste heat from the combustion turbine is not supplied to a HRSG and coupled with a steam turbine/generator. Because simple-cycle units use fuel to drive a single turbine, they are less efficient than NGCC units.

Simple-cycle plants have operational flexibility, and can be switched into and out of electricity producing mode, or cycled at varying loads in response to intermittent renewable generation. Because simple-cycle units do not generate steam, simple-cycle units can start quickly to respond to changing demand. Simple-cycle combustion turbine technology typically offers the lowest capital cost of the natural gas-fired generation alternatives. Based on an assessment of technology size, reliability, dispatchability, and costs, WFEC concluded that natural gas-fired simple-cycle combustion turbines capable of producing approximately 100 MW gross output would be an available technology capable of achieving all Project goals and objectives.

2.2.5.3 RICE

RICE are stationary internal combustion engines that use reciprocating motion to convert heat energy into mechanical work to turn a generator. There are two basic types of stationary RICE, spark ignition and compression ignition engines. Spark ignition engines use a spark (across a spark plug) to ignite a compressed fuel-air mixture. Typical fuels for such engines are gasoline and natural gas. Compression ignition engines compress air to a high pressure, heating the air to the ignition temperature of the fuel, which then is injected. The high compression ratio used for compression ignition engines results in a higher efficiency than is possible with spark ignition engines. Diesel fuel oil is normally used in compression ignition engines, although some are dual fueled (natural gas is compressed with the combustion air and diesel oil is injected at the top of the compression stroke to initiate combustion).

RICE have typically been used for backup, standby, or emergency power, but have increasingly been used for larger utility-scale power generation applications, especially in areas with high levels of electricity generation from intermittent sources such as wind and solar (EIA, 2023d). Reciprocating engines tend to be smaller than other types of natural gas-fired electricity generators. Based on information available from EIA, as of 2018, the capacity of the average reciprocating engine generator was 4 MW, compared with 56 MW for natural gas combustion turbines, and 166 MW for combined-cycle units. Before 2010, reciprocating engines typically had no more than 9 MW in capacity, but in recent years, larger units that range from 16 MW to approximately 19 MW have become available.

Like simple-cycle combustion turbines, one advantage of reciprocating engines is their ability to provide incremental electricity quickly. Because these units can start and stop quickly and operate at partial loads, they have become increasingly used in areas with high shares of renewable electricity generation from wind and solar (EIA, 2023d). In addition, reciprocating engines can start up when there is no power available from the grid, which helps electric transmission grid operators to restore power after major storms.

Based on industry publications, utility-sized RICE engines are typically sized to produce approximately 9 MW or 18 MW of power, which means between 6 and 12 engines would be needed to replace the planned centralized generation of approximately 100 MW. RICE engines typically achieve higher efficiencies than simple-cycle combustion turbines; however, capital costs of RICE engines are significantly higher on a $/kW basis than simple-cycle combustion turbines. Nevertheless, based on an assessment of technology size, reliability and dispatchability, WFEC concluded that natural gas-fired RICE engines capable of producing approximately 100 MW gross output would be an available technology capable of achieving all Project goals and objectives.

2.3 Technology Selection

WFEC evaluated a number of gas-fired simple-cycle combustion turbines and RICE options capable of providing approximately 100 MW of net output at full load. Options were evaluated for full load gross and net heat rate (i.e., efficiency), minimum emissions compliant load, startup time and ramp rate, emissions, preliminary capital costs ($/kW), and fixed and variable O&M costs. In addition, available technologies were evaluated based on operating experience and commonality with the existing WFEC generating fleet.

Based on an evaluation of available technologies, WFEC concluded both SCCT and RICE could fulfill the Project goals of providing reliable, efficient, and dispatchable replacement power at the Anadarko Power Plant. Although RICE engines are somewhat more efficient than SCCTs, the capital cost of RICE engines was determined to be approximately 20% higher than a similarly sized SCCT plant. In addition, it was determined that certain emissions from the RICE engines, including carbon monoxide, volatile organic compounds (VOC), and formaldehyde (CH_2O), would likely be higher than the emissions from an SCCT. Finally, generating assets at the Anadarko Power Plant currently include five GE LM6000 Sprint SCCT (Units AN-UNIT7, AN-UNIT8, AN-UNIT9, AN-UNIT10, and AN-UNIT11) with a nominal output of 47 to 50 MW each, and WFEC has experience with the operation and maintenance of this technology.

Based on a comprehensive assessment of gas-fired SCCT and RICE generating technologies, including availability, reliability, dispatchability (i.e., startup time and ramp rate), anticipated emissions, costs, and commonality with the existing WFEC fleet, two (2) GE LM6000PC Sprint simple-cycle combustion turbines with a nominal generating gross output of approximately 100 MW were determined to be the best fit generating technology for the replacement power project at the Anadarko Power Plant.

2.4 Alternative Project Locations

Because the stated objective of the Project is to replace power generation at the Anadarko Power Plant, construction of alternative generating capacity at other locations was not assessed and would not meet the Project goals and objectives. Furthermore, locating the Project at the Anadarko Power Plant provides several advantages. First, electrical infrastructure is already in place and the new combustion turbines can directly tie into the existing 69 kV substation at the Anadarko Power Plant. Second, as noted above, WFEC already operates five GE LM6000 Sprint SCCTs at the Anadarko Power Plant. As such, the generating plant has existing infrastructure for natural gas, raw water treatment, and wastewater treatment and discharge. Construction of the proposed Project at a greenfield site would require significantly more infrastructure and equipment to support operation of the SCCTs. Finally, the Anadarko Power Plant is an existing power generating plant with similar generating technologies (e.g., SCCTs); thus, skilled craft professionals and system operators are already located at the plant. For these reasons, WFEC determined that replacement power at the Anadarko Power Plant was needed, and did not assess alternative locations for the proposed Project as relocating operations would not meet Project goals and objectives.

2.5 No Action Alternative

Under the no action alternative, RUS would not provide financial assistance to WFEC to construct and operate the proposed Project. As a result, WFEC would be required to secure alternative financing for the Project or forego construction of the new generating assets. Following the retirement of Anadarko UNIT1R, UNIT2R, and UNIT3, WFEC would have to seek alternative generating resources and power purchase agreements in order to continue to meet member cooperative demand and SPP margin requirements. The No Action Alternative would result in increased project financing costs which would have an adverse impact on the financial viability of the Project, or require WFEC to pursue higher cost options from alternative generating resources.

3.0 AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

This Chapter provides a description of the existing natural and human resource conditions present in the vicinity of the proposed Project that may be impacted by construction and operation of the proposed action and No Action Alternative. The affected environment and potential environmental consequences of the Project are assessed for the following resources:

- Land Use
- Floodplains
- Wetlands
- Water Resources
- Coastal Resources
- Biological Resources
- Cultural and Historic Resources
- Aesthetics
- Air Quality
- Socioeconomics and Environmental Justice
- Noise
- Transportation
- Human Health and Safety
- Corridors
- Soils

Studies and existing environmental permits issued to the Anadarko Plant were referenced to inform preparation of the EA. Previous environmental studies include an Environmental Impact Analysis Report prepared to assess potential environmental and social impacts associated with the installation of the plant's 280 MW combined-cycle generating unit (Units AN-UNIT4, AN-UNIT5, and AN-UNIT6) which were installed in 1975 (Sanderson & Porter, 1975). The impact analysis was conducted in compliance with NEPA and in accordance with the Rural Electrification Administration's "Guide for Preparation of an Environmental Analysis for a new Generating Plant or an Addition to an Existing Plant" dated May 20, 1974. In addition, information regarding existing air emissions and wastewater discharge at the Anadarko Plant was obtained from the facility's Title V Operating Permit (Permit No. 2022-0559-TVR4) dated September 5, 2023, and the facility's Oklahoma Pollution Discharge Elimination System (OPDES) permit No. OK0000639 issued June 14, 2023. U.S. EPA's NEPAssist Tool was also utilized to identify key environmental indicators with a 1 and 5 mile radius of the Project Area. The NEPAssist Reports are attached in Attachment 2.

3.1 Land Use

3.1.1 General Land Use

3.1.1.1 Affected Environment

The proposed Project Site consists of relatively flat terrain, with site topography varying from 1165 to 1180 feet above mean sea level. The site is developed for light industrial use and is surrounded on the east, north, and west sides by cultivated cropland and fragmented wooded areas. The Washita River is also located north of the parcel. Residential and commercial areas associated with the city of Anadarko are located to the southwest and south.

The Project Site is currently zoned I-1 (Light Industrial) and A-1 (Agricultural) by the City of Anadarko. Adjacent zoning classifications are A-1 (Agricultural) and R-3 (Single Family Residential) (Glenn Briggs & Associates, Inc, no date). Attachment 3 shows the City of Anadarko Zoning Map.

The Project Site is currently developed with seven buildings, including corporate offices, an engineering building, two warehouses, two turbine buildings, and a repair building. The facility also contains three substations, several cooling tower cells, turbines, three underground storage tanks (USTs) (used for a glycol-based fluid), a natural gas regulating station, and parking areas.

3.1.1.2 Environmental Consequences

3.1.1.2.1 No Action Alternative

The No Action Alternative would have no short-term or long-term impacts to land use at or in the vicinity of the proposed Project. However, electric power generation needed to respond to WFEC member demand and for continued compliance with the SPP capacity reserve requirements for the WFEC service area would have to be acquired by WFEC from one or more alternative generating resources. As such, the No Action Alternative may result in land use impacts off-site to develop these generation sources.

3.1.1.2.2 Proposed Action

The Proposed Action will impact approximately 28.5 acres of land currently developed for light industrial and agricultural use at the Anadarko Power Plant. Approximately 6.6 acres will be impacted for construction of the SCCT units and construction areas, and 21.9 acres will be for the generation tie-in line and associated structures which will be in an undeveloped land area zone for agricultural use.

Although the Proposed Action will result in approximately 28.5 acres of land being disturbed for development of the SCCT units and associated infrastructure, this change will not result in adverse impacts to land use at the Project Site and is consistent with local development and zoning restrictions.

3.1.1.3 Mitigation

No mitigation measures are proposed for general land use.

3.1.2 Important Farmlands

3.1.2.1 Affected Environment

In 2001, there were 15.35 million acres of nationally significant agricultural land in Oklahoma; in 2016, there were 15.22 million acres of nationally significant agricultural land, representing a loss of approximately 130,000 acres, or less than 1% of the total, over the 15-year period (FIC, 2023)). According to the Caddo County Agricultural Census, as of 2017 land under agricultural cultivation is up 7% since 2012 (USDA, 2017).

Prime farmland soil occupies a majority of the undeveloped portion of the Project Site (USDA, 2023b); however, the site is currently zoned and developed for light industrial use.

3.1.2.2 Environmental Consequences

3.1.2.2.1 No Action Alternative

The No Action Alternative would have no short-term or long-term impacts to important farmlands at or in the vicinity of the proposed Project. The Anadarko Plant would continue to be used for energy generation.

3.1.2.2.2 Proposed Action

Soil types within the Project Site are described in Section 3.14.1.1. Projects with a federal nexus that result in the conversion of prime farmland to nonagricultural uses may be subject to review pursuant to the Farmland Protection Policy Act (FPPA). However, land identified as an “urbanized area” is not subject to review under the FPPA.

Given the fact that the Project Site is currently zoned, that a majority of the site has been developed for industrial use, and that only approximately two acres of land associated with the generation tie-in line and associated structures will span prime farmland that is currently used for agricultural production, the Proposed Action will have minimal impacts to farmland.

3.1.2.3 Mitigation

No mitigation measures are proposed for impacts to farmland.

3.1.3 Formally Classified Lands

3.1.3.1 Affected Environment

The Project Site is not located within any formally classified lands. The location and proximity of formally classified lands from the Project Site are listed below:

- National Wildlife Refuges/Wilderness Areas: The nearest wildlife refuge is the Wichita Mountains National Wildlife Refuge/Wilderness Area, which is approximately 31.6 miles south of the site (Google, 2023a).

- Wild, Scenic, and Recreational Rivers: There are no National Designated Wild or Scenic Rivers in Oklahoma (NWSRS, 2023).

- State Parks and State Fish and Wildlife Management Areas: The nearest state park is Fort Cobb State Park which is approximately 12.4 miles northwest of the Project Site. Fort Sill National Cemetery is located approximately 22.1 miles south of the Project Site (Google, 2023b)

- Bureau of Land Management (BLM) administered lands: There are no BLM administered lands within or near the Project Site (BLM, 2023).

- Native American owned lands and leases administered by the Bureau of Indian Affairs (BIA): The Project Site is not located on American Indian Reservation Land or Off Reservation Trust Lands.

3.1.3.2 Environmental Consequences

3.1.3.2.1 No Action Alternative

The No Action Alternative would have no short-term or long-term impacts to formally classified lands at or in the vicinity of the proposed Project.

3.1.3.2.2 Proposed Action

Construction and operation of the Proposed Action will not be expected to adversely impact formally classified lands. Given the proposed Project location, the Project will have no adverse impacts to nearby parks or recreation areas.

3.1.3.3 Mitigation

No mitigation measures are proposed for formally classified lands.

3.2 Floodplains

3.2.1 Affected Environment

Based on a review of the Federal Emergency Management Agency's (FEMA) National Flood Hazard Layer (NFHL) Viewer, approximately 6.2 acres of the 28.5-acre Project footprint are located within Zone A and Zone AE 100-year floodplains associated with the Washita River. Attachment 4 provides a map of designated floodplains and regulatory floodways in the vicinity of the Project Site (FEMA, 2023).

3.2.2 Environmental Consequences

3.2.2.1 No Action Alternative

The No Action Alternative would have no short-term or long-term impacts to floodplains or the designated floodway at or in the vicinity of the proposed Project.

3.2.2.2 Proposed Action

Project infrastructure that will be located within mapped floodplains will consist solely of generation interconnect structures (e.g., transmission line poles), the new turbines will not be located in the floodplain. As described above, construction of the generation tie-in structures will disturb approximately 6.5 acres of land located within FEMA-mapped Zone A and AE floodplains. It is anticipated that up to 12 interconnect structures will be installed, and that vegetated areas within the generation tie-in route will be kept cleared throughout the life of the Proposed Action. However, given the small size of the permanent structures that will be located within the floodplain, the Proposed Action will not result in a change to the base flood elevation. WFEC will not stockpile construction-related debris or equipment in the floodplain, and will obtain the necessary floodplain permits for construction in these areas. Based on the type of structures that will be permanently located within the floodplain, construction and operation of the Proposed Action will have negligible long-term impacts to floodplains.

3.2.3 Mitigation

WFEC will not stockpile debris or equipment in the floodplain during construction. The longest possible spans between generation tie-in structures would be used so as to reduce new permanent structures in floodplain areas.

3.3 Wetlands

3.3.1 Affected Environment

According to the National Wetland Inventory (NWI), there are no wetlands, streams, or other surface water features in the Project Site (NWI, 2023). NWI-mapped features in proximity to the Project Site are displayed in Attachment 5. All surface water features are located 400 feet or more from the Project Site boundary (NWI, 2023). Based on a desktop evaluation of aerial imagery, it was determined that no field surveys will be required to confirm NWI data and the absence of jurisdictional wetlands within the Project Site.

3.3.2 Environmental Consequences

3.3.2.1 No Action Alternative

The No Action Alternative would have no short-term or long-term impacts to wetlands at or in the vicinity of the proposed Project. However, electric power generation needed to address projected demand increase in the WFEC service area would have to be acquired by WFEC from one or more alternative generating resources. As such, the No Action Alternative may result in wetland impacts off-site to develop these generation sources.

3.3.2.2 Proposed Action

Given the lack of wetlands within the Project Site, and the planned use of soil erosion and sediment control Best Management Practices (BMPs), construction and operation of the Proposed Action will not be expected to cause impacts to wetlands in the vicinity of the Project.

3.3.3 Mitigation

At a minimum, WFEC will install sediment and erosion control structures and BMPs to comply with the OPDES General Permit for Stormwater Discharges Associated with Construction Activities. In addition, compliance with the general stormwater permit will require WFEC to prepare and implement a Project-specific Stormwater Pollution Prevention Plan (SWPPP). The SWPPP will describe the sediment and erosion control BMPs that will be implemented during construction to reduce the potential for adverse impacts to off-site surface water features. All necessary BMPs will be installed prior to initiating soil-disturbing activities.

3.4 Water Resources

3.4.1 Surface Water Features

3.4.1.1 Affected Environment

The Project Site is located approximately 0.15 miles south of the Washita River in Caddo County (Stream Segment 310830, Waterbody ID 3108300100_10) within the Middle Washita Watershed (Hydraulic Unit Code (HUC) 11130303). Other surface water features within a 15-mile radius of the Project Site include Lake Chickasha (located approximately 6.0 miles northeast of the site); Public Service Reservoir No. 3 (located approximately 6.5 miles northeast of the site); Lake Louis Burtschi (located approximately 11.5 miles southeast of the site); Fort Cobb Lake located approximately 14.0 miles northwest; and numerous intermittent streams and tributaries. The Anadarko Power Plant currently obtains raw water from the Fort Cobb Reservoir. The long-term average flow into the plant currently averages about 1.3 million gallons per day (MGD). Attachment 5 provides a map showing the location of the surface water features in proximity to the Project Site. No surface water features are located within the Project Site.

3.4.1.2 Environmental Consequences

3.4.1.2.1 No Action Alternative

The No Action Alternative would have no short-term or long-term impacts to surface water and water supply at or in the vicinity of the proposed Project.

3.4.1.2.2 Proposed Action

Potential impacts to surface water features associated with construction activities will be short-term in nature and minimized through the use of sediment and erosion control BMPs. Based on implementing erosion and sediment BMPs during the construction phase of the Project in accordance with Oklahoma stormwater and erosion control regulations, construction of the SCCT units and associated equipment will have minimal short-term impacts to surface water in the vicinity of the Project.

Potential long-term impacts to surface water features will generally be related to water use associated with operation of the SCCT units. The Anadarko Power Plant currently receives approximately 1.3 MGD of raw water from the Fort Cobb Reservoir to support existing power generating operations. It is estimated that 197,290 gallons of water per day will be needed to supply water to the new SCCTs for inlet cooling, water injection, and wet compression. Raw water requirements for the new units will be within the existing capacity and water rights available to the Anadarko Power Plant, and the Fort Cobb Reservoir has adequate capacity to continue to supply water to the plant. In addition, water requirements for the new SCCT units will be off-set by the permanent retirement of three existing gas-fired boilers. Existing raw water storage and water treatment systems (e.g., demineralization) at the plant will be used to supply water to the new

SCCTs. Given water availability, existing water treatment infrastructure at the plant, and the fact that water requirements for the new SCCT units will use less water than the three retired gas-fired boilers, surface water impacts related to water use will be minimal.

Potential impacts to water quality from Project-related wastewater discharges to surface water are discussed in Section 3.4.2.

3.4.1.3 Mitigation

At a minimum, WFEC will install and maintain sediment and erosion control structures and BMPs during construction of the Proposed Action as required by the OPDES General Permit for Stormwater Discharges Associated with Construction Activities. The Project-specific SWPPP, required to obtain coverage under the stormwater general permit, will describe the sediment and erosion control BMPs that will be implemented and maintained during construction. Sediment and erosion control BMPs may include silt fencing, inlet protection, straw bale barriers, riprap, and erosion control blankets. All necessary sediment and erosion control measures will be installed prior to initiating soil-disturbing activities. Perimeter silt fencing will be installed as needed around the site to further reduce the potential for adverse impacts to off-site surface water features.

3.4.2 Water Quality

3.4.2.1 Affected Environment

The Washita River, located directly north of the Project Site, is classified as an Impaired Water and included on the Oklahoma §303(d) list of Impaired Waters. The Washita River is identified as being impaired for Enterococcus, sediment, fish bioassessments, and turbidity (ODEQ, 2023a). Enterococci are indicators of fecal material in the water, and are typically not considered harmful to humans, but their presence in the environment may indicate the possible presence of disease-causing bacteria, viruses, and protozoa (USEPA, 2023a). Biological assessments are used to measure the overall biological integrity of an aquatic community and the synergistic effects of stressors on the aquatic biota. Among other things, biological assessments can be used to determine the effects of nonpoint source pollution (e.g., agricultural pesticides), cumulative pollution (i.e., multiple impacts over time or continuous low-level stress), and nontoxic mechanisms of impact (e.g., trophic structure changes due to nutrient enrichment). Biotic response to impacts on the physical habitat such as sedimentation from stormwater runoff and physical habitat alterations from dredging, filling, and channelization can also be detected using biological assessments (USEPA, 2011).

3.4.2.2 Environmental Consequences

3.4.2.2.1 No Action Alternative

The No Action Alternative would have no short-term or long-term impacts to water quality at or in the vicinity of the proposed Project.

3.4.2.2.2 Proposed Action

The Anadarko Power Plant currently discharges wastewater to the Washita River. Wastewater discharge from the plant is authorized by OPDES permit OK0000639. The plant currently discharges an average 0.5 MGD of wastewater consisting of commingled cooling tower blowdown, low volume waste streams, and stormwater runoff. Discharge from the plant is monitored for flow, total residual oxidants, free available oxidants, total suspended solids, oil and grease, pH, and temperature.

The proposed SCCT units will result in approximately 5,000 additional gallons per day of wastewater discharge from the plant. Project-related wastewater will consist of raw water treatment system discharge, cooling system blowdown, oil/water separator discharge, and stormwater from process areas. Wastewater from the Proposed Action will be treated at the Anadarko Power Plant in the plant's existing wastewater treatment system and discharged to the Washita River via the plant's existing, or modified, OPDES permit. Sanitary wastewaters will be discharged to the local publicly owned treatment works. Wastewater discharge from the Proposed Action will not include any constituents related to the water quality standards for which the Washita River is classified as impaired, and will not be subject to Total Maximum Daily Load (TMDL) limitations established by Oklahoma Department of Environmental Quality (ODEQ) for the river. It is anticipated that wastewater discharge from the Proposed Action will be within the plant's existing permit limits, and therefore will not result in adverse impacts to surface water quality.

The Proposed Action will result in an incremental increase in wastewater generated at the Anadarko Power Plant. However, wastewaters generated by the Proposed Action are identical to wastewaters already generated at the plant, and existing wastewater treatment and discharge infrastructure at the plant will be used to treat wastewater from the Proposed Action. Given the quantity and characteristics of wastewaters generated by the Proposed Action, the availability of wastewater treatment infrastructure, and discharge limitations and monitoring requirements established in the plant's OPDES discharge permit, wastewater discharge associated with the Proposed Action is expected to have minimal impact on surface water quality in the vicinity of the Project.

3.4.2.3 Mitigation

WFEC will utilize existing wastewater treatment infrastructure at the Anadarko Power Plant to treat Project-related wastewater prior to discharge in accordance with the plant's existing, or modified, OPDES permit.

3.4.3 Groundwater

3.4.3.1 Affected Environment

Based on findings from a 2008 Geotechnical Investigation, groundwater at the Anadarko Power Plant will be encountered between 11.2 and 21.7 feet below ground surface (Burns & McDonnell, 2008). The Project Site is within the Washita River Reach 3 aquifer, which is an alluvial aquifer consisting of unconsolidated alluvial and terrace Quaternary-age deposits adjoining the Washita River (OSU Geology, 1984). Reach 3 begins upstream near Anadarko and terminates downstream in Alex and Bradley, Oklahoma (OSU Geology, 1984). The Washita River alluvial aquifer is an unconfined, or water table, aquifer; Precambrian to cretaceous aged bedrock underlies the aquifer in much of reach 4 (OSU Geology, 1984). The average depth to water is 22 feet and the average saturated thickness is 61 feet and can be as much as 189 feet (OSU Geology, 1984). The Washita River Reach 3 aquifer does not supply drinking water to the residents of Anadarko and Caddo County and is not designated as a sole source aquifer (USEPA, 2023b). Drinking water for Anadarko is sourced from Fort Cobb Reservoir (City of Anadarko, 2015a).

3.4.3.2 Environmental Consequences

3.4.3.2.1 No Action Alternative

The No Action Alternative would have no short-term or long-term impacts to groundwater at or in vicinity of the proposed Project.

3.4.3.2.2 Proposed Action

The Proposed Action does not include new groundwater wells or groundwater withdrawals. Water for the Proposed Action will be obtained from Fort Cobb Reservoir, which is the water source for existing power generating operations at the Anadarko Power Plant. In addition, WFEC will implement and maintain spill prevention controls and countermeasures (as described in Section 3.4.3.3) to minimize the possibility of a release reaching soils or migrating to groundwater. Because the Proposed Action will not include groundwater withdrawals, and spill controls and countermeasures will be implemented to minimize the risk of a release to groundwater, the Proposed Action will result in no adverse impacts to groundwater resources.

3.4.3.3 Mitigation

To minimize the potential for a release to groundwater, all hazardous substances and petroleum products, including oils and lubricants, will be located indoors and/or within secondary containment. In accordance with the requirements of 40 CFR Part 112, secondary containment structures will be designed to contain 100% of the largest single storage container within the containment area plus the volume of a 24-hour, 25-year storm (if located outside). WFEC will update the Anadarko Power Plant's existing Spill Prevention Control and Countermeasure (SPCC) Plan, as needed, during construction and operation of the Proposed

Action, to ensure the plant has adequate containment, training, and spill response supplies available to respond to a spill.

3.5 Coastal Resources

The Project Site is located in Anadarko, OK. There are no coastal resources located in the vicinity of the Project Site.

3.6 Biological Resources

3.6.1 General Fish, Wildlife, and Vegetation Resources

3.6.1.1 Affected Environment

The Project Site is located in the Northwestern Cross Timbers ecoregion (Ecoregion 29h) of the Central Oklahoma/Texas Plains (USEPA, 2004). Ecoregion 29h is underlain by Permian-age sandstone, siltstone, and shale. Natural vegetation mapped in the Northwestern Cross Timbers ecoregion includes blackjack oak/post oak savanna, tall grass prairie, and forests dominated by sugar maple. Eastern redcedar is native to fire-protected areas of the ecoregion and has become more common due to the combined effects of grazing and fire suppression. Cultivation and overgrazing have largely destroyed native prairie in the ecoregion.

Based on information available from the Oklahoma Biodiversity Information System (OBIS), there are 392 animal species and 874 plant species in Caddo County. This includes 34 mammal species, 56 bird species, 48 reptile species, 12 amphibian species, and 155 insect species, among others (OBIS, 2023).

The proposed Project is located at the Anadarko Power Plant, which is developed as a gas-fired electric power generating facility. The Project Site includes portions of the existing power plant, graveled areas and maintained lawns within the power plant's boundary, cultivated cropland, and a wooded area (see, Figure 1-2.). Existing utility lines crisscross the Project Site. Given development of the area as a power plant, limited natural habitat for wildlife is available within the Project Site apart from approximately four acres of deciduous woodland located along the eastern edge of the site. Wildlife present in the area will include species able to adapt to areas developed for industrial development and areas in active agricultural production.

3.6.1.2 Environmental Consequences

3.6.1.2.1 No Action Alternative

The No Action Alternative would have no short-term or long-term impacts to wildlife or vegetation resources at or in the vicinity of the proposed Project.

3.6.1.2.2 Proposed Action

Construction of the Proposed Action will result in converting approximately 3.6 acres of land at the Anadarko Power Plant that is currently maintained gravel or lawn area to industrial use, parking, and temporary construction laydown. Construction of the generation interconnect line will consist of rebuilding 0.36 miles of existing on-site transmission line and construction of 0.54 miles of new transmission line. Negligible impacts to wildlife and vegetation resources are expected from the rebuilt portion of the transmission line. Construction of the new line will result in the conversion of approximately four acres of fragmented, deciduous woodland to cleared right-of-way (ROW).

Wildlife within the Project Site, including common wildlife species adapted to industrial development and active agricultural cultivation, may be impacted during construction of the Proposed Action. Approximately four acres of tree clearing is expected to be required for construction of the proposed generation interconnect line which will result in a small, but permanent, loss of wildlife habitat (i.e., deciduous woodland). Noise and human activity associated with construction of the Proposed Action may result in short-term, temporary displacement impacts to wildlife species, but are not expected to result in long-term impacts to wildlife and vegetation within the Project Site.

3.6.1.3 Mitigation

No mitigation measures are proposed for general fish, wildlife, and vegetation resources.

3.6.2 Threatened and Endangered Species

3.6.2.1 Affected Environment

The species list provided by the U.S. Fish and Wildlife Service (USFWS) identifies five federally listed species with current and historical ranges within the vicinity of the proposed Project (see Attachment 6a) (USFWS, 2024). Candidate and listed species are described in Attachment 6b. No critical habitat was identified within the Project Site (USFWS, 2024).

3.6.2.2 Environmental Consequences

3.6.2.2.1 No Action Alternative

The No Action Alternative would have no short-term or long-term impacts to rare, threatened, or endangered species at or in the vicinity of the proposed Project. However, electric power generation needed to address projected demand increase in the WFEC service area would have to be generated by one or more alternative generating resources. As such, the No Action Alternative could result in impacts to threatened and endangered species depending on the location and type of generating resource used to address increased demand.

3.6.2.2.2 Proposed Action

Construction of the Proposed Action will result in the conversion of approximately 3.6 acres of land at the Anadarko Power Plant that is currently maintained gravel/lawn area to industrial use, parking, and temporary construction laydown. In addition, construction of the transmission line will result in the conversion of approximately four acres of fragmented, deciduous woodland to cleared transmission line ROW.

A desktop evaluation was performed to identify whether suitable habitat for any of the five USFWS-listed species is present within the Project Site. Based on this evaluation, it was determined that preferred habitat for the following federally threatened species is not present in the Project Site: rufa red knot (*Calidris canutus rufa*) and piping plover (*Charadrius melodus*) (USFWS, 2023a; USFWS, 2023b); therefore, the Project will have no effect on either of these species.

The Project Site contains potential habitat for the remaining three species on the USFWS species list:

Whooping Crane (*Grus americana)* – Endangered

Whooping cranes are only found in Oklahoma during the spring and fall migration periods (Oklahoma Department of Wildlife Conservation, 2024). Migrating birds feed in croplands and roost in shallow, freshwater wetlands (Cornell Lab of Ornithology, 2024; USFWS, 2023c). Studies have indicated that cranes prefer to stopover in areas free from human activity (Armbruster, 1990). Although there is a small amount of cropland within the Project Site, it is unlikely that whooping cranes will use those areas during their migration due to the lack of high-quality wetlands in the vicinity, and the presence of the existing operational power plant; therefore, the Project will have no effect on this species.

Monarch Butterfly (*Danaus plexippus*) – Candidate

Monarch butterflies typically occur in prairies, meadows, and grasslands across most of North America (NPS, 2017, USFWS, 2023d). Although monarchs feed on the nectar of many flowers, they lay their eggs only on certain types of milkweed plants, many of which have been eradicated as noxious weeds. The Project Site is currently developed as a power plant and lacks necessary milkweed and overwintering habitat for the Monarch Butterfly. Additionally, mature individuals will be able to fly out of the Project Area during construction activities to more suitable habitat; therefore, the Project will have no effect on the Monarch Butterfly.

Tricolored Bat (*Perimyotis subflavus*) – Proposed Endangered

On September 14, 2022, the USFWS issued a proposed rule to list the tricolored at as an endangered species. Species designated as “proposed endangered” are not protected by the take prohibitions of

Section 9 until the rule is finalized. The USFWS has yet to come to a final determination on either listing the tricolored bat as endangered or withdrawing the proposal.

Tricolored bats generally hibernate in underground caves and abandoned mines. Outside of hibernation, tricolored bats occupy forested areas (USFWS, 2023e). This species roosts in dead or live tree foliage and caves, and forages in forested landscapes and along waterways. It should be noted that the primary cause of tricolored bat decline is White Nose Syndrome (WNS), and the Project will not include any activities that will cause the spread of WNS. As described in Section 3.1.1, the proposed Project Site is currently used for electric power production and only a minimal amount of tree clearing is expected during the construction of the Proposed Action. The vegetation slated for removal consists of scattered shrubs and woody tree species, such as western soapberry, American elm, and hackberry; and is situated between two disturbed areas. The Project Area lacks contiguous hardwood forest habitat, riparian areas, and the required cave habitat for hibernacula; therefore, the Project will have no effect on the Tricolored Bat.

3.6.2.3 Mitigation

Industry-accepted best management practices to prevent birds from colliding with or being electrocuted by utility lines, towers, and poles will be adopted as appropriate.

The construction and operation of the Project will comply with the Endangered Species Act, which provides for the protection of endangered and/or threatened species and critical habitat. If more extensive tree clearing is needed, WFEC will consult with USFWS and Oklahoma Department of Wildlife Conservation to confirm whether the areas planned to be cleared will be considered potential habitat for this species, and to discuss appropriate avoidance measures (e.g., clearing trees in the winter only). Other mitigation/avoidance measures will be implemented as indicated by agency officials. Should any evidence of the presence of endangered and/or threatened species or their critical habitat be brought to the attention of the contractor, the contractor will immediately report this evidence to WFEC and a representative of the Agency. Construction shall be temporarily halted pending the notification process and further directions issued by the Agency after consultation with the USFWS.

3.6.3 Migratory Bird Treaty Act and Bald and Golden Eagle Protection Act

3.6.3.1 Affected Environment

The USFWS species list indicated that bald eagles (*Haliaeetus leucocephalus*) could occur within the Project Site (Attachment 6a). Bald eagles typically nest in forested areas near large bodies of water, avoiding heavily developed areas when possible (Cornell Lab of Ornithology, 2023). Eagles may perch in tall trees adjacent to bodies of water during the day (Cornell Lab of Ornithology, 2023). Bald eagles are increasingly being seen in suburban and farmland areas (USFWS, 2023f).

Bald eagles are protected under the Bald and Golden Eagle Protection Act (BGEPA), with enforcement under USFWS authority. This act states that it is prohibited to take, possess, purchase, barter, offer to sell, transport, export or import, of any bald or golden eagle, alive or dead, including any part, nest, or egg, unless allowed by permit (16 U.S.C. 668-668d). The USFWS species list states that there are bald eagles in the vicinity of the Proposed Action (USFWS, 2024). Additionally, numerous migratory bird species pass through Oklahoma in the spring and fall.

3.6.3.2 Environmental Consequences

3.6.3.2.1 No Action Alternative

The No Action Alternative would have no short-term or long-term impacts to migratory birds at or in the vicinity of the Proposed Action.

3.6.3.2.2 Proposed Action

Project activities with the potential to impact Migratory Bird Treaty Act (MBTA)- or BGEPA-listed species will consist of tree and vegetation removal as well as the installation of an approximately 0.91-mile, high-voltage generation interconnect line.

Impacts to Bald and Golden Eagles are not expected to occur as a result of the Project. While Bald and Golden Eagles may visit areas within the vicinity of the Project Area, suitable nesting habitat, which includes tall, large diameter trees and preferred foraging areas including large, open expanses of water, are not present within the Project Area. Additionally, the Center for Conservation Biology's Mapping Portal does not depict eagle nests or roosts within or adjacent to the Project Area.

Adult migratory birds will not be directly harmed during Project construction because of their mobility and ability to avoid areas of human activity. During operations, there will be the potential for bird strikes on the new interconnect line. However, the Project Site is already crisscrossed by utility lines, and approximately a third of the line will be rebuilt in the location of an existing line; therefore, the new line will represent a negligible change relative to existing site conditions.

3.6.3.3 Mitigation

Industry-accepted best management practices to prevent birds from colliding with or being electrocuted by utility lines, towers, and poles will be adopted as appropriate.

If possible, the initial vegetation clearing will be performed outside the peak migratory bird breeding/nesting period (May 1-July 1) to avoid impacts to nesting birds (USDA, 2020). If vegetation clearing activities cannot be avoided during this period, WFEC will conduct pre-clearance surveys of the site. If a field survey identifies one or more active bird nest(s), appropriate measures will be taken to avoid incidental take, including establishing an avoidance buffer until the young have fledged. If an active nest is identified that cannot be avoided, WFEC will consult with the Oklahoma Department of Wildlife Conservation and USFWS to determine an appropriate course of action.

3.6.4 Invasive Species

3.6.4.1 Affected Environment

Invasive species are generally defined as species that are non-native to the ecosystem under consideration and whose introduction causes or is likely to cause economic or environmental harm or harm to human health (USDA, 2023a). Invasive species occur throughout Oklahoma (Oklahoma Invasive Plant Council (OKIPC), 2022). Oklahoma has designated three noxious weeds, as well, which are required by law to be controlled if observed (OKDAFF, 2000). These are musk thistle (*Carduus nutans L.*), Scotch thistle (*Onopordum acanthium L.*), and Canada thistle (*Cirsium arvense*). The Project Site consists largely of developed industrial areas and maintained lawn and gravel areas, with a small amount of agricultural, forested, and cleared ROW areas. It is possible that invasive plants may occur within portions of the Project Site.

3.6.4.2 Environmental Consequences

3.6.4.2.1 No Action Alternative

Invasive species, if present at the Project Site, would remain subject to current management practices (e.g., mowing, herbicide applications) at the Anadarko Power Plant. The No Action Alternative would have no short-term or long-term impacts to invasive species at or in the vicinity of the Proposed Action

3.6.4.2.2 Proposed Action

Ground disturbance, vehicle traffic during construction, and clearing wooded areas could lead to the introduction and establishment of invasive plant species in the Project Site. However, the overall potential for degradation of non-disturbed or natural habitats is low, given the disturbed nature of the site and proposed mitigation measures.

3.6.4.3 Mitigation

If it is determined that the Proposed Action resulted in the introduction of invasive species at the Project Site, WFEC will develop an appropriate weed management plan(s) in keeping with any relevant Oklahoma policies to prevent invasive species from becoming established.

3.7 Historic and Cultural Resources

3.7.1 Affected Environment

Civil & Environmental Consultants (CEC) conducted a cultural resources survey in November 2023 for the Proposed Action in Caddo County, Oklahoma, titled: *Cultural Resources Survey Report for the Western Farmers Electric Cooperative Proposed Anadarko Combustion Turbine Project, Caddo County, Oklahoma* (CEC, 2023). The Area of Potential influence (APE) studied by CEC included a total of 35.86 acres, which included the construction site, transmission line rebuild ROW corridor and new transmission line ROW corridor. A one-mile buffer surrounding the Proposed Action was also included.

There are no NRHP listed cultural resources located within the APE. The cultural historical survey identified three cultural resources which are listed in the NRHP within one mile of the APE. An additional seven non-NRHP listed cultural resources were also identified within one mile of the APE.

3.7.2 Environmental Consequences

3.7.2.1 No Action Alternative

The No-Action Alternative would have no short-term or long-term impact to cultural resources in the vicinity of the Project Area.

3.7.2.2 Proposed Action

Given the location of both the NHRP-listed and non-NHRP-listed cultural resources located within one mile of the APE and the proposed Project-related construction activities, none of these resources will be affected by the Proposed Action. Based on its review and acceptance of these recommendations, the RUS made a determination of no adverse effect to historic properties and started consultation on December 28, 2023. The Caddo Nation, Osage Nation, Delaware Nation, Oklahoma SHPO and Oklahoma Archeological Survey concurred with the Determination of Effect. The Apache Tribe of Oklahoma, Cheyenne and Arapaho Tribes, Kiowa Tribe and Wichita and Affiliated Tribes were also consulted but did not respond. As a result of the identification and consultation efforts, it was agreed that no historic or cultural properties will be adversely affected by the Proposed Action. Neither construction nor operation of the Proposed Action will result in short-term or long-term impacts to historic and cultural resources.

3.7.3 Mitigation

The Caddo Nation, Osage Nation, and Delaware Nation will be notified if any inadvertent discoveries are made during project activities.

3.8 Aesthetics

3.8.1 Affected Environment

The Project will occur largely within the existing footprint of the existing Anadarko Power Plant. There are 11 existing stacks associated with the plant’s current generating units, as well as several smaller stacks for ancillary equipment.

The surrounding land use is primarily undeveloped or agricultural, or residential, with some industrial and commercial areas also in the vicinity. The City of Anadarko is located to the southwest of the Anadarko Power Plant. There are three parks in Anadarko: Unity Park, Downtown Pocket Park, and an unnamed local residential community park. Additionally, the Caddo County Fairgrounds are located directly south of the Project Site just over Watson Drive. Highway 281, local roads, and railroads cross through the City of Anadarko. Attachment 7 lists the aforementioned areas and their respective approximate distance from the Project Site. Overall, the power plant is currently visible to passing motorists from the south and east, and generally obscured by buildings and vegetation from the west (Google, 2023b; Google, 2023c).

3.8.2 Environmental Consequences

3.8.2.1 No Action Alternative

The No Action Alternative would have no short- or long-term impacts to aesthetics at or in the vicinity of the proposed Project.

3.8.2.2 Proposed Action

The Proposed Action includes the construction of two combustion turbine stacks, each approximately 80 feet above ground level with a diameter of approximately 120 inches. Exhaust stacks associated with the new SCCT units will be consistent with the heights of stacks and tall structures already at the Project Site. The stacks will generally be visible from areas south and east of the Project Site, but will not be visible from most areas in the City of Anadarko due to tree coverage and surrounding buildings.

Aesthetic and visual impacts associated with construction and operation of the Proposed Action will be consistent with the existing industrial character of the Project Site. As such, adverse impacts to aesthetics or visual resources will be minimal.

3.8.3 Mitigation

No mitigation measures are proposed for aesthetic impacts.

3.9 Air Quality and Climate

Potential air quality effects can be short-term (i.e., construction-related) or long-term effects from stationary emission sources, increased traffic, and similar activities. The federal Clean Air Act (CAA) requires the USEPA to set primary National Ambient Air Quality Standards (NAAQS) to provide public health protection, including protecting the health of sensitive populations, and secondary NAAQS to protect plants, forests, crops, and materials from damage due to exposure to six "criteria" pollutants. The pollutants include ozone (O_3), particulate matter (PM), carbon monoxide, nitrogen dioxide (NO_2), sulfur dioxide (SO_2), and lead (Pb). Federal and State environmental agencies implement requirements of the CAA through a combination of emission standards and permitting requirements that limit air emissions from emission sources to achieve, and ensure continued compliance with, all applicable NAAQS.

In Oklahoma, ODEQ's Air Quality Division (AQD) has primary responsibility and authority to prepare and implement Oklahoma's air quality management plan under the Oklahoma Environmental Quality Act and the Oklahoma Clean Air Act (27A O.S. §§2-1-101 et seq.). The USEPA has delegated authority to AQD to implement and enforce most of the federal CAA programs under state statutes and rules. AQD air quality rules at Oklahoma Administrative Code (OAC) 252:100 require air permits for industrial and commercial sources that release pollutants into the air. Air permits limit the type and quantity of air pollutants that can be released from the source, and require source owners and operators to monitor and report air emissions. Permits are issued to large sources ("major" sources) and smaller sources ("minor" or "area" sources).

3.9.1 Air Quality

3.9.1.1 Affected Environment

The Proposed Action is located in Caddo County Oklahoma. Caddo County has been designated as being in attainment or unclassifiable with all existing NAAQS (USEPA, 2023e). In fact, all counties in Oklahoma are currently designated as being in attainment for all six criteria pollutants. The nearest nonattainment area to the Proposed Action is the Dallas-Fort Worth (DFW) nonattainment area located approximately 130-miles south-southeast of the Project Site in north-central Texas. The DFW area has been designated as being in nonattainment with respect to the 2008 and 2015 8-hour O_3 standards (TCEQ, 2023).

3.9.1.2 Environmental Consequences

3.9.1.2.1 No Action Alternative

The No Action Alternative would have no short-term or long-term impacts to air quality in the vicinity of the Proposed Action; however, the No Action Alternative could result in air quality impacts at another location within the WFEC service area. Air quality impacts from the No Action Alternative would depend on the location and type of electric power generating resource used to provide the replacement power needed to respond to WFEC member cooperative demands and meet SPP capacity requirements as an alternative to proceeding with the Proposed Action.

3.9.1.2.2 Proposed Action

Impacts to air quality are evaluated in terms of criteria pollutant emissions and hazardous air pollutant (HAP) emissions associated with the Proposed Action. Potential impacts associated with project-related greenhouse gas GHG emissions are assessed in Section 3.9.2.

Construction

Construction of the Proposed Action will result in construction-related fugitive dust and construction equipment exhaust emissions. Construction-related emission generating activities will include clearing and grading of the site, excavation of footings and foundations, and construction of the combustion turbines and associated equipment and infrastructure. The use of heavy construction equipment during the construction phase of the project, including bulldozers, cranes, dump trucks, graders, and similar equipment, will also generate internal combustion engine exhaust emissions.

Operation

The primary source of emissions during operation of the Proposed Action will be the proposed gas-fired SCCTs. Other potential new emissions sources include the chiller tower and fugitive emissions from the fuel handling system and on-site vehicle traffic. Following construction of the SCCTs, WFEC will permanently retire the three gas-fired high-pressure boilers (AN-UNIT1R, AN-UNIT2R, and AN-UNIT3).

Annual emission increases from the Anadarko Plant resulting from the Proposed Action were evaluated using the actual-to-potential test defined in the Oklahoma Prevention of Significant Deterioration (PSD) regulations in OAC 252:100-8-30(b)(4). Potential annual emissions were calculated using vendor hourly emissions data and assuming a maximum annual capacity factor equal to 36 percent. Using the actual-to-potential test provides a conservatively high estimate of emissions from the Proposed Action. Project-related emission increases are summarized in Table 3-1.

Table 3-1. Project-Related Emission Increases

Pollutant	New LM6000 Units (2 total)	Chiller Cooling Tower[2] (tons/yr)	New Generation Project Total Emissions (tons/yr)
	Total Annual Emissions[1] (tons/yr-2CTs)		
NO_X	146.4	--	146.4
CO	77.4	--	77.4
VOC	27.4	--	27.4
PM_{10}	22.1	0.33	22.4
$PM_{2.5}$	22.1	0.0015	22.1
SO_2	2.1	--	2.1
H_2SO_4	2.6	--	2.6
CO_2-e	192,571	--	192,571

1. Annual emissions were calculated based on full load operation and an annual capacity factor of 36%, including emissions from unit startups and shutdowns. Annual emissions provided herein are preliminary and may change as a result of the air permitting process; however, any changes to annual emissions from the Proposed Action will be minimal.
2. Emissions from the chiller cooling tower were estimated based on the design circulating water flow rate, an assumed drift rate of 0.0010%, and circulating water total dissolved solids concentration of 3,280 ppm.

Based on project-related emission calculations summarized in Table 3-1, the Proposed Action will result in emission increases above the PSD significant levels for NOx, PM_{10}, $PM_{2.5}$, and CO_2. Emission increases of other pollutants will be below the applicable PSD thresholds. As such, the Proposed Action will be subject to PSD permitting at OAC 252:100-8 as a major modification to an existing major stationary source of emissions.

PSD permitting is designed to protect public health and welfare by limiting emissions such that emissions from a new source or modification will not cause or contribute to an exceedance of a NAAQS, while allowing for economic growth to occur in a manner consistent with the preservation of existing clean air resources (USEPA, 2023f). Among other things, PSD permitting requires installation of the Best Available Control Technology (BACT), an ambient air quality impact analysis, and public involvement in the permitting process.

BACT is defined as an emissions limitation which is based on the maximum degree of control that can be achieved taking into consideration energy, environmental, and economic impacts associated with control technology.

Air quality modeling required by the PSD permitting process generally involves: (1) an assessment of existing air quality; and (2) dispersion modeling to predict ambient concentrations that will result from the applicant's proposed project and future growth associated with the project. Air quality impact modeling is required as part of the PSD permitting process to demonstrate that new emissions emitted from a proposed major stationary source or major modification, will not cause or contribute to a violation of any applicable NAAQS or PSD increment. PSD increment is the maximum allowable increase in concentration of an air pollutant that is allowed to occur above a baseline concentration for a pollutant. PSD increment is designed to prevent air quality in attainment areas from deteriorating to the level set by the NAAQS. It is important to note that a permit for the Proposed Action will not be issued by ODEQ-AQD if modeling demonstrates that the air quality will exceed the PSD increment or result in ambient concentrations above the applicable NAAQS.

In addition to PSD permitting, the proposed SCCTs will be subject to the applicable federal New Source Performance Standards (NSPS) at 40 CFR Part 60 Subparts KKKK and TTTT. The State of Oklahoma has adopted these standards by reference, and been granted authority by the USEPA to implement and enforce these standards (see, OAC 252:100 Subchapter 41). The applicable Part 60 Subpart KKKK standards are described below. The Part 60 Subpart TTTT GHG emission standards are described in Section 3.9.2.

The Subpart KKKK NSPS applies to stationary combustion turbines with a heat input at peak load equal to or greater than 10 MMBtu/hr that commence construction, modification, or reconstruction after February 18, 2005. Key pollutants regulated by the NSPS include NOx and SO_2. Subpart KKKK emission limits that will apply to the proposed SCCTs are summarized in Table 3-2.

Table 3-2. Subpart KKKK Emission Limits

Pollutant	Combustion Turbine	Emission Standard
NOx	New turbine firing natural gas with a combustion turbine heat input at peak load >50 MMBtu/hr and ≤850 MMBtu/hr	25 ppmvd @ 15% O_2 or 1.2 lb/MWh of useful output, 4-hour average for loads ≥ 75% of peak load
	Turbines with an output of 30 MWe or more, operating at less than 75% of peak load	96 ppmvd @ 15% O_2 or 4.7 lb/MWh of useful output, 4-hour average
SO_2		0.90 lb/MWh gross output, or must not burn any fuel which contains total potential sulfur emissions in excess of 0.060 lb. SO_2/MMBtu heat input

In addition, to the emission standards, Subpart KKKK requires initial performance testing to demonstrate compliance with the emission standards, as well as emissions monitoring, record keeping and reporting requirements.

Combustion turbine emissions may also be subject to the National Emissions Standard for Hazardous Air Pollutants (NESHAP) at 40 CFR Part 63 Subpart YYYY. The Subpart YYYY standards apply to stationary combustion turbines located at a major source of HAP emissions. A major source of HAP emissions is defined as a source that emits, or has the potential to emit, any single HAP at a rate of 10 tons or more per year or any combination of HAP at a rate of 25 tons or more per year. Based on emission calculations, the Anadarko Plant is classified as an area source (or minor source) of HAP emissions, meaning that total HAP emissions from the plant are below the major source thresholds. Based on emission calculations and projected utilization of the new SCCTs, the facility is expected to remain an area source of HAP emissions, and this rule will not apply to the facility.

3.9.1.3 Mitigation

Potential short-term air quality impacts associated with the construction phase of the Proposed Action will be mitigated through the implementation of fugitive dust control measures, including watering, to reduce generation of fugitive dust. In addition, all construction equipment will be maintained in accordance with manufacturer instructions. Construction of the Proposed Action may temporarily increase ambient concentrations of exhaust-related emissions and suspended particulate matter for short periods of time. Construction-related emissions impacts will depend on the type and level of activity and prevailing weather conditions; however, these short-term emission increases will end following construction and will not result in a significant change to the overall air quality.

Emissions during operation of the Proposed Action will be subject to all applicable federal and state emission standards. The Proposed Action will be subject to PSD permitting for NOx, PM_{10}, and $PM_{2.5}$ emissions; and the remaining criteria pollutant emissions increases will be below the applicable PSD significant thresholds. The Proposed Action will also be subject to PSD permitting for GHG emissions (see, Section 3.9.2).

As such, WFEC will be required to control NOx, PM_{10}, and $PM_{2.5}$ emissions using BACT, and conduct ambient air quality impact modeling demonstrating that emissions from the Proposed Action will not cause or contribute to adverse air quality impacts or the exceedance of a NAAQS. Based on a comprehensive review of available emission control technologies, WFEC anticipates firing low sulfur fuel (natural gas) exclusively combined with good combustion practices as BACT to reduce the formation of $PM_{10}/PM_{2.5}$ emissions, and water injection as BACT for the control of NOx emissions. WFEC will submit a comprehensive PSD construction permit application to ODEQ-AQD seeking a Construction Permit, which will authorize construction and initial operation of the Proposed Action. Within 180 days from startup of steady state operations, WFEC will submit a TV Operating Permit Application that will incorporate the applicable PSD Construction Permit and NSPS requirements.

As a result, the air permitting process, including the requirement to control emissions using BACT and air quality impact modeling to demonstrate that the Proposed Action will not cause or contribute to the exceedance of an applicable NAAQS, and the resulting emission limits, emissions monitoring, and reporting requirements, the Proposed Action will not result in adverse air quality impacts.

3.9.2 Greenhouse Gas Emissions and Climate

3.9.2.1 Affected Environment

Climate describes the long-term pattern of weather in a particular area, and is often defined as the average weather in a particular region and time period, usually taken over 30-years (NASA, 2005). The City of Anadarko experiences four seasons, with hot summers and cold winters. July and August are typically the hottest months of the year. The average high temperature in July and August is 93°F and the average low temperatures are 69°F and 68°F, respectively. January is typically the coldest month of the year. The average high temperature in January is 49°F and the average low temperature in January is 23°F. The wet season in Anadarko occurs from May to June with an average of 4.70 inches of precipitation. December and January experience an average of 1 inch of snowfall (U.S. Climate Data, 2023).

Between February and June, Anadarko experiences more wind than the remainder of the year. During this time, windspeeds average greater than 10.9 miles per hour. April is the windiest month of the year, with average wind speeds of 12.4 miles per hour. August is the month that experiences the least amount of wind in Anadarko, with an average wind speed of 9.2 miles per hour (Weather Spark, 2023).

Climate change refers to long-term shifts in temperatures and weather patterns. These shifts may be natural; however, the USEPA has determined that beginning in the 1800s, human activities have been the main driver of climate change, and anthropogenic greenhouse gas GHG emissions from human activities have been identified as the primary contributor to climate change (USEPA, 2023g). GHGs are defined as gases that trap heat within the Earth's atmosphere, and include CO_2, methane (CH_4), nitrous oxide (N_2O), and fluorinated gases. The largest source of GHG from human activities in the United States is from burning fossil fuels for electricity, heat, and transportation (USEPA, 2023h). Total U.S. GHG emissions in 2021 were estimated at 6,340 million metric tons (mt) of CO_2 equivalent (CO_2e) emissions, with approximately 12 percent (743 mt) related to natural gas combustion for electric power generation (EIA, 2023e).[2]

Concentrations of CO_2 in the atmosphere are naturally regulated by many processes that are part of the global carbon cycle. The flux, or movement, of carbon between the atmosphere and the earth's land and oceans is dominated by natural processes like plant photosynthesis (EIA, 2023f). As an example, land use, land-use change, and forestry in the U.S. is a net sink and offsets approximately 12% of GHG emissions (USEPA, 2023j). Although these natural processes can absorb some of the anthropogenic CO_2 emissions produced each year, CO_2 emissions from human activities exceed the capacity of these processes to absorb carbon, resulting in increased atmospheric concentrations of CO_2 (EIA, 2023f). Climatological effects of global climate change may include, but not necessarily be limited to, changes in precipitation patterns, lengthening of the frost-free and growing season, more droughts and heat waves, longer wildfire season, more intense hurricanes, and sea level rise (NASA, 2023).

The USEPA has published state-level assessments of climate change impacts based on Climate Change Indicators. In its August 2016 assessment of "What Climate Change Means for Oklahoma," USEPA stated: "Most of Oklahoma did not become warmer during the last 50 to 100 years. But soils have become drier, annual rainfall has increased, and more rain arrives in heavy downpours. In the coming decades, summers are likely to be increasingly hot and dry, which would reduce the productivity of farms and ranches, change parts of the landscape, and possibly harm human health" (USEPA, 2016).

On January 20, 2021, President Biden issued Executive Order (EO) 13990, "Protecting Public Health and the Environment and Restoring Science to Tackle the Climate Crisis," which declared, among other things, the Administration's policy to reduce GHG emissions and bolster resilience to the impacts of climate change (CEQ, 2023a). A White House fact sheet published to accompany EO 13990 directed the Council on Environmental Quality (CEQ) to review its regulations implementing the procedural requirements of NEPA and identify necessary changes or actions needed to meet the objectives of EO 13990. Consistent with EO 13990 objectives, on January 9, 2023, CEQ issued an interim guidance to assist federal agencies in analyzing GHG emissions and climate change effects from proposed projects under NEPA (*Guidance on Consideration of Greenhouse Gas Emissions and Climate Change*, CEQ, 2023b).

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[2] The term "CO_2 equivalent" or CO_2e means the number of metric tons of CO_2 emissions with the same global warming potential as one metric ton of other greenhouse gas emissions.

The CEQ interim guidance states that agencies should quantify reasonably foreseeable direct and indirect gross and net GHG emissions increases or reductions, both for individual pollutants and aggregated in terms of CO_2e. NEPA reviews should present annual GHG emission increases or reductions, as well as net emissions over a project's lifetime, particularly for projects that have both increases and reductions. GHG emissions and reductions should be quantified for the proposed action and alternatives, including the no-action alternative, which will serve as the baseline for considering effects (CEQ, 2023b).

The CEQ guidance does not establish any specific GHG emissions quantity as significantly affecting the quality of the environment. To provide context for GHG emissions and climate effects, the CEQ guidance suggests that once GHG emissions have been quantified, agencies should apply the social cost of greenhouse gas emissions (SC-GHG) to each individual type of GHG emissions expected from the proposed action as a way of monetizing (in U.S. dollars) the climate change effects from the incremental project-related GHG emissions (88 FR 1196 at 1202). The SC–GHG translates metric tons of emissions into the unit of dollars, allows for comparisons to other monetized values, and estimates the damages associated with GHG emissions over time and associated with different GHG pollutants including CO_2, CH_4, and N_2O. The SC–GHG estimates provide an aggregated monetary measure of the future stream of damages associated with an incremental metric ton of emissions and associated physical damages (e.g., temperature increase, sea-level rise, infrastructure damage, human health effects), and is intended to provide context about a proposed action's climate effects even if no other costs or benefits are monetized.

3.9.2.2 Environmental Consequences

3.9.2.2.1 No Action Alternative

As described in Section 1.2, the determination of need for replacement power at the Anadarko Power Plant was established based on near-term load requirements, projected load growth, and continued compliance with SPP capacity reserve requirements. As such, the No Action Alternative would result in siting new capacity resources at other locations to address these project needs and maintain adequate SPP capacity reserve margins. GHG emissions and incremental climate impacts resulting from the No Action Alternative would depend on the location and type of electric power generating resource used to provide replacement power and respond to WFEC member cooperative demands as an alternative to proceeding with the Proposed Action.

3.9.2.2.2 Proposed Action

Construction, operation, and demolition of the Proposed Action will result in direct and indirect GHG emissions. Direct emissions occur from sources at the facility, such as emissions associated with fuel combustion in the proposed SCCTs. Indirect GHG emissions do not physically occur at the facility and are generally associated with emissions from the construction and demolition of the facility, production of raw materials, feedstock production and transportation, and distribution of finished products (EPA, 2023e).

Lifecycle GHG emissions are defined as the aggregate quantity of GHG emissions (including direct emissions and significant indirect emissions such as emissions from raw material and feedstock production) related to the full lifecycle of the facility, including all stages of materials production and transportation, facility operation, and demolition. GHG emissions from the Proposed Action will consist primarily of CO_2 emissions from the combustion of natural gas in the SCCTs, with minor emissions of CH_4 and N_2O. Indirect GHG emissions will occur from manufacturing the SCCTs and ancillary equipment, production of construction materials, materials transportation, and combustion-related CO_2 emissions during construction of the facility.

An assessment of lifecycle GHG emissions includes an assessment of GHG emissions during all phases of the project. Lifecycle emissions can be divided into the following project phases (USEPA, 2023i):

1. Materials production and transportation;
2. Facility construction;
3. Facility operation; and
4. Facility demolition.

Lifecycle GHG emissions are the sum total of GHG emissions from each of the four project phases, expressed by the following equation:

$$GHG_{\text{Life cycle}} = GHG_{\text{Materials}} + GHG_{\text{Construction}} + GHG_{\text{Operation}} + GHG_{\text{Demolition}}$$

Construction phase emissions are a function of the materials of construction, materials sourcing, construction equipment, construction sequencing, and construction duration and schedule. Similarly, demolition phase emissions are a function of the types of equipment used at the time of demolition, demolition duration and sequencing, and waste disposal.

The National Renewable Energy Laboratory (NREL) has published lifecycle GHG emissions for various electricity generating technologies (NREL, 2021). Lifecycle GHG emissions published by NREL were developed taking into consideration some 3,000 published lifecycle assessment studies on utility-scale electricity generation for various generating technologies including wind, solar photovoltaics, lithium-ion battery storage, natural gas, and coal technologies.

The NREL assessment found that lifecycle GHG emissions from renewable electricity generation technologies are generally less than those from fossil fuel-based technologies, and that the proportion of GHG emissions from each lifecycle stage differs by technology. For fossil-fueled technologies, fuel combustion during operation of the facility emits the large majority of GHG emissions. For renewable energy technologies, most GHG emissions occur upstream of operation, including raw material sourcing and construction. Median lifecycle emission factors published by NREL for various electricity generating technologies are summarized in Table 3-3.

Table 3-3. NREL Median Life Cycle Emission Factors for Selected Electricity Generating Technologies by Life Cycle Phase (g CO_2e/kWh)

Generating Technology	One-Time Upstream	Ongoing Combustion	Ongoing Non-Combustion	One-Time Downstream	Total Lifecycle
Photovoltaic	~28	--	~10	~5	43
Wind	12	--	0.74	0.34	13
Lithium-ion Battery	32	--	NR	3.4	33
Natural Gas	0.8	389	71	0.02	486
Oil	NR	NR	NR	NR	840
Coal	<5	1,010	10	<5	1,001

Based on NREL lifecycle estimates, construction and demolition phase GHG emissions are generally less for natural gas generation compared to renewable energy alternatives, primarily due to resource extraction, component manufacturing, and facility construction. Operation phase GHG emissions are higher for all fossil-based generating technologies. The Proposed Action will be designed to provide approximately 100.4 gross MW of capacity (98.4 MW net output) to respond to periods of peak demand and fluctuations in power generation from renewable resources and to meet SPP capacity reserve requirements. Assuming an average annual capacity factor of 36 percent, the Proposed Action will provide approximately 310,314 megawatt hours (MWhrs) of net power generation to the grid on an annual basis. Assuming a project operating life of 30 years from construction to demolition, and using NREL estimates, lifecycle GHG emissions for the various generating technologies are described in Table 3-4.

Table 3-4. REL Lifecycle GHG Emissions for Electricity Generation (Metric tons)

Generating Technology		Lifecycle Emission Rate (g CO_2e/kWh)	Average Annual GHG Emissions (Metric tons/year)[1]	Total Lifecycle GHG Emissions (Metric tons)[2]
Renewable	Wind	13	4,034	121,022
	Solar PV	43	13,344	400,305
Storage	Lithium-ion Battery	33	10,240	307,211
Non-Renewable	Natural Gas	486	150,813	4,524,378
	Oil	840	260,664	7,819,913
	Coal	1,001	310,624	9,318,729

1. Annual emissions are calculated based on lifecycle emission rate (g CO_2e/kWh) and projected annual net generation assuming an annual capacity factor of 36%.
2. Total life cycle GHG emissions were calculated assuming a project life of 30 years.

Wind, solar, and renewable resources coupled with energy storage have lower lifecycle GHG emissions because those technologies do not generate combustion-related emissions during operations. However, as discussed in Section 2.0, adding additional wind and solar capacity to WFEC's existing generation portfolio would not achieve the stated project objectives of providing reliable replacement capacity at the Anadarko Plant and continued compliance with SPP reserve requirements. In addition, renewable resources are not dispatchable, and would not be available to respond to fluctuations in demand and power generated by existing renewable resources. Similarly, battery storage would not provide the capacity or dispatchability required to achieve Project goals and objectives. Of the generating technologies available to meet all Project goals, including reliable, efficient, and cost-effective capacity with the ability to respond rapidly to fluctuations in demand/generation, natural gas generation results in the lowest total lifecycle GHG emissions.

A large majority, more than 80 percent (see, Table 3-3), of the total life cycle GHG emissions from the Proposed Action will be generated during the operating phase of the Project. Although the Proposed Action will result in combustion-related GHG emissions, the proposed natural gas generating technology results in significantly less GHG emissions than other fossil-based generating technologies. As such, regional GHG emissions under the No Action Alternative could be higher than those projected from the Proposed Action if higher emitting or less efficient generating technologies are used to satisfy SPP capacity reserve requirements and provide power to WFEC members.

In addition, the proposed new SCCTs will generate fewer GHG emissions, on a lb./MWh basis, than those previously generated by the three less efficient, high-pressure boilers slated for retirement. Based on historical operating data available from the EPA's Clean Air Markets Database, the high-pressure boilers at the Anadarko Plant operated at an average heat rate of approximately 13,750 Btu/kWh-gross. The proposed new SCCTs will operate at a full load heat rate of approximately 8,947 Btu/kWh-gross (LHV), or an overall efficiency improvement of approximately 35 percent. This improved efficiency directly translates to a 35 percent reduction in fuel use and GHG emissions on a lb. CO_2/MWh basis for each MWh produced, although total GHG emissions from the plant could increase depending on utilization and dispatch of the new units compared to the less efficient boilers.

In addition to quantifying lifecycle GHG emissions, the CEQ guidance suggests that agencies provide context for GHG emissions and related climate effects by applying the best available estimates of the SC-GHG to the incremental metric tons (mt) of each individual type of GHG emission expected from a proposed action and its alternatives (88 FR 1202, January 9, 2023). The "*Technical Support Document: Social Cost of Carbon, Methane, and Nitrous Oxide Interim Estimates under Executive Order 13990*" released by the Interagency Working Group (IWG) on Social Cost of Greenhouse Gases in February 2021 presents interim estimates of the social cost of carbon for CO_2, CH_4, and N_2O emissions (IWG SC-GHG, 2021).

The Social Cost of CO_2 (SC-CO_2), CH_4 (SC-CH_4), and N_2O (SC-N_2O), as outlined by the IWG using a 5% discount rate are summarized in Table 3-5.

Table 3-5. IWG SC-GHG 2020 – 2050 (in 2020 dollars per metric ton)

Year	CO_2	CH_4	N_2O
2020	$14	$670	$5,800
2025	$17	$800	$6,800
2030	$19	$940	$7,800
2035	$22	$1,100	$9,000
2040	$25	$1,300	$10,000
2045	$28	$1,500	$12,000
2050	$32	$1,700	$13,000

Using the 2025 social costs provided in Table 3-5, and projected GHG emissions from the proposed SCCTs, the total annual SC-GHG associated with the Proposed Action is summarized in Table 3-6.

Table 3-6. Total SC-GHG

Greenhouse Gas	GHG Emission Factor (lb/MMBtu)[1]	GHG Emission Rate (lb/hr)[2]	Direct GHG Annual Emissions (mt/yr)[3]	SC-GHG $/mt	Total Corresponding Social Cost
CO_2	117	59,541	85,170	$17	$1,447,890
CH_4	0.0022	1.1	1.6	$800	$1,280
N2O	0.0002	0.1	0.1	$6,800	$680
Total GHG Emissions (per SCCT)		59,542	85,172		$1,449,850
Total GHG Emissions (Two SCCTs)		119,084	170,344		$2,899,700
Average SC-GHG ($/mt):					$17.02

1. Emission factors taken from 40 CFR Part 98, Tables C-1 and C-2 for natural gas combustion.
2. Hourly emissions calculated based on full load heat input of 508.9 MMBtu/hr higher heating value (HHV) (per SCCT).
3. Total direct annual emissions calculated assuming an annual capacity factor of 36 percent for each SCCT.

GHG emissions totaled 6,340.2 million mt of CO_2e in the U.S. in 2021 (EPA, 2023g). Assuming an average SC-GHG of $17/mt CO_2e, translates to a total SC-GHG of almost $110 billion/year from existing sources. Based on an assessment of recent legislative actions prepared by the non-profit organization RMI, the U.S.

government will spend more than $500 billion on climate technology and clean energy over the next decade under three recently enacted laws, including $362 billion from the Inflation Reduction Act (IRA), $98 billion from the Infrastructure Investment and Jobs Act, and $54 billion from the CHIPS and Science Act (RMI, 2022). In the context of social costs, the Proposed Action will contribute to an incremental increase to climate impacts and the total costs society will incur in the future related to climate change from GHG emissions. However, based on emission calculations and SC-GHG estimates provided above, the Proposed Action will contribute less than 0.0027% of total GHG emissions from U.S. sources, and the social cost attributable to the Proposed Action will represent an insignificant contribution to costs expected to be expended to address climate related challenges.

The CEQ guideline suggests providing comparisons or equivalents to describe GHG emissions and related impacts in more familiar terms. Techniques may include placing a proposed action's GHG emissions in more familiar metrics such as household emissions per year (see, 88 FR 1203). The CEQ suggests that such comparisons may be a useful supplement that can be presented along with project-related monetized SC-GHG.

Using the EPA's household carbon footprint calculator, a household of four located in Anadarko, using natural gas as their primary source of heat, and two cars would exhaust approximately 25.4 metric tons of direct CO_2 emissions annually (USEPA, 2023k). This includes direct emissions from natural gas and electric power consumption, vehicle emissions, and emissions from waste generation and disposal. Based on these estimates, direct GHG emissions from the Proposed Action (i.e., 170,344 metric tons/year CO_2e) will equate to GHG emissions from approximately 6,700 households.

Given the relatively minor incremental contribution to overall GHG emissions from the Proposed Action, the estimated SC-GHG evaluated in the context of overall societal carbon costs, and GHG emissions from other human-related activities, climate impacts from the Proposed Action will be minimal.

3.9.2.3 Mitigation

No mitigation strategies beyond using state-of-the-art, efficient low carbon fuel (natural gas) combustion technology with evaporative cooling or wet compression is proposed to achieve further GHG emission reductions. The Proposed Action represents the most efficient and cost-effective generating technology available to achieve the stated Project goals.

Hydrogen combustion is being studied as an alternative to natural gas combustion as a method of reducing CO_2 emissions from power generation; however, hydrogen co-firing would not achieve all Project goals and objectives due to hydrogen supply limitations, and inadequate hydrogen transportation, distribution, and storage infrastructure.

Post-combustion carbon capture and sequestration (CCS) technologies, including amine-based carbon capture systems, have not been demonstrated as being technically feasible on non-baseload simple-cycle natural gas-fired combustion turbines designed to cycle in response to energy demand. Furthermore, the long-term sequestration of CO_2 in geologic formations, and the infrastructure needed to transport CO_2 from the point of capture to the sequestration field, has not been developed. In June 2023, Oklahoma passed SB 200 which directed the Oklahoma Corporation Commission (OCC) and ODEQ to study and begin the process to gain delegation for Underground Injection Class VI well permitting for carbon sequestration projects. On June 14, 2023, the Oklahoma Secretary of Energy, OCC, and ODEQ held a stakeholder meeting to begin this process and request comment from interested parties. The study is on-going. Finally, the cost of CCS, if technically feasible, including design, engineering, and installation of the carbon capture equipment, pipeline transport of the CO_2, and development of the geologic sequestration field would exceed the SC-GHG estimated for the Proposed Action.

The Proposed Action is consistent with national and state science-based GHG reduction policies, and is intended to provide reliable generating capacity and respond quickly to fluctuations in demand and power generation from renewable resources. The National Conference of State Legislatures published a report in September 2021 identifying the states and territories that have enacted legislation outlining GHG emissions reduction goals and requirements (NCSL, 2023). Oklahoma was identified in the report as a state that does not currently have GHG emissions reduction requirements; however, in 2010, Oklahoma established a 15% renewable energy goal by 2015. The State, and WFEC, have easily surpassed this goal, with nearly 50% of the State's power from renewable resources (Oklahoma Secretary of Energy and Environment, 2021). The Proposed Action will support the continued development of renewable energy resources in the State by providing reliable, rapidly dispatchable energy during periods of low renewable energy generation.

In addition to providing a dispatchable resource and supporting continued reliability of renewable resources, the proposed SCCTs will have to meet all applicable federal and state emission standards, including the federal NSPS limiting CO_2 emissions from fossil-based generating units. Emission standards for GHG emissions electric generating units, including stationary gas-fired combustion turbines, are in 40 CFR Part 60 Subpart TTTT. The Subpart TTTT emission standards are provided in Attachment 8. Based on the stated Project goals and objectives, WFEC anticipates that the proposed SCCTs will operate at or less than their design efficiency multiplied by their potential electric output as net electric sales. As such, Subpart TTTT will require the units to meet a CO_2 emission limit of 120 lb. CO_2/MMBtu heat input to the units, which the units will readily meet.

On May 23, 2023, the USEPA published a proposed rule to revise CO_2 emission limits applicable to fossil fuel-fired power plants (88 FR 33240, May 23, 2023). Among other things, the proposed rule would revise CO_2 emission limits for new gas-fired combustion turbines. For new and reconstructed fossil fuel-fired combustion turbines, USEPA proposed creating the following three subcategories based on the function the combustion turbine serves:

- Low load ("peaking units") subcategory that consists of combustion turbines with a capacity factor of less than 20 percent
- Intermediate load subcategory for combustion turbines with a capacity factor that ranges between 20 percent and a source-specific upper bound that is based on the design efficiency of the combustion turbine
- Base load subcategory for combustion turbines that operate above the upper-bound threshold for intermediate load turbines

Emission limits would be established for each subcategory and phased in over the next several years. USEPA proposed a heat input-based CO_2 emission limit for the low-load subcategory that mirrors the existing Subpart TTTT standard. Combustion turbines operating within the intermediate-load subcategory would be subject to an initial output-based standard of 1,150 lb. CO_2/MWh-gross, which would be revised downward in 2032. For units operating in the baseload subcategory, USEPA proposed emission limits based on either 90 percent capture of CO_2 using CCS by 2035, or co-firing of 30 percent by volume low-GHG hydrogen beginning in 2032 and co-firing 96 percent by volume low-GHG hydrogen beginning in 2038.

Revisions to the Subpart TTTT NSPS are currently proposed, and USEPA has requested comment on all aspects of the rule, including emission limits and timing. Nevertheless, WFEC will be obligated to ensure compliance with the revised standards when finalized. Depending on the applicable emission limits and timing, the imposition of more restrictive CO_2 emission limits to stationary combustion turbines will reduce lifecycle GHG emissions from the Proposed Action.

3.10 Socioeconomics and Environmental Justice

3.10.1 Population and Employment

3.10.1.1 Affected Environment

3.10.1.1.1 Population Growth Trends

Population growth trends were assessed based on data available from the U.S. Census Bureau (USCB). USCB population data show there has been a decline in the population of Caddo County, Oklahoma since 2010. The 2010 Census reported a population of 29,600 compared to a population of 26,945 reported in the 2020 Census. The USCB's population data estimate for July 1, 2022, reported 26,198, substantiating the population trend of Caddo County, Oklahoma to be in decline (USCB, 2022a).

The USCB population data also show a similar trend of decline for the population of Anadarko City, Oklahoma. The 2020 Census reported a population of 5,745, a decline from the 2010 Census which reported a population of 6,762. The USCB's population data estimate for July 1, 2022, reported a population of 5,531, substantiating the population trend of Anadarko City, Oklahoma to be in decline (USCB, 2022b).

3.10.1.1.2 Racial and Ethnic Characteristics

The largest city near the Project Site is the City of Anadarko for which census data show the total population to be approximately 5,531 as of July 1, 2022. Of that, 38.5% are of American Indian and Alaskan Native descent, with the second most prevalent race being persons of Caucasian descent at 35.1% (including persons of Hispanic descent). The remaining population are reported to be either African American, Asian, Hispanic, or multi-racial (USCB, 2022b).

The racial distribution of Caddo County is somewhat different than that of the City of Anadarko. The population of Caddo County as of July 1, 2022, was approximately 26,198. The most significant difference regarding racial characteristics is the higher percentage of persons of Caucasian descent at 65.3% (including persons of Hispanic descent) and the decline of persons of American Indian and Alaskan Native descent to 23.3%. Similar to the rise in persons of Caucasian descent (including persons of Hispanic descent), there was also a rise in the overall percent of persons of only Caucasian descent (not including persons of Hispanic descent) from 31.9% (City of Anadarko) to 55.1% (Caddo County). There was also a decline, when compared to the City of Anadarko, in the percentage of population reporting as multi-racial (USCB, 2022c).

The American Indian and Alaskan Native population of Caddo County can be broken down into the following Official Tribes: Caddo Nation of Oklahoma, Comanche Nation, Delaware Nation, Fort Sill Apache Tribe, Kiowa Tribe of Oklahoma, and Wichita and affiliated Tribes (Oklahoma Department of Libraries, 2023). In general, as described above, the City of Anadarko has a larger minority population than the surrounding area. A map showing the distribution of minority populations in Caddo County is included as Attachment 9a.

3.10.1.1.3 Employment and Income

During the four-year period starting in 2017 and ending in 2021, the total population age 16 or over in the City of Anadarko’s civilian labor force made up 53.5% of the city’s population. Of the city’s population age 25 or older, 88.9% had achieved high school graduation or above, with 14.0% of the city’s population above the age of 25 having a bachelor’s degree or higher. The median household income between 2017 and 2021 in the City of Anadarko was $44,203 (in 2021 dollars) with approximately 57.2% of residents owning their housing unit. The City of Anadarko has a poverty rate of 29.3% (USCB, 2022c).

Similar to the City of Anadarko, the total population age 16 or over in Caddo County’s civilian labor force made up 51.1% of the county’s population. Of the county’s population age 25 and older, 85.7% had achieved high school graduation or above, with 14.8% having a bachelor’s degree or higher. The median household income in Caddo County was $47,566 (in 2021 dollars) with approximately 72.6% of Caddo County residents owning their housing unit. Caddo County has a poverty rate of 26.1% (USCB, 2022c).

A map depicting median income for the area is included as Attachment 9b and a map depicting poverty population for the area is included as Attachment 9c.

3.10.1.2 Environmental Consequences

3.10.1.2.1 No Action Alternative

The No Action Alternative would have no significant short-term or long-term impacts associated with employment or population at or in the vicinity of the proposed Project.

3.10.1.2.2 Proposed Action

The Proposed Action will be expected to have a beneficial impact on employment and the local economy. Construction of the Proposed Action will create a number of temporary construction jobs, and result in increased demand for skilled labor in areas of excavation and grading, construction of the combustion turbines, related infrastructure, electrical, plumbing, and related trades. The number of construction workers is expected to peak at approximately 100, with the daily average being lower, during the approximate 17-month construction period. Construction of the Proposed Action will result in increased demand for both skilled and unskilled labor and provide an opportunity for local residents to gain employment. Because the Proposed Action is located within Caddo County, with a population of approximately 26,000 persons, it is expected that many of the construction workers will be from the immediate area, including the City of Anadarko, Chickasha (located approximately 15 miles east of the City of Anadarko), and other smaller communities in the area. Oklahoma City, a major population center with a population of more than 680,000 persons is located approximately 45-miles northeast of the Project Site, will also provide a source, as needed, for skilled and unskilled construction workers.

Following construction of the Proposed Action, WFEC will continue to operate the Anadarko Power Plant as a gas-fired electric generating resource. The Anadarko Power Plant is a major employer in the City of Anadarko and Caddo County, and offers the opportunity for both skilled and unskilled labor jobs, as well as managerial, administrative, and support staff opportunities. The Anadarko Power Plant will continue to provide job opportunities to the local community and is an important part of the economic base in the City of Anadarko. Because the Anadarko Power Plant is an existing power plant, the Proposed Action will not be expected to result in a significant increase in overall jobs at the site, and will not be expected to adversely affect population or community resources in the City of Anadarko or Caddo County.

3.10.1.3 Mitigation

No mitigation measures are proposed for population and employment impacts.

3.10.2 Environmental Justice

3.10.2.1 Affected Environment

Environmental justice (EJ) concerns may arise from human health or environmental effects of a project on either minority or low-income populations. The need to identify environmental justice issues is stated in Executive Order 12898, entitled "Federal Actions to Address Environmental Justice in Minority Populations and Low-income Populations." The EO states "each Federal agency shall 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." A Presidential Memorandum accompanying the EO directed agencies to incorporate environmental justice concerns into their NEPA processes and practices.

EJ issues are identified by determining whether minority or low-income populations are present in the area of the Project. If so, disproportionate effects on these populations would be considered. Guidance published by the Council on Environmental Quality (CEQ) states that minority populations should be identified when the percentage of minority residents in the affected area exceeds 50 percent or is meaningfully greater than the percentage of minority residents in the general population (CEQ, 1997). If the percentage of minority residents of the population in the census tract within which the project is located exceeds the county level by more than 10 percent, it is considered to be "meaningfully greater" for the purposes of this analysis. The CEQ guidance also states that the low-income populations should be identified based on poverty thresholds as reported by the USCB. If the poverty rate for the population of the census tract within which the Project is located exceeds the county poverty rate by more than 10 percent, it is considered to be an area of environmental justice concern for the purposes of this analysis.

To determine if there are disproportionate effects present within a specific population or community, the USEPA has created the EJScreen tool (USEPA, 2023m). This tool is a mapping and screening tool that identifies areas of potential environmental quality issues and demographic socioeconomic indicators. An EJ Index combines a single environmental factor with a two-factor demographic index (average of low income and people of color population). A Supplemental Index uses a five-factor demographic index rather than the two-factor demographic index. The five factors are low income, unemployed, limited English speaking, less than high school education, and low life expectancy. EJScreen also provides environmental and socioeconomic data broken down into Health Indicators, Climate Indicators, and Critical Service Gaps. Each index/indicator is compared to the state and national averages. The USEPA identifies the 80th percentile or higher as a possible EJ/socioeconomic concern.

The EJScreen report prepared for a ten-mile radius (EJ10-Mile) around the Proposed Action shows an area with a high percentage of low-income population (i.e., 90 to 95th percentile) and a community with a high percentage of people of color (i.e., 80 to 90th percentile) within approximately 1 mile of the Project site; thus, EJ concerns and the potential for disproportionate environmental and socioeconomic impacts on these communities are evaluated, as appropriate, in Section 3.10.2.2 and other sections of this EA. Based on the EJScreen ten-mile radius report, the low income communities and communities with a high percentage of people of color within the ten-mile radius are identified as having disproportionate environmental impacts (when compared to other communities in Oklahoma) for Superfund Proximity (i.e., site count/km distance, 90th percentile) and Lead Paint (80th percentile). The area is at, or below the 80th percentile ranking (above which indicates potential for EJ concerns) for all EJ and Supplemental indexes when compared to the national percentile, with the exception of the supplemental ozone index (82nd national percentile). The complete EJ ten-mile radius report is provided in Attachment 9d. Census data from the 2010 and 2020 USCB are presented in Section 3.10.1.1.1 and 3.10.1.1.2.

The Climate and Economic Justice Screening Tool (CEJST) developed by CEQ is an additional tool that can be used to help identify communities that may be disadvantaged or overburdened by pollution and underinvestment (CEQ, 2023c). The CEJST uses datasets that are indicators of burdens in eight categories: climate change, energy, health, housing, legacy pollution, transportation, water and wastewater, and workforce development. The tool uses this information to identify communities that are experiencing these burdens. The census tract in which the City of Anadarko is located, identified as tract 40015162100, is identified as being disadvantaged with respect to one or more burden thresholds and associated socioeconomic threshold. Burden thresholds include climate change impacts from projected wildfire risk, and health burdens such as asthma, heart disease, and lower life expectancy, coupled with the socioeconomic impact of lower income.

3.10.2.2 Environmental Consequences

3.10.2.2.1 No Action Alternative

No Action Alternative would have no short-term or long-term socioeconomic or EJ impacts at or in the vicinity of the Proposed Action. However, the No Action Alternative could result in socioeconomic and/or EJ impacts at another location within the WFEC service area. Impacts from the No Action Alternative would depend on the location and type of electric power generating resource used to provide replacement power and respond to WFEC member cooperative demands as an alternative to proceeding with the Proposed Action.

3.10.2.2.2 Proposed Action

The Proposed Action is located in close proximity to an area with a meaningful greater percentage of low-income persons and a community with a higher percentage of people of color; however, the Proposed Action is not expected to exacerbate or contribute to disproportionate environmental or health impacts on these communities. Based on a review of EPA’s EJScreen Mapping Tool, the communities are identified as having disproportionate environmental impacts (when compared to other communities in Oklahoma) for Superfund Proximity and Lead Paint. These impacts result from legacy pollution associated with prior industrial and building material activities, and the Proposed Action will not contribute to these environmental impacts.

The communities are at, or below the 80th percentile ranking (above which indicates potential for EJ concerns) for all EJ and Supplemental indexes when compared to the national percentile, with the exception of the supplemental ozone index (82nd national percentile). However, ozone concentrations in the area are reported to be 62.8 parts per billion (ppb) compared to the state average of 62.3 ppb and the NAAQS of 70 ppb. As such, average ozone concentrations are somewhat above the state average, but well below the NAAQS which is designed to be protective of human health and the environment. The EJ10-Mile Radius Report is included in Attachment 9d.

Other potential impacts from the Proposed Action affecting human health, including solid and hazardous waste management and environmental risk management, are evaluated in Section 3.12. Air quality and climate impacts are evaluated in Section 3.9. As described in the air quality section, potential short-term air quality impacts associated with the construction phase of the Proposed Action will be mitigated through the implementation of fugitive dust control measures to reduce generation of fugitive dust and all construction equipment will be maintained in accordance with manufacturer's instructions. Construction-related emissions will end following construction and will not result in a significant change to the overall air quality. Emissions during operation of the Proposed Action will be subject to all applicable federal and state emission standards, and the Proposed Action will be subject to PSD permitting for NOx, PM10, and PM2.5 emissions. As such, WFEC will be required to control NOx, PM10, and PM2.5 emissions using BACT, and conduct ambient air quality impact modeling demonstrating that emissions from the Proposed Action will not cause or contribute to adverse air quality impacts or the exceedance of a NAAQS.

Based on a review of USEPA's EJScreen Mapping Tool and CEJST, the Proposed Action is located in relatively close proximity to a community of color and a community with a relatively high percentage of low-income persons that have been disproportionately impacted for EJ indexes related to proximity to superfund sites and lead paint. However, operation of the Proposed Action will not contribute to disproportionate environmental or human health impacts for these, or other, EJ indexes. The Proposed Action will not be designed with USTs, will not treat or dispose of hazardous wastes, and will not be expected to use or store hazardous chemicals in quantities that will require a Risk Management Plan (RMP). Air emissions and wastewater discharges will meet all applicable federal, state, and permit requirements. In addition, the Proposed Action will result in beneficial socioeconomic impacts on the local community (see, Section 3.10.1.2.2).

3.10.2.3 Mitigation

As outlined in 7 CFR Part 1970.14(b) and 40 CFR Part 1506.6, meaningful engagement with the City of Anadarko, Caddo County, local Tribes, and the State of Oklahoma should be conducted to assess human health, climate-related risks, concerns, and mitigation. A comprehensive list of activities to involve the public are further outlined in the regulations cited above in this paragraph.

3.11 Miscellaneous Issues

3.11.1 Noise

3.11.1.1 Affected Environment

Noise is generally defined as loud, unpleasant, unexpected, or undesired sound that interferes with or disrupts normal activities. Prolonged exposure to high noise levels has been demonstrated to cause hearing loss; however, the principal human response to environmental noise is annoyance. The perceived importance of noise depends upon the setting, the time of day, the activity creating the noise, and the sensitivity of the individual. Sensitivity receptors may include school settings, churches, nursing homes, and medical facilities.

Sensitive receptors in the surrounding area include two schools, three medical facilities, and 12 religious facilities located within one mile of the proposed Project Site (Google, 2023c; USGS, 2023). A list of these receptors and their distance to the Site are included in Attachment 10a. Additionally, more than 100 residences are located within one mile of the Project Site, generally southwest of the site within the Anadarko city limits (Google, 2023c). A figure showing nearby sensitive receptors is included as Attachment 10b. Some vegetative buffers exist along the railroad right-of-way located south of the Project Site and between the facility and potential noise receptors.

Oklahoma statutes and City of Anadarko ordinances provide for a general prohibition of noise-generating activities that disturb the peace and quiet of a city, neighborhood, family, etc., or create a nuisance (see, e.g., Oklahoma Statutes Title 47 Chapter 12 §12-402; and Anadarko Code of Ordinances Section 5-1-5 Loud Noises). The USEPA has identified a day-night average sound level (Ldn) of 55 A-weighted decibels (dBA) as the level below which no adverse impact occurs. The USEPA suggests that noise level from industrial sites should not exceed 75 dBA during the day and 70 dBA during the night. An Ldn of 65 dBA represents a compromise between community impact and the need for construction, as such, this value is commonly used for noise planning purposes (USEPA, 1974).

The proposed Project Site is an existing, operational electric power generating plant. The plant currently consists of a number of operating units, including five simple-cycle combustion turbines and three combustion-turbines operating in the combined-cycle mode with a heat recovery steam generator. The five simple-cycle combustion turbines are essentially the same as the proposed new SCCT units. As such, the plant is currently producing noise that is representative of that generated by a gas-fired electric generating plant, including noise from the operation of simple-cycle combustion turbines, vehicle use, and related activities. The site is primarily surrounded by agricultural activities to the north and east, and commercial/residential development to the south and southwest (Google, 2023c). Existing industrial, agricultural, commercial, and residential activities will all contribute to ambient noise in vicinity of the proposed Project.

3.11.1.2 Environmental Consequences

3.11.1.2.1 No Action Alternative

The No Action Alternative would have no short-term or long-term impacts to noise in the vicinity of the proposed Project.

3.11.1.2.2 Proposed Action

Project-related construction activities will result in short-term, transitory noise impacts in the immediate vicinity of the Project. Noise generating activities will include operation of construction and earth moving equipment, including trucks, bulldozers, cranes, and similar equipment.

During operations, it is expected that noise impacts associated with the operation of the proposed new SCCT units will be similar to current noise generating activities at the site. As is currently the case, the facility will operate 24 hours per day, 7 days per week; with most activity occurring at the site during periods of peak power demand, generally 5-9 a.m. during the winter season and 4-8 p.m. during the summer (Oklahoma's Electric Cooperatives). Operation of the new SCCT units and related activities are expected to be the same as, or less than, current noise generating activities at the site. Noise from the Proposed Action will become an element of the baseline noise-generating activities at the electric power generating plant and contribute to ambient noise in the vicinity of the facility. Baseline noise generation at the existing facility has not resulted in noise complaints from sensitive receptors in the surrounding area. Based on expected noise generating activities during operation of the new SCCT units and the distance to sensitive noise receptors, noise impacts from the Proposed Action will be minimal.

3.11.1.3 Mitigation

Construction-related noise impacts will be mitigated as much as practical to minimize nighttime noise impacts by limiting noise-generating activities to the hours 6:00 a.m. and 6:00 p.m, depending on the time of year and taking into consideration construction-related safety considerations. Any deviations from this schedule will be rare and short in duration. During operation of the Proposed Action, noise from the new SCCT units will be mitigated by incorporating noise reduction into the design of the units. The combustion turbine specification prepared for the Project specifies that near field noise from the units cannot exceed 85 dBA under normal equipment operation (measured at 1 m in the horizontal plane and 1.5 m above the gas turbine base). Construction- and operating-noise impacts will also be mitigated by the presence of existing vegetative buffers between active construction/operating areas and potential noise receptors.

3.11.2 Transportation and Traffic

3.11.2.1 Affected Environment

The main entrance of the Anadarko Power Plant is located on NE 7th Street. A secondary entrance to the plant is located at N. Country Club Road and Watson Road. It is anticipated that the N. Country Club Road entrance will be used for construction traffic related to the Proposed Action to reduce traffic at the main entrance. One route is available to reach this entrance that generally circumvent residential neighborhoods: from U.S. Highway 62 (U.S. 62) onto N. Country Club Road. U.S. 62 is a fully improved, paved, four-lane highway with a posted speed limit of 65 mph. Upon entering city limits, the speed limit is reduced to 35 mph.

The Project Site is approximately 2.8 miles northeast of Anadarko Municipal Airport and 15.1 miles east of Chickasha Municipal Airport. Additional airports in the area are the Lawrence landing strip located approximately 17 miles to the northwest; Carnegie Municipal Airport located approximately 20 miles to the northwest; and SkyRoads Airport located approximately 19 miles to the southwest.

3.11.2.2 Environmental Consequences

3.11.2.2.1 No Action Alternative

The No Action Alternative would have no impact on the traffic or changes to any traffic patterns in the vicinity of the proposed Project.

3.11.2.2.2 Proposed Action

Existing roads will be used for construction access to the Project Site. Potential impacts to traffic will generally occur during construction of the Proposed Action and be related to construction workers commuting to the site. The number of construction workers is expected to peak at approximately 100, with the daily average being lower, during the construction period. Because the Proposed Action is located within Caddo County, with a population of approximately 26,000 persons, it is expected that some construction workers will be from the immediate area, including the City of Anadarko, Chickasha (located approximately 15 miles east of the City of Anadarko), and other smaller communities in the area. Oklahoma City, a major population center with a population of more than 680,000 persons is located approximately 45-miles northeast of the Project Site, will also provide a source for skilled and unskilled construction workers.

Minor traffic-related impacts will likely occur during construction of the Proposed Action at access points to the Project site. During construction, increased traffic will be expected due to ingress and egress of construction vehicles and construction workers on U.S. 62, U.S. Highway 281 (U.S. 281), and city roads leading to the Project site, including North Country Club Road and Watson Drive. However, roads leading to the Project Site are improved and paved, and are expected to handle the increased traffic without modifications. In addition, construction-related traffic impacts will be transitory and limited to the approximate 17-month construction period. Traffic flows will return to pre-construction levels following construction of the Proposed Action.

The FAA requires notice for any construction or alteration meeting criteria listed in 14 CFR Part 77.9 in order to promote air safety and the efficient use of air space. Based on the FAA's Notice Criteria Tool (FAA, 2023) which provides a preliminary determination of Part 77 notice applicability, the new SCCT exhaust stacks (approximately 80 feet agl) are not expected to require FAA notice, indicating that the stacks will not pose a hazard to aircraft navigation. Once transmission line structure heights and locations are known, the FAA Notice Criteria Tool will be used to determine if notice to the FAA is needed.

3.11.2.3 Mitigation

Entrances and exits for construction traffic have been designated along with the anticipated use of a railroad for delivery of the transmission structures. WFEC will coordinate with the City of Anadarko and Caddo County, as needed, to ensure the existing traffic control infrastructure can support construction of the Proposed Action, and to coordinate access to the Project site to minimize traffic impacts during construction.

3.11.3 Utilities

3.11.3.1 Affected Environment

Utility requirements for the Proposed Action will include water, electricity, sanitary sewer, natural gas, and internet. The Anadarko Power Plant currently is equipped with the following utilities:

- Water: Raw water is obtained from Fort Cobb Reservoir. The Fort Cobb Reservoir Conservatory District manages and operates the reservoir.

- Natural Gas: There is an existing natural gas regulating station, meter, and tie in located at the Project site. Natural Gas is provided to the plant by two suppliers, Enable Oklahoma Intrastate Transmission, LLC and ONEOK Western Trails Pipeline.

- Electricity: Auxiliary electric power from the generating plant is used to provide internal electricity.

- Telecommunications: WFEC self-provides telecommunication services to the proposed Project site.

- Sewer: The Anadarko Power Plant is currently served by the Anadarko sanitary sewer system. The Anadarko Wastewater Treatment Plant has a capacity of 1.94 MGD (City of Anadarko, 2015a).

3.11.3.2 Environmental Consequences

3.11.3.2.1 No Action Alternative

The No Action Alternative would have no short-term or long-term impacts to utilities at or in the vicinity of the proposed Project.

3.11.3.2.2 Proposed Action

Construction of the Proposed Action will require water, electricity, telecommunications (i.e., telephone, and internet). Utility requirements associated with operating the Proposed Action will include water, electricity, natural gas, and telecommunications.

Because the Proposed Action will take place at the existing Anadarko Power Plant, WFEC expects to use existing utility infrastructure at the plant to provide water, electricity, sanitary wastewater services, and natural gas for the Project. Adequate utilities are available at the Anadarko Power Plant to support the Proposed Action. Additional fiber cable will be laid, as needed, to support Project telecommunications.

Given availability of the necessary utilities, construction and operation of the Proposed Action will result in no short- or long-term impacts to utilities.

3.11.3.3 Mitigation

No mitigation measures are proposed for utility impacts.

3.11.4 Community Resources

3.11.4.1 Affected Environment

Community resources that may be impacted by the construction and operation of the Proposed Action include availability and adequacy of local fire and police resources and access to emergency medical services.

Emergency and medical services are located in close proximity to the proposed Project site. The Physician's Hospital of Anadarko, located 0.6 miles from the Project Site, is a Level IV trauma hospital (Oklahoma State Department of Health, 2017). Additionally, the Grady Memorial Hospital, located 17.6 miles from the Project Site, is a Level III trauma hospital with a wide variety of medical specialties available (GMH, 2023).

The Anadarko Police Department is located approximately 1.18 miles from the proposed Project Site. The Department is a full-service police department with 18 sworn personnel (City of Anadarko, 2015c). The Anadarko fire department operates two stations, and the primary response area covers 139 square miles for fire protection and 339 square miles for the ambulance service. There are 21 full-time line personnel and four volunteers; additionally, there are nine paramedics (City of Anadarko, 2015b).

3.11.4.1.1 No Action Alternative

The No Action Alternative would have no short-term or long-term impacts to community resources in the vicinity of the proposed Project.

3.11.4.1.2 Proposed Action

Construction and operation of the Proposed Action could require access to local fire and police resources, as well as access to local emergency medical services. Access to emergency and medical resources will be needed in the event of a significant health/safety or environmental accident at the Project Site or unanticipated criminal activity.

Because the Proposed Action is located at an existing WFEC power plant in an area of industrial, commercial, and residential development, the existing emergency medical and emergency response infrastructure in the City of Anadarko has experience with industrial operations and adequate coverage, resources, and expertise to provide services during construction and operation of the Proposed Action. As such, the Proposed Action will not be expected to overstress or adversely impact access to human health and safety resources in the community.

3.11.4.2 Mitigation

No mitigation measures are proposed for impacts to community resources.

3.12 Human Health and Safety

Potential human health and safety impacts resulting from the Proposed Action are assessed for the proposed Project Site and communities located immediately adjacent to the Project site. Impact indicators for human health and safety include a potential increase in electromagnetic field radiation in comparison to recommended exposure limits, and potential impacts from the production, storage, and disposal of solid or hazardous wastes. Air quality impacts are assessed in Section 3.9 and water quality impacts are assessed in Section 3.4.2.

3.12.1 Electromagnetic Fields and Interference

3.12.1.1 Affected Environment

Electromagnetic radiation (EMR) consists of waves of electric and magnetic energy moving together through space. Electromagnetic radiation can range from low to high frequency, measured in hertz, and can range from low to high energy, measured in electron volts. Electromagnetic fields (EMFs) generally refer to alternating current low frequency magnetic fields that are created by electricity flowing through wires. There are two general categories of EMFs: non-ionizing and ionizing. Non-ionizing radiation is low-level radiation which is generally perceived as harmless to humans. Non-ionizing radiation can be generated by microwave ovens, computers, wireless (wi-fi) networks, cell phones, Bluetooth devices, powerlines, and magnetic resonance imaging (MRIs). Ionizing radiation is high-level radiation, which has the potential for cellular and DNA damage. Ionizing radiation can be generated by sunlight, x-rays, and some gamma rays (NIEHS, 2023). EMR associated with power lines is a type of low frequency non-ionizing radiation.

3.12.1.2 Environmental Consequences

3.12.1.2.1 No Action Alternative

The No Action Alternative would have no short-term or long-term impacts associated with electromagnetic fields and interference at or in the vicinity of the proposed Project.

3.12.1.2.2 Proposed Action

Common EMF sources include power and transmission lines, electrical panels, transformers, motors, and appliances. The Proposed Action includes a new electric power generation interconnect transmission line to connect the new SCCT units to an existing on-site 69 kV substation. The new transmission line will be contained within the existing boundaries of the Anadarko Power Plant.

The new transmission line will be considered a potential EMF source. The strength of the EMF will be proportional to the amount of electrical current passing through the power line and will decrease dramatically with distance. There are no federal standards limiting occupational or residential exposure to EMF; however, at least six states have set standards for transmission line electric fields (NIEHS, 2002). In general, a distance of 300 feet or more from a power line is considered a safe distance as EMF from power lines at that distance are no different than typical levels around a house (CDPH, 2008). The new transmission line is not expected to be within 500 feet of any residence; therefore, EMF impacts will not be a concern.

3.12.1.3 Mitigation

No mitigation measures are proposed for electromagnetic fields and interference from the new power line.

3.12.2 Solid and Hazardous Wastes

3.12.2.1 Affected Environment

Solid and hazardous wastes generated by the Project could negatively impact health and safety at the Project site and adjacent communities if wastes are improperly managed and stored on site or improperly transported off site for disposal.

3.12.2.2 Environmental Consequences

3.12.2.2.1 No Action Alternative

The No Action Alternative would have no short-term or long-term health impact to communities from solid or hazardous water management activities in the vicinity of the proposed Project.

3.12.2.2.2 Proposed Action

Hazardous materials are not expected to be stored at the site during construction; however, gasoline and diesel fuel may be delivered and utilized on site during construction. Non-hazardous solid wastes generated during the construction process, including construction debris and general refuse, will be managed and disposed of off-site at a permitted solid waste disposal facility in accordance with state and local regulations. Hazardous wastes are not expected to be generated during the construction process; however, any hazardous waste generated during construction will be segregated and disposed of off-site at a permitted hazardous waste treatment, storage, disposal (TSD) facility in accordance with federal and state regulations.

Solid wastes generated during operation of the Proposed Action will consist of general trash, discarded equipment and parts, and wastes generated from servicing the equipment including used glycol, oils, and lubricants. Solid wastes generated during operation of the SCCT units will likely be classified as non-hazardous solid wastes subject to the Resource Conservation and Recovery Act (RCRA) Subpart D standards and the corresponding Oklahoma solid waste regulations (Title 252 Chapter 515 – Management of Solid Waste). Solid wastes exhibiting one or more hazardous waste characteristic or listed as a hazardous waste will be managed in accordance with RCRA Subpart C and the corresponding Oklahoma hazardous waste standards (Title 252 Chapter 205 – Hazardous Waste Management). All solid and hazardous wastes generated by the Proposed Action will be transported off-site for proper treatment and disposal. No wastes will be disposed of on-site.

3.12.2.3 Mitigation

Solid and hazardous wastes generated during construction and operation of the Proposed Action will be characterized in accordance with the requirements of 40 CFR Section 261 and Oklahoma regulations. All wastes will be managed, stored, and transported off-site for disposal in accordance with applicable federal and state solid waste regulations. Implementation of strict solid/hazardous waste management procedures will ensure that operation of the proposed SCCT units will result in no short-term or long-term environmental, health, or safety impacts associated with waste management.

3.12.3 Environmental Risk Management

3.12.3.1 Affected Environment

Construction and operation of the combustion turbines and related equipment could result in potential employee-related workplace health and safety issues. Potential risk management requirements will include worker safety during construction and operation of the Project, environmental contamination from the improper storage and handling of hazardous materials and wastes, and health and safety impacts to surrounding communities resulting from construction and operation of the Proposed Action. The area potentially impacted by health, safety, and environmental risks will include the Anadarko Power Plant where the Proposed Action will be conducted and the surrounding communities.

The Anadarko Power Plant is an existing WFEC electric generating facility. As such, WFEC has developed and implemented comprehensive health, safety, and environmental (HSE) plans and processes to address worker safety, environmental monitoring, and compliance. The Anadarko Power Plant is currently equipped with three 3,000-gallon USTs, which are used to store a glycol-based fluid; however, the facility is not identified on the Oklahoma Leaking Underground Storage Tank (LUST) database (ODOT, 2023a). Based on information available from EPA’s Enforcement Compliance History Online (ECHO) database, there is no indication of a release to the environment from the handling and storage of hazardous substances at the facility. The facility is registered as a RCRA hazardous waste generator, and no violations related to the storage and handling of RCRA-regulated wastes are listed on ECHO (USEPA, 2023l).

3.12.3.2 Environmental Consequences

3.12.3.2.1 No Action Alternative

The No Action Alternative would have no short-term or long-term impacts associated with human health and safety at or in the vicinity of the proposed Project.

3.12.3.2.2 Proposed Action

The Proposed Action will result in potential human health and safety impacts associated with construction and operation of the combustion turbines, transmission line, and associated equipment. Potential construction and operational related job site hazards will include, but not be limited to, trip, slip, and fall hazards; injuries such as head impacts, eye, and foot injuries; and vehicular traffic. Chemicals used for combustion turbine operation and equipment maintenance and cleaning, and wastes generated during construction and operation of the Proposed Action, could also represent an environmental risk if improperly managed or stored. Potential human health, safety, and environmental risks to the surrounding community will generally be related to air emissions and wastewater discharges resulting from the Proposed Action. In addition, health and safety of the surrounding communities could be adversely impacted if operation of the Proposed Action will overstress existing community resources such as emergency medical services, and police/fire response times.

3.12.3.3 Mitigation

Health, safety, and environmental risks resulting from the Proposed Action will be mitigated by the implementation of comprehensive HSE plans during construction and operation of the proposed SCCT units, and through monitoring and compliance with all federal, state, and local environmental and occupational safety standards. During construction and operation of the Project, WFEC will be required to develop and implement workplace HSE plans and programs to ensure compliance with all applicable OSHA standards and monitor operations for compliance with all environmental standards. The plant's existing HSE plans will be updated, as necessary, during construction of the Project to address construction-related health and safety issues, and operation of the new combustion turbines will be integrated into the plant's existing plans.

The HSE plans will describe the methods that WFEC and its contractors will use to protect their employees from occupational hazards. Plans will require the use of certain safe practices and equipment, including environmental, health, and safety monitoring, and require recordkeeping of workplace injuries and illnesses. The HSE plans will include requirements to provide fall protection, prevent trenching cave-ins, ensure that workers safely enter confined spaces, prevent exposure to harmful substances, require guards on machines, provide respirators or other safety equipment, and provide training for certain jobs. Contractors will be expected to develop and implement appropriate HSE plans and ensure that their employees are aware of potential job hazards, trained on the appropriate use of personal protective equipment (PPE), and utilize appropriate PPE while on the job site in order to mitigate hazards to themselves and others.

As described in Section 3.12.2, non-hazardous solid wastes and hazardous wastes generated during construction and operation of the Proposed Action will be managed and disposed of off-site in permitted solid/hazardous waste disposal facilities in accordance with state and local regulations. No wastes will be disposed of on-site.

As described in Section 3.4.2, wastewater generated by the Proposed Action will be managed on-site using the plant's existing wastewater treatment systems and discharged in accordance with the plant's OPDES discharge permit. Constituents in wastewaters generated by the Proposed Action will not contribute to impairment or adverse impacts to surface waters. Similarly, as described in Section 3.9, air emissions resulting from the Proposed Action will be subject to permitting by the ODEQ-AQD and controlled to ensure compliance with all federal and state air quality regulations. As part of the air permitting process, WFEC will be required to demonstrate that emissions from the Proposed Action will not cause or contribute to an exceedance of a NAAQS.

In addition, construction and operation of the Proposed Action will have minimal impact on currently available human health and safety access within the City of Anadarko, including emergency medical services and police/fire response resources. As described in Section 3.11.4, existing medical and emergency services in the City of Anadarko and Caddo County have sufficient expertise and capacity to support requirements of the Proposed Action.

3.13 Corridor Analysis

3.13.1 Affected Environment

The Proposed Action includes a new transmission line to connect the SCCT units to an existing, on-site, 69 kV substation. The line will be located entirely within WFEC's existing property, although an approximately 1-mile section will be outside of the plant boundaries but on property currently owned by WFEC. As such, no corridor analysis is needed.

3.14 Geology and Soils

3.14.1 Affected Environment

3.14.1.1 Geology and Soils

This region within which the Proposed Action is located is composed of rolling hills underlain by Permian-age sandstone, siltstone, and shale (USEPA, 2004). As described in the Report of Geotechnical Exploration (Burns & McDonnell, 2008), the site is underlain by Alluvium (Qal), Terrace Deposits (Qt), and Whitehorse Group (Pwh). During site investigations, borings encountered 4 to 6 inches of topsoil underlain by alluvial soils which consisted of interbedded fine- and coarse-grained soils. Bedrock was encountered at depths ranging from 45.2 to greater than 50 feet below existing ground surface and the bedrock consisted of interbedded shale/siltstone/claystone bedrock (Burns & McDonnell, 2008). The geotechnical report is included as Attachment 11b.

3.14.1.2 Site Topography

The Project Site mainly encompasses flat terrain and is currently developed as a power plant. Topography of the site varies from 1167 to 1185 feet above mean sea level (USGS, 2022b). A USGS topographic map showing the Project Site is included as Attachment 11a.

3.14.2 Environmental Consequences

3.14.2.1 No Action Alternative

The No Action Alternative would have no short-term or long-term impacts to geology or soils at or in the vicinity of the proposed Project.

3.14.2.2 Proposed Action

Construction of the Proposed Action will have no impact on site geology. Potential impacts to soil resources associated with construction of the facility include soil erosion and loss of soil productivity. Construction will affect approximately 28.5 acres of previously developed industrial property. Construction activities, such as vegetation clearing, trenching, grading, topsoil segregation, and back filling, will increase erosion potential by destabilizing the soil surface. Soil compaction can result from the movement of heavy construction vehicles at the proposed Project Site. During construction, soils at the proposed Project Site will be exposed to erosion from stormwater runoff and wind, resulting in a small, short-term impact to this resource.

3.14.3 Mitigation

Potential impacts to soils will be minimized through the use of sediment and erosion control BMPs. WFEC will implement soil erosion BMPs during the construction phase of the Project to reduce the potential for soil and sediment leaving the construction site. At a minimum, WFEC will install erosion control structures and BMPs to comply with the Oklahoma General Permit OKR10 for Stormwater Discharges from Construction Activities. BMPs may include silt fencing, fiber rolls, hydroseeding, soil binders, mulching, or similar controls. Disturbed areas will be stabilized and revegetated, as soon as practicable, once construction activities are completed. These measures will minimize the potential for adverse impacts to soil resources.

4.0 CUMULATIVE EFFECTS

This section of the EA evaluates the cumulative effects of the Proposed Action combined with other past, present, and reasonably foreseeable future actions (RFFAs) that have affected, or may affect, the same resources. Cumulative effects are evaluated based on the region of influence (ROI) for each environmental, socioeconomic, or significant cultural resource. The ROI represents the physical area wherein effects may occur and varies for each resource.

4.1 Region of Influence

Cumulative effects are evaluated based upon the geographic area of potential impact for each resource which may extend beyond the proposed Project Site. The ROI, or geographic area of potential effects, for each group of environmental, health and safety, cultural, and socioeconomic resources is provided in Table 4-1.

Table 4-1. Cumulative Effect Region of Influence

Resource	Region of Influence	Basis
Land Use, Geology, Soils, and Farmland	Anadarko and Caddo County	Evaluate land use and geologic impacts on the city and county level within which the Proposed Action is located.
Air Resources • Air Quality • Climate	20 km (12.4 miles)	As described in Oklahoma DEQ Air Dispersion Modeling Guidelines for Oklahoma Air Quality Permits, the approximate radius of impact (ROI) used for air quality impact modeling if Project-related emissions exceed major source PSD and Title V thresholds.
Water Resources • Surface Water • Wetlands • Floodplains • Groundwater	Watershed within which the Project is located	Middle Washita Watershed (HUC 11130303).
Terrestrial Resources • Vegetation • Wildlife • Threatened & Endangered Species • Critical Habitat	Ecoregion within which the Project is located	The area assessed includes the ecoregion within which the Project is located. Ecoregions denote areas of general similarity in the type, quality, and quantity of environmental resources. The Proposed Action is located in the Northwestern Cross Timbers ecoregion (Ecoregion 29h).

Resource	Region of Influence	Basis
Community Resources • Transportation • Utilities • Solid Waste • Visual and Noise	City of Anadarko and Caddo County	Evaluate community resource impacts on the city and county level within which the Proposed Action is located.
Socioeconomic Resources and Public Health • Cultural Resources • Public Health and Safety • Environmental Justice	City of Anadarko and Caddo County	Evaluate socioeconomic resource impacts, public health, and environmental justice impacts on the city and county level within which the Proposed Action is located.
Cultural and Historic Resources	City of Anadarko and Caddo County	Evaluate cultural and historic resource impacts on the city and county level within which the Proposed Action is located.

4.2 Past, Present, and Reasonably Foreseeable Future Actions

The Proposed Action is located at the Anadarko Power Plant in Anadarko, Oklahoma. Anadarko is the county seat of Caddo County, with a city population of 5,531 and a county population of 26,368 (USCB 2022c). Anadarko is located approximately 60 miles southwest of Oklahoma City, Oklahoma. The city is located on U.S Route 62 and U.S Route 8 and has direct access via interstate and state highway, rail, and air.

Past and present actions that have affected resources within the Anadarko and Caddo County region include:

- Residential, commercial, and industrial development in the Anadarko area
- Agricultural activities in Caddo County

Reasonably foreseeable future actions (RFFAs) that may affect resources within the Anadarko and Caddo County region include:

- Construction of the White Rock Wind Project, including 51 Vestas Turbines, located south of Anadarko;
- ODOT's "County Improvements for Roads and Bridges" (CIRB) outlines 375 replacements or rehabilitations of County Bridges and roughly 806 miles of County Roads to be improved across the state for state fiscal years (SFY) 2020 through SFY 2024. Regarding the upcoming SFY 2024,

a combination of utilities, right-of-way, and 0.25 miles of bridge/approaches are scheduled for improvement within Caddo County, OK (ODOT, 2019).

- ODOT's CIRB SFY 2023 through SFY 2027 outlines 192 replacements or rehabilitations of County Bridges and roughly 398 miles of County Roads to be improved across the state. Regarding the upcoming SFY 2024, a combination of utilities, right-of-way, contract preliminary engineering, and 0.14 miles of bridge rehabilitation are scheduled for improvement within Caddo County, OK. SFY 2025 plans for improvement include right-of-way and utility improvements. SFY 2027 includes improvements to bridge and approaches (ODOT, 2023b).
- ODOT's CIRB SFY 2024 through SFY 2028 outlines 176 replacements or rehabilitations of County Bridges and roughly 392 miles of County Roads to be improved across the state. Regarding the upcoming SFY 2024, a combination of utilities, right of way, 0.14 miles of bridge rehabilitation, 0.25 miles of bridges and approaches, and 72 miles of contract P.E. are scheduled for improvement within Caddo County, OK. SFY 2025 plans for improvement include additional contract P.E. SFY 2026 and SFY 2027 consist of bridge and approach improvements (ODOT, 2023c).
- U.S. Department of Commerce Economic Development Administration (EDA) awarded $2.6 million grant to Delaware Nation Economic Development Authority, LLC with the goal of renovating the Greentech Center located in Anadarko, OK. Dated July 12, 2022. The EDA investment was expected to create 227 new jobs and generate $881,000 in private investment (EDA, 2022).
- "Community Action Plan (CAP) for Anadarko, Oklahoma" dated July 2018 (USEPA, 2018), outlines multiple socioeconomic goals, including:

  Goal 1- Farmer's market new location to ensure success;

  Goal 2- Community gathering space that is environmentally friendly, inviting to all, and promotes physical activity;

  Goal 3- Community Garden to help promote fresh, local and healthy food; and

  Goal 4- Improve cooperation and coordination between producers, tribes, and downtown restaurants, stores, and various other entities to improve local food options.

RFFAs that may affect resources within the Anadarko and Caddo County region are generally related to the continued economic development and infrastructure improvements in the region.

4.3 Land Use (Geology, Soils, and Farmland)

The cumulative impacts of past and present activities on land use can be understood based on the current site conditions. The Proposed Action will not impact land use or geology; therefore, only cumulative impacts to farmland and soils are discussed below.

Potential Project-related impacts to important farmland are evaluated in Section 3.1.2. Soil in the vicinity of the proposed Project is classified as prime farmland; however, the entire plant footprint has already been developed for industrial use. The Proposed Action will result in approximately 0.33 miles of new transmission line spanning undeveloped and agricultural land. This represents a small fraction of available prime farmland in Caddo County, and the land spanned by the line will still be able to be cultivated after construction. Construction of the Proposed Action, when combined with other RFFAs, will represent a negligible contribution to cumulative effects of farmland depletion in Caddo County, and will not contribute to adverse impacts to agricultural production.

Potential Project-related impacts to soils are evaluated in Section 3.14.2. The Proposed Action will occur within 28.5 acres of land currently developed for industrial use at the Anadarko Power Plant. During construction of the SCCT Facility, disturbed areas will be exposed to erosion. However, WFEC will implement sediment and soil erosion BMPs during construction to minimize the potential for sediment runoff during construction, and disturbed areas will be stabilized and revegetated in the earliest timeframe. RFFAs for the region will consist of similar temporary ground disturbance related to construction projects, as well as more consistent soil erosion resulting from agricultural activities. The proposed Project will result in a minimal addition to cumulative impacts on soils in the region.

4.4 Air Resources

The Proposed Action is located in Caddo County, Oklahoma. Cumulative air quality impacts from past and present activities in Caddo County can be assessed based on available air quality data. The ODEQ operates a statewide network of ambient air quality monitors to determine compliance with the Clean Air Act's NAAQS (ODEQ, 2023b). The nearest air quality monitors to the Project Site are located east of Oklahoma City, approximately 40 miles northeast of the Project Site, and in Lawton, Oklahoma, approximately 35 miles southwest of the Project Site. Although no monitors are physically located in Caddo County, air quality data from the air quality monitors can be extrapolated to assess air quality in Caddo County. Based on available data, Caddo County has been designated as being in attainment or unclassifiable with all existing NAAQS (USEPA, 2023e).

Air quality impacts from the Proposed Action are assessed in Section 3.9.1. As described in Section 3.9.1, emissions from the proposed new SCCT units will be controlled using the BACT, and WFEC will be required to demonstrate that emissions from the Proposed Action will not cause or contribute to the exceedance of a NAAQS. Air quality impacts from the identified RFFAs will be expected to be minimal as the RFFAs are generally related to infrastructure improvements and economic development in the area, and no RFFAs were identified that will result in significant air emissions or air quality impacts.

Environmental impacts may also result from GHG emissions that contribute to global climate change. Climatological effects of global climate change from past and present activities include changes in precipitation patterns, lengthening of the frost-free and growing season, more droughts and heat waves, and longer wildfire seasons (NASA, 2023). As described in Section 3.9.2, the USEPA has published state-level assessments of climate change impacts based on Climate Change Indicators. In its August 2016 assessment of "What Climate Change Means for Oklahoma," USEPA stated: "Most of Oklahoma did not become warmer during the last 50 to 100 years. But soils have become drier, annual rainfall has increased, and more rain arrives in heavy downpours."

Construction and operation of the Proposed Action will contribute to an incremental increase in GHG emissions in the region from fuel combustion. GHG emissions from the identified RFFAs will likely be minimal and associated with vehicle emissions, as none of the identified RFFAs include large combustion-based emission sources. Given the relatively minor incremental contribution to overall GHG emissions from the Proposed Action and identified RFFAs, and the corresponding contribution to the overall societal carbon costs, climate impacts will be minimal (see, Section 3.9.2.2.2). In the coming decades, USEPA projects that summers in Oklahoma are likely to be increasingly hot and dry, which would reduce the productivity of farms and ranches, change parts of the landscape, and possibly harm human health (USEPA 2016); however, those changes would likely result from GHG emission contributions from other human activities, with minimal contribution from the Proposed Action and identified RFFAs.

4.5 Water Resources (Wetlands, Surface Waters, Groundwater, Floodplains)

The Project Site is located approximately 0.15 miles south of the Washita River in Caddo County (Stream Segment 310830, Waterbody ID 3108300100_10) within the Middle Washita Watershed (HUC 1113030). Surface water features in the ROI include the Washita River and related wetlands and floodplains.

Past and present surface water quality impacts to the Washita River can be assessed based on existing water quality data. As described in Section 3.4.2, the Washita River in the vicinity of the Proposed Action is classified as an Impaired Water and included on the Oklahoma §303(d) list of Impaired Waters. The Washita River is identified as being impaired for Enterococcus, sediment, fish bioassessments, and turbidity (ODEQ, 2023a). Impairment of the river is generally related to historical effects of nonpoint source pollution (e.g., agricultural production and agricultural pesticides), trophic structure changes due to nutrient enrichment, and sediment and erosion runoff from areas such as agricultural fields, roadways, and parking lots.

Based on a review of data available from the National Wetlands Inventory, there are no wetlands or other surface water features present within the Project Site (NWI, 2022). The Project Site is within the Washita River Reach 3 aquifer, which is an alluvial aquifer consisting of unconsolidated alluvial and terrace Quaternary-age deposits adjoining the Washita River in southwestern Oklahoma (OSU Geology, 1984). Past and present impacts to the aquifer are generally related to water withdrawals for agricultural purposes and irrigation.

4.5.1 Wetlands

As described in Section 3.4.1 potential impacts to surface water features associated with construction activities will be short-term in nature and minimized through the use of sediment and erosion control BMPs.

The permanent site drainage system, which includes storm water piping/drains and sediment traps connected to a stormwater retention pond, will continue to provide stormwater and erosion control during operation of the facility. Similarly, it is anticipated that any RFFA-related construction activities in the ROI, including road and bridge projects and wind farm development, will be conducted in accordance with Oklahoma construction general stormwater permit requirements, including development and implementation of a Stormwater Pollution Prevention Plan and installation of sediment and erosion control BMPs to minimize potential impacts to surface water features.

Based on regulatory requirements that currently apply to construction projects, including the requirement to implement and maintain erosion and sediment BMPs during the construction, construction and operation of the Proposed Action and the identified RFFAs will not be expected to contribute to cumulative impacts to wetland resources in the ROI.

4.5.2 Surface Waters

As discussed in Section 3.4.2, given the quantity and characteristics of wastewaters generated by the Proposed Action and discharge limitations and monitoring requirements established in the plant's OPDES discharge permit, wastewater discharge associated with the Proposed Action will not contribute pollutants that will exacerbate impairment of the Washita River, and will be expected to have minimal impact on surface water quality in the ROI. In addition, none of the identified RFFAs will be expected to result in wastewater discharges to surface water. As such, neither the Proposed Action nor identified RFFAs will be expected to add to cumulative impacts to surface water quality.

4.5.3 Groundwater

As described in Section 3.4.3, water required for the Proposed Action will be provided by Fort Cobb Reservoir, and the Proposed Action will not include new groundwater wells or groundwater withdrawals. In addition, none of the identified RFFAs will be expected to require significant groundwater withdrawals or contribute to potential groundwater impacts. All hazardous substances and petroleum products, including oils, lubricants, and fuel associated with the Proposed Action and identified RFFAs, are subject to federal and Oklahoma hazardous material storage requirement, including, as applicable, spill response and secondary containment to prevent releases to the environment. Given the requirement for secondary containment structures and implementation of spill response plans, the probability of adverse impacts to groundwater resources from the spill or release of a petroleum product or hazardous substance is considered low, and the Proposed Action and identified RFFAs will not be expected to contribute to cumulative impacts to groundwater resources in the ROI.

4.6 Biological Resources (Vegetation, Wildlife, and Threatened & Endangered Species)

Cultivation and overgrazing have largely destroyed native prairie in the ROI for biological resources. The Project Site is almost entirely within the boundaries of an existing industrial facility, with little available habitat. The Proposed Action will result in the permanent loss of approximately four acres of deciduous woodland or vegetation resources, therefore contributing to the cumulative loss of vegetative resources in the region. This will also contribute to cumulative impacts on wildlife resources, due to this small loss of available habitat.

As discussed in Section 3.6.2, federally listed threatened and endangered species may occur in the vicinity of the Project, however, based on the absence of suitable habitat and the existing developments within the Project Area, impacts to these species are not anticipated. Given the mitigation measures that will be implemented during construction of the facility (see Section 3.6.2.3), the proposed Project will not contribute to cumulative impacts to threatened and endangered species in the vicinity of the Project.

Additionally, while Bald and Golden Eagles may visit areas within the vicinity of the Project Area, suitable nesting habitat, which includes tall, large diameter trees and preferred foraging areas including large, open expanses of water, are not present within the Project Area. Given the planned mitigation measures (see Section 3.6.3.3), it is unlikely the Proposed Action will contribute to cumulative impacts related to Bald or Golden Eagles, or migratory birds.

4.7 Community Resources

Potential impacts to community resources include impacts to transportation and cumulative traffic-related impacts, utilities, solid waste management, noise, and aesthetic/visual impacts.

4.7.1 Transportation

Transportation infrastructure in the City of Anadarko is maintained by the Anadarko Street Department. The department is responsible for road maintenance within the city limits. Duties of the department include clearing obstructions from roadways, patching, and repaving roads (City of Anadarko, 2023). Transportation infrastructure in Caddo County is the responsibility of Field District 7 of ODOT. ODOT is responsible for the construction and maintenance of highways, roads, and bridges outside city limits, including U.S. 62 and U.S. 281 which are the main highways to the City of Anadarko. ODOT reviews the transportation infrastructure on an on-going basis and develops strategic plans for transportation maintenance and improvements. ODEQ recently published its 2024-2027 Asset Preservation Plan which encompasses transportation infrastructure preservation activities for Oklahoma interstates, U.S. and state highways, and bridges (ODOT, 2023d). The plan includes projects to improve the pavement condition of interstates and highways, rehabilitate bridges, and provide accessibility improvements throughout the state.

Potential traffic-related impacts from the Proposed Action are evaluated in Section 3.11.2. As described in Section 3.11.2, construction of the Proposed Action will be expected to result in temporary traffic-related impacts during the construction phase of the Project, including increased traffic along access points to the Project Site generally related to ingress and egress of construction vehicles and construction workers. However, roads leading to the Project Site are currently improved and paved, and are expected to handle the increased traffic without modifications. Transportation and traffic impacts resulting from the identified RFFAs will be expected to be minimal as the RFFAs generally relate to economic improvement projects. The only RFFA identified that will be expected to result in increased traffic is the planned renovation of the Greentech Center, which is expected to create 227 new jobs. The Greentech Center is located at 1617 Industrial Road in Anadarko, approximately 1.6 miles east of the city center and 0.33 miles north of U.S. 62. Renovation of the Greentech Center could contribute to traffic in the vicinity of the Proposed Action, however, existing transportation infrastructure appears adequate for both projects, and traffic flows to the Anadarko Power Plant will return to pre-construction levels following construction of the Proposed Action. Other identified RFFA's, including the planned ODOT upgrades to local bridges and roads over the next few years, will improve transportation infrastructure in the vicinity of the Proposed Action.

Based on a review of the existing transportation infrastructure, ODOT's asset preservation plan, and ODOT's road/bridge improvement plans, the existing transportation infrastructure in both Caddo County and the City of Anadarko is sufficient to adequately serve existing commercial, industrial, and residential development in the city. Taking into account potential Project-related impacts and impacts from RFFAs, cumulative transportation-related impacts are expected to be minimal and supported by existing transportation infrastructure.

4.7.2 Utilities

Utility impacts are evaluated in Section 3.11.3. Given the quantity of utilities needed to operate the SCCTs and the availability of utilities in the vicinity of the Project, construction and operation of the facility will not contribute to cumulative impacts to utilities in the area of the Project.

4.7.3 Solid Waste

Past and present impacts from the management and disposal of solid and hazardous wastes can be described based on a review of solid/hazardous disposal sites subject to federal and state enforcement and remediation requirements. Based on a review of EPA's National Priorities List and Superfund Site, there are 18 in Oklahoma, however, none of the sites are listed in Anadarko or Caddo County (ODEQ, 2023c). Solid wastes currently generated from industrial, commercial, and residential activities in the City of Anadarko are generally managed by private waste collection companies and disposed of in solid waste landfills operating under permit issued by ODEQ.

As described in Section 3.12.2, all solid wastes generated during construction and operation of the Proposed Action will be managed in accordance with applicable RCRA and corresponding Oklahoma solid waste regulations. It is assumed that all solid wastes generated by the identified RFFA projects will be similarly managed in accordance with federal and state regulations and disposed of at permitted disposal facilities. None of the identified RFFAs included development of new solid waste disposal facilities. Given the comprehensive regulation of solid/hazardous waste management and disposal, the Proposed Action and identified RFFAs will not contribute to cumulative environmental impacts from solid waste management.

4.7.4 Noise

As described in Section 3.11.1, the Proposed Action will likely result in short-term, transitory noise impacts in the immediate vicinity of the Project during construction; and minimal impacts during operations. Given the distance to sensitive noise receptors, the lack of other RFFAs in the vicinity, and the expected nature of noise generating sources at other economic development RFFAs in the area, the Project is not expected to contribute to cumulative noise impacts in the area.

4.7.5 Aesthetics and Visual Resources

Since the Project Site is currently developed as a power plant, aesthetic impacts resulting from the Proposed Action will be negligible. Therefore, construction and operation of the facility will not contribute to cumulative impacts on aesthetics and visual resources in the region.

4.8 Cultural Resources

The Project is not expected to result in any adverse effect to historic properties; therefore, construction and operation of the facility will not contribute to cumulative impacts on cultural resources in the region.

4.9 Socioeconomic Resources and Public Health

4.9.1 Public Health and Safety

Cumulative public health and safety impacts from past and present activities in the City of Anadarko can be assessed based on a review of Health Indicators available from the EPA's EJScreen ten-mile radius report (included as Attachment 9d). Based on information available from the EJ ten-mile radius report, Health Indicators in the vicinity of the Proposed Action are at or above the 80th percentile (compared to national averages) for low-life expectancy, heart disease, asthma, and persons with disabilities. However, specific environmental variables affecting public health, including diesel particulate matter, air toxics cancer risk, air toxics respiratory hazard, toxic release to air, traffic proximity, and wastewater discharge are all below the national average, indicating that the higher Health Indicators are likely related to low-income and accessibility to health care services rather than environmental factors. As described in Section 3.11.4, emergency and medical services located in close proximity to the Proposed Action include the

Physician's Hospital of Anadarko and the Grady Memorial Hospital. In addition, Caddo County Health Department provides healthcare services to low-income individuals.

Potential public health and safety impacts from the Proposed Action are assessed in several sections of this EA, including Section 3.4.2 Water Quality; Section 3.9.1 Air Quality, Section 3.9.2 Climate, and Section 3.12 Human Health and Safety. In general, the Proposed Action will result in minimal impacts to public health and safety, and potential impacts will be mitigated through compliance with applicable federal and state environmental and safety standards and regulations. In addition, as described in Section 3.11.4, the City of Anadarko has sufficient expertise and capacity to support the Proposed Action, and the identified RFFAs will not be expected to adversely impact public health and safety. The identified RFFAs are generally related to economic development in the area, and no RFFAs were identified that will result in significant air emissions or air quality impacts, water use, wastewater discharge, solid/hazardous waste generation or disposal, or significant public health services.

4.9.2 Socioeconomic Impacts

As discussed in Section 3.10.1, communities located near the Proposed Action are identified as having a high percentage of low-income population. However, the Proposed Action is expected to have a beneficial impact on employment and the local economy. Construction and operation of the Proposed Action will result in increased demand for both skilled and unskilled labor and provide an opportunity for local residents to gain employment. Similarly, the identified RFFAs will be expected to have beneficial socioeconomic impacts. The identified RFFAs are generally related to economic development in the area, will provide increased employment opportunities, and add to the local economy.

4.9.3 Environmental Justice

As discussed in Section 3.10.2, the Proposed Action will be located in relatively close proximity to an area with a high percentage of low-income population and a community with a high percentage of people of color. As such, EJ concerns and the potential for disproportionate environmental and socioeconomic impacts on these communities are evaluated in Section 3.10.2.2 and other sections of this EA. Based on the EJScreen ten-mile radius report (included as Attachment 9d), the low income communities and communities with a high percentage of people of color in the vicinity of the Proposed Action are identified as having disproportionate environmental impacts (when compared to other communities in Oklahoma) for Superfund Proximity and Lead Paint, both of which represent legacy pollution.

Based on potential environmental impacts, the Proposed Action will not contribute to disproportionate environmental or human health impacts for these, or other, EJ indexes. Similarly, the identified RFFAs will not be expected to contribute to disproportionate environmental impacts on the surrounding communities. The identified RFFAs are generally related to economic development in the area, and no RFFAs were identified that will result in significant air emissions or air quality impacts, water use, wastewater discharge, solid/hazardous waste generation or disposal, or contribute to other EJ indicators. In addition, both the Proposed Action and the identified RFFAs will be expected to benefit economic development in the area and provide increased employment opportunities.

4.10 Summary of Cumulative Effects Analysis

A summary of the cumulative effects analysis taking into consideration the Proposed Action combined with other past, present, and RFFAs that have affected, or may affect, the same resources is provided in Table 4-2.

Table 4-2. Summary of Cumulative Effects Assessment

Resource	Region of Influence	Cumulative Impacts	Contribution of the Proposed Action to Cumulative Impacts
Land Use (Geology, Soils, and Farmland)	City of Anadarko and Caddo County	Past and present actions have resulted in the conversion of farmland to residential, commercial, and industrial use and reduced agricultural production. Farmland conversion to industrial, commercial, and residential use can result in soil impacts from increased stormwater runoff and sediment erosion associated with construction activities.	Negligible contribution to cumulative effects of farmland depletion; no effect on agricultural production. Minimal addition to cumulative impacts on soil resources. Mitigation will occur via the Proposed Action's SWPPP and installation of erosion control BMPs.
Air Resources • Air Quality • Climate	City of Anadarko, Caddo County, and surrounding area	Cumulative impacts to air resources can be assessed based on available air monitoring data. Caddo County has been designated as being in attainment or unclassifiable with all existing NAAQS. Planned economic development activities in the area that will include stationary emission sources will be subject to review and permitting by the ODEQ-AQD.	The Proposed Action will be subject to permitting by the ODEQ-AQD. As such, emissions from the proposed SCCT units will be controlled using BACT and WFEC will be required to demonstrate that emissions from the Proposed Action will not cause or contribute to the exceedance of a NAAQS.

Resource	Region of Influence	Cumulative Impacts	Contribution of the Proposed Action to Cumulative Impacts
Water Resources • Surface Water • Wetlands • Floodplains • Groundwater	Watershed within which the Project is located	Cumulative impacts to water resources can be evaluated based on available water quality data. Planned economic development activities may result in impacts to surface waters from increased stormwater runoff and soil erosion, and water quality impacts for permitted wastewater discharges.	The Proposed Action will result in an incremental increase in wastewater discharge from the Anadarko Power Plant; however, discharges from the plant will be subject to OPDES permitting and discharge limits. Construction-related soil disturbance will be subject to ODEQ general stormwater permit requirements. As such, the Proposed Action will not contribute to cumulative adverse impacts to surface water, wetlands, floodplains, or groundwater within the watershed.
Biological Resources • Vegetation • Wildlife • Threatened & Endangered Species • Critical Habitat	Ecoregion within which the Project is located	Impacts for past, present, and RFFAs have contributed to modified vegetative communities in the area and conversion of natural habitat to commercial, residential development and agricultural production.	The Proposed Action will result in a small additional conversion of undeveloped area within the WFEC property to transmission line ROW; however, the Project will require minimal vegetation removal, will have no impact on designated critical or suitable habitat for threatened and endangered species, and will have a minimal contribution to cumulative impacts to terrestrial resources.
Community Resources • Transportation • Utilities • Solid Waste • Noise • Aesthetics and Visual Resources	City of Anadarko, Caddo County, and surrounding area	Past and present impacts to community resources have been sufficiently addressed by the City of Anadarko and Caddo County. Future economic development projects may stress community resources such as roadways, traffic and utilities; and may result in increased ambient noise and impacts to viewsheds. Development in accordance with local plans and zoning restrictions will minimize potential community resource impacts.	The Proposed Action, which will be conducted at an existing gas-fired power generating plant, will not be expected to significantly contribute to cumulative impacts to community resources, including noise, aesthetics/visual resources, utilities, or solid waste management and disposal. Construction of the Proposed Action could have a temporary impact on traffic in the Anadarko area.

Resource	Region of Influence	Cumulative Impacts	Contribution of the Proposed Action to Cumulative Impacts
Cultural and Historic Resources	City of Anadarko and Caddo County	Impacts for past and present actions have contributed to destruction of cultural and historic resources.	Based on the results of field surveys, it is expected that the Proposed Action will not contribute to cumulative impacts on cultural and historic resources.
Socioeconomic Resources and Public Health • Socioeconomics • Public Health and Safety • Environmental Justice	City of Anadarko, Caddo County, and surrounding area	Past and present impacts to socioeconomic, public health, and EJ indicators can be evaluated based on EPA's EJ indexes. The EJScreen report prepared for a ten-mile radius around the Proposed Action shows an area with a high percentage of low-income population (i.e., 90 to 95th percentile) and a community with a high percentage of people of color (i.e., 80 to 90th percentile) located within approximately 1 mile of the Project site; The areas are identified as being disproportionately impacted for the Superfund Proximity and Lead Paint EJ indexes.	The Proposed Action will not impose any additional socioeconomic burdens on the City of Anadarko and surrounding residents. Construction and operation of the Proposed Action will result in beneficial economic impacts, including the opportunity for local residents to gain employment for skilled and unskilled labor. Operation of the Proposed Action will not contribute to disproportionate environmental or human health impacts for EJ indexes for which the surrounding communities have historically been disproportionately impacted.

5.0 SUMMARY OF MITIGATION

Table 5-1 summarizes the mitigation measures identified in the various resource sections of this EA.

Table 5-1. Mitigation for Proposed Action

Resource	Mitigation Measure
Land Use, Important Farmlands, and Formally Classified Lands	None
Floodplains	WFEC will not stockpile debris or equipment in the floodplain during construction. The longest possible spans will be used for the transmission line to reduce new permanent structures in floodplain areas.
Wetlands	WFEC will prepare a SWPPP and install BMPs as required by the OPDES General Permit for Stormwater Discharges Associated with Construction Activities. All BMPs will be installed prior to initiating soil-disturbing activities.
Water Resources	WFEC will prepare a SWPPP and install BMPs as required by the OPDES General Permit for Stormwater Discharges Associated with Construction Activities. All BMPs will be installed prior to initiating soil-disturbing activities. WFEC will utilize existing wastewater treatment infrastructure at the Anadarko Power Plant to treat Project-related wastewater prior to discharge in accordance with the plant's existing, or modified, OPDES permit. All hazardous substances and petroleum products, including oils and lubricants, will be located indoors and/or within secondary containment. WFEC will update the Anadarko Power Plant's existing SPCC Plan, as needed.
Coastal Resources	None

Resource	Mitigation Measure
Biological Resources	Industry-accepted best management practices will be implemented to prevent birds from colliding with or being electrocuted by utility lines, towers, and poles will be adopted, as appropriate. The construction and operation of the Project will comply with the Endangered Species Act, which provides for the protection of endangered and/or threatened species and critical habitat. If more extensive tree clearing is needed, WFEC will consult with USFWS and Oklahoma Department of Wildlife Conservation to confirm whether the areas planned to be cleared will be considered potential habitat for this species, and to discuss appropriate avoidance measures (e.g., clearing trees in the winter only). Other mitigation/avoidance measures will be implemented as indicated by agency officials. Should any evidence of the presence of endangered and/or threatened species or their critical habitat be brought to the attention of the contractor, the contractor will immediately report this evidence to WFEC and a representative of the Agency. Construction shall be temporarily halted pending the notification process and further directions issued by the Agency after consultation with the USFWS. If possible, the initial vegetation clearing will be performed outside the peak migratory bird breeding/nesting period (May 1-July 1) to avoid impacts to nesting birds (USDA, 2020). If vegetation clearing activities cannot be avoided during this period, WFEC will conduct pre-clearance surveys of the site. If a field survey identifies one or more active bird nest, appropriate measures will be taken to avoid incidental take, including establishing an avoidance buffer until the young have fledged. If an active nest is identified that cannot be avoided, WFEC will consult with the Oklahoma Department of Wildlife Conservation and USFWS to determine an appropriate course of action. If it is determined that the Proposed Action resulted in the introduction of invasive species at the Project Site, WFEC will develop an appropriate weed management plan(s) in keeping with any relevant Oklahoma policies to prevent invasive species from becoming established.
Cultural and Historic Resources	The Caddo Nation, Osage Nation, and Delaware Nation will be notified if any inadvertent discoveries are made during project activities.
Aesthetics	None

Resource	Mitigation Measure
Air Quality	WFEC will implement fugitive dust control measures, including watering, during construction of the Proposed Action, and all construction equipment will be maintained in accordance with manufacturer's instructions. Emissions during operation of the Proposed Action will be subject to all applicable federal and state emission standards and will therefore be subject to PSD permitting for NOx, PM10, PM2.5, and GHG emissions. Project-related emissions of all other regulated air pollutants will be below the PSD significant levels. BACT will be used to control NOx, PM10, and PM2.5 emissions. Ambient air quality impact modeling will be performed to demonstrate that emissions from the Proposed Action will not cause or contribute to adverse air quality impacts or the exceedance of a NAAQS. WFEC anticipates firing low sulfur fuel (natural gas) exclusively combined with good combustion practices as BACT to reduce the formation of PM_{10}/$PM_{2.5}$ emissions, and water injection as BACT for the control of NOx emissions. WFEC will submit a comprehensive PSD Construction Permit application to ODEQ-AQD seeking approval to construct and initially operate the Proposed Action. Within 180 days from startup of steady state operations, WFEC will submit a TV Operating Permit Application that will incorporate the applicable PSD Construction Permit and NSPS requirements. No mitigation strategies beyond using efficient low carbon fuel (natural gas) combustion technology with evaporative cooling or wet compression is proposed to achieve further GHG emission reductions.
Social Impact/ Environmental Justice	Meaningful engagement with the City of Anadarko, Caddo County, local Tribes, and the State of Oklahoma to assess human health and climate-related risks, concerns, and mitigation.
Noise	Construction-related noise impacts will be mitigated as much as practical to minimize nighttime noise impacts by limiting noise-generating activities to the hours between 6:00 a.m. and 6:00 p.m. depending on the time of year and taking into consideration construction-related safety considerations. During operation of the Proposed Action, noise from the new SCCT units will be mitigated by incorporating noise reduction into the design of the units, as described in the specification. Noise impacts will also be mitigated by the presence of existing vegetative buffers between active construction/operating areas and potential noise receptors.
Transportation	WFEC will coordinate with the City of Anadarko and Caddo County, as needed, to ensure the existing traffic control infrastructure can support construction of the Proposed Action, and to coordinate access to the Project Site to minimize traffic impacts during construction.
Utilities	None

Resource	Mitigation Measure
Community Resources	None
Electromagnetic Fields and Interference	None
Solid Waste	Solid and hazardous wastes generated during construction and operation of the Proposed Action will be characterized in accordance with the requirements of 40 CFR Section 261 and Oklahoma regulations. All wastes will be managed, stored, and transported off-site for disposal in accordance with applicable federal and state solid waste regulations.
Environmental Risk Management	Monitoring and compliance with all federal, state, and local environmental and occupational safety standards will occur during construction and operations. During construction and operation of the Project, WFEC will develop and implement workplace HSE plans and programs to ensure compliance with all applicable OSHA standards and monitor operations for compliance with all environmental standards. The plant's existing HSE plans will be updated, as necessary, during construction of the Project to address construction-related health and safety issues, and operation of the new combustion turbines will be integrated into the plant's existing plans.
Corridor Analysis	None
Soils	WFEC will prepare a SWPPP and install BMPs as required by the OPDES General Permit for Stormwater Discharges Associated with Construction Activities. All BMPs will be installed prior to initiating soil-disturbing activities. Disturbed areas will be stabilized and revegetated, as soon as practicable, once construction activities are completed.

6.0 COORDINATION, CONSULTATION, AND CORRESPONDENCE

6.1 Agency Coordination

Coordination, consultation, and correspondence with environmental regulatory or natural resource agencies is necessary to support impact assessment conclusions, and in some cases to meet statutory requirements. The following agencies were contacted during the preparation of this EA; a brief summary is below:

- Oklahoma State Historic Preservation Office: RUS submitted a letter dated December 28, 2023, to SHPO stating that a finding of no historic properties affected in accordance with 36 CFR 800.4(d)(1) would be appropriate for the Project. Additionally, RUS submitted a finding of no adverse effect in accordance with 36 CFR 800.5(b). SHPO concurred with this finding.

- Oklahoma Archaeological Survey (OAS): RUS submitted a letter dated December 28, 2023, to the OAS stating that a finding of no historic properties affected in accordance with 36 CFR 800.4(d)(1) would be appropriate for the Project. Additionally, RUS submitted a finding of no adverse effect in accordance with 36 CFR 800.5(b). OAS concurred with this finding.

- USFWS: In a letter dated March 22, 2024, USFWS provided an official species list. This is included as Attachment 6a.

6.2 Tribal Consultation

The following Tribes received initial notification of the proposed project and the final NHPA Section 106 Archaeological and Historical Reports for their review and possible comment:

- Apache Tribe of Oklahoma
- Caddo Nation of Oklahoma
- Cheyenne and Arapaho Tribes, Oklahoma
- Delaware Nation, Oklahoma
- Kiowa Indian Tribe of Oklahoma
- Osage Nation
- Wichita and Affiliated Tribes

6.3 Additional Public Involvement

The Draft Environmental Assessment will be available for public review at the Anadarko Public Library and the following Rural Development website: https://www.rd.usda.gov/resources/environmental-studies/assessment/anadarko-power-plant-combustion-turbine

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8.0 LIST OF PREPARERS

Table 8-1 identifies the RUS and consultant staff involved in the preparation of this EA.

Table 8-1. RUS Staff and Consultants Involved in Preparation of this EA

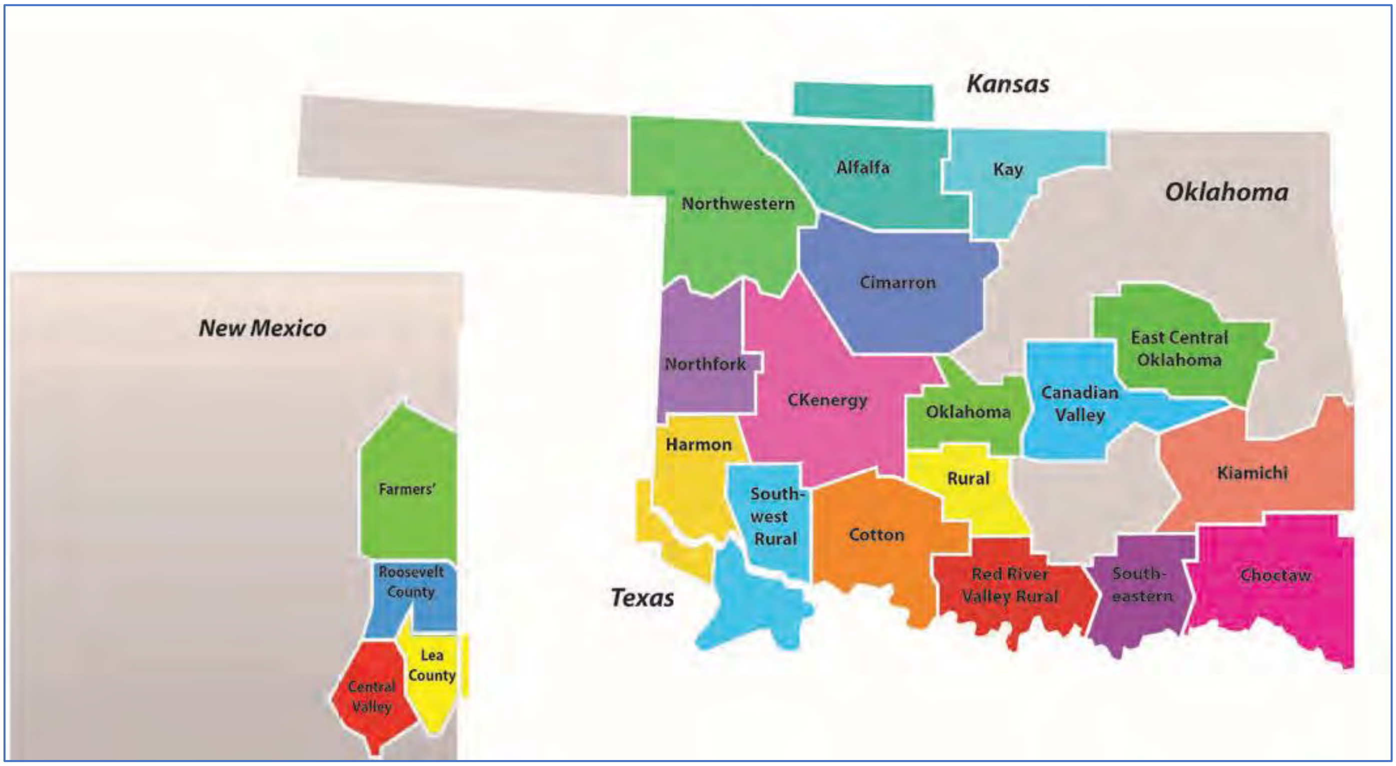
Name	Agency/Company	Role/Resource Specialty
N/A	RUS	Environmental and Historic Protection Division Staff
Lauren Circolone	Sargent & Lundy	Senior Manager/Professional Engineer
Kenneth Snell	Sargent & Lundy	Senior Environmental Manager
Julianna Crumlish	Sargent & Lundy	Senior Environmental Associate
Lohitaksha Rao	Sargent & Lundy	Senior Environmental Associate
Anna Rausch	Sargent & Lundy	Environmental Associate
Jill Lagace	Sargent & Lundy	Project Associate
Mike Miller	Sargent & Lundy	Designer (GIS Mapping)

ATTACHMENTS

Attachment 1. Purpose and Need Supporting Documents

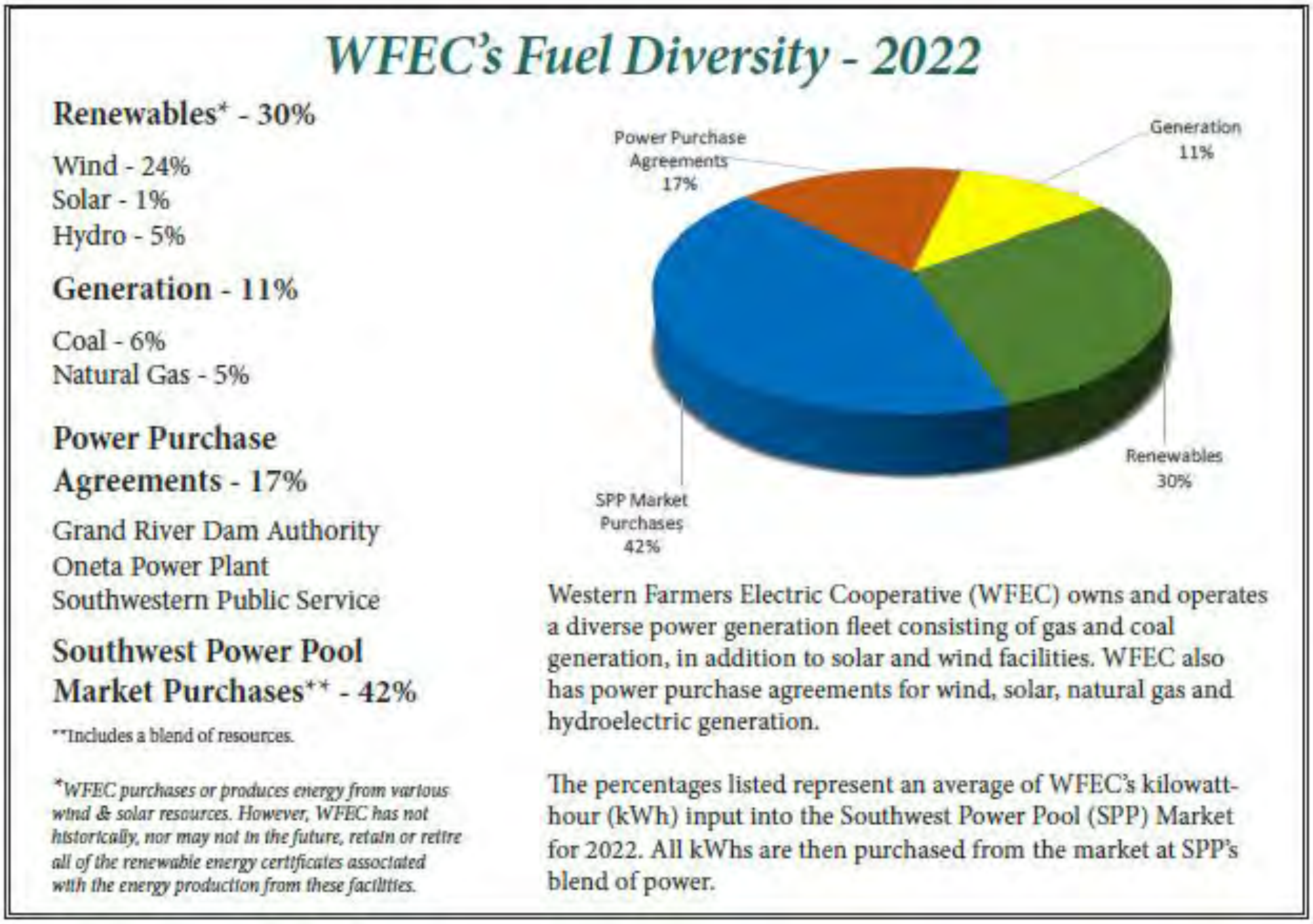
Attachment 1a. WFEC Service Territory Figure

Source: WFEC 2022 Annual Report.



Attachment 1b. WFEC Fuel Diversity Figure

Source: WFEC 2022 Annual Report



WFEC's Fuel Diversity - 2022

Renewables* - 30%

Wind - 24%
Solar - 1%
Hydro - 5%

Generation - 11%

Coal - 6%
Natural Gas - 5%

Power Purchase Agreements - 17%

Grand River Dam Authority
Oneta Power Plant
Southwestern Public Service

Southwest Power Pool Market Purchases - 42%**

**Includes a blend of resources.

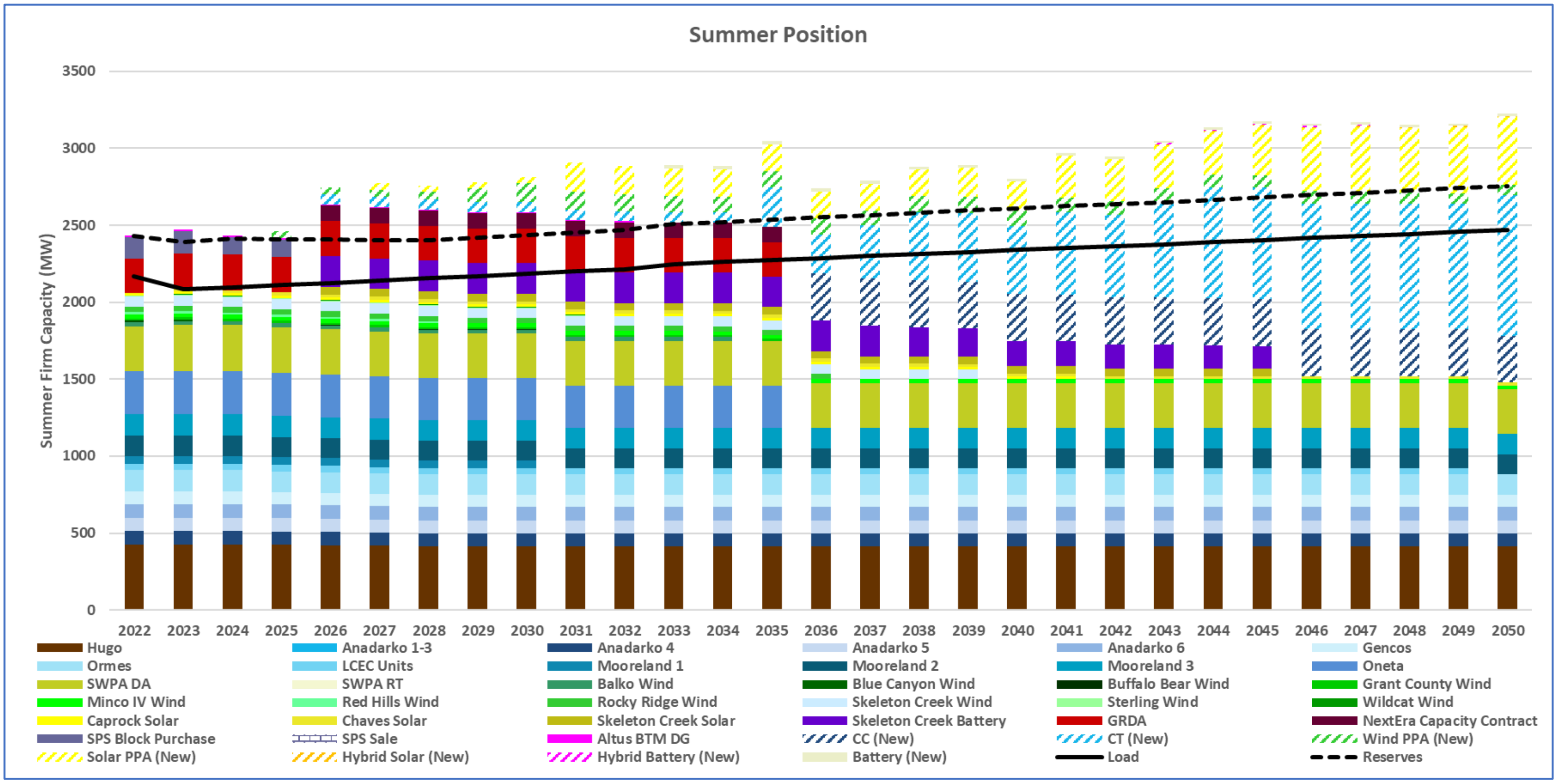
**WFEC purchases or produces energy from various wind & solar resources. However, WFEC has not historically, nor may not in the future, retain or retire all of the renewable energy certificates associated with the energy production from these facilities.*

Western Farmers Electric Cooperative (WFEC) owns and operates a diverse power generation fleet consisting of gas and coal generation, in addition to solar and wind facilities. WFEC also has power purchase agreements for wind, solar, natural gas and hydroelectric generation.

The percentages listed represent an average of WFEC's kilowatt-hour (kWh) input into the Southwest Power Pool (SPP) Market for 2022. All kWhs are then purchased from the market at SPP's blend of power.

Attachment 1c. Near-Term and Long-Term Load Forecast Figure

(Source: WFEC 2022 IRP)

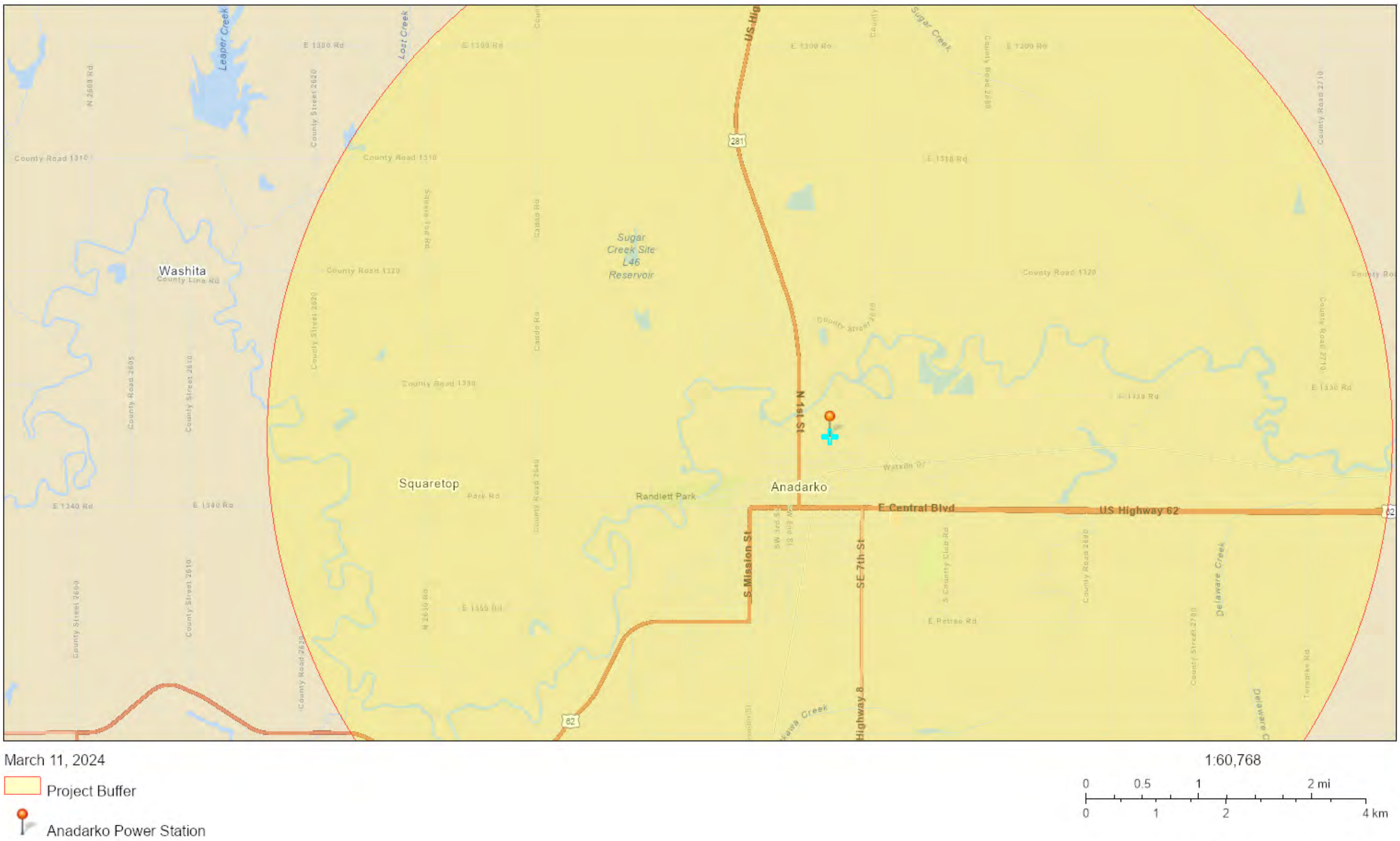


Attachment 2. NEPAssist Map

NEPAssist Report

Anadarko Power Station

A3 Landscape



March 11, 2024

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🟨 Project Buffer

Anadarko Power Station

Texas Parks & Wildlife, Esri, TomTom, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, EPA, NPS, USDA, USFWS

Project Location	35.081587,-98.238866
Within 1 mile of an Ozone 1-hr (1979 standard) Non-Attainment/Maintenance Area?	no
Within 1 mile of an Ozone 8-hr (1997 standard) Non-Attainment/Maintenance Area?	no
Within 1 mile of an Ozone 8-hr (2008 standard) Non-Attainment/Maintenance Area?	no
Within 1 mile of an Ozone 8-hr (2015 standard) Non-Attainment/Maintenance Area?	no
Within 1 mile of a Lead (2008 standard) Non-Attainment/Maintenance Area?	no
Within 1 mile of a SO2 1-hr (2010 standard) Non-Attainment/Maintenance Area?	no
Within 1 mile of a PM2.5 24hr (2006 standard) Non-Attainment/Maintenance Area?	no
Within 1 mile of a PM2.5 Annual (1997 standard) Non-Attainment/Maintenance Area?	no
Within 1 mile of a PM2.5 Annual (2012 standard) Non-Attainment/Maintenance Area?	no
Within 1 mile of a PM10 (1987 standard) Non-Attainment/Maintenance Area?	no
Within 1 mile of a CO Annual (1971 standard) Non-Attainment/Maintenance Area?	no
Within 1 mile of a NO2 Annual (1971 standard) Non-Attainment/Maintenance Area?	no
Within 1 mile of a Federal Land?	no
Within 1 mile of an impaired stream?	yes
Within 1 mile of an impaired waterbody?	no
Within 1 mile of a waterbody?	yes
Within 1 mile of a stream?	yes
Within 1 mile of an NWI wetland?	Available Online
Within 1 mile of a Brownfields site?	yes
Within 1 mile of a Superfund site?	no

Within 1 mile of a Toxic Release Inventory (TRI) site?	yes
Within 1 mile of a water discharger (NPDES)?	yes
Within 1 mile of a hazardous waste (RCRA) facility?	yes
Within 1 mile of an air emission facility?	yes
Within 1 mile of a school?	yes
Within 1 mile of an airport?	no
Within 1 mile of a hospital?	no
Within 1 mile of a designated sole source aquifer?	no
Within 1 mile of a historic property on the National Register of Historic Places?	yes
Within 1 mile of a Land Cession Boundary?	yes
Within 1 mile of a tribal area (lower 48 states)?	yes
Within 1 mile of the service area of a mitigation or conservation bank?	no
Within 1 mile of the service area of an In-Lieu-Fee Program?	yes
Within 1 mile of a Public Property Boundary of the Formerly Used Defense Sites?	no
Within 1 mile of a Munitions Response Site?	no
Within 1 mile of an Essential Fish Habitat (EFH)?	no
Within 1 mile of a Habitat Area of Particular Concern (HAPC)?	no
Within 1 mile of an EFH Area Protected from Fishing (EFHA)?	no
Within 1 mile of a Bureau of Land Management Area of Critical Environmental Concern?	no
Within 1 mile of an ESA-designated Critical Habitat Area per U.S. Fish & Wildlife Service?	no
Within 1 mile of an ESA-designated Critical Habitat river, stream or water feature per U.S. Fish & Wildlife Service?	no

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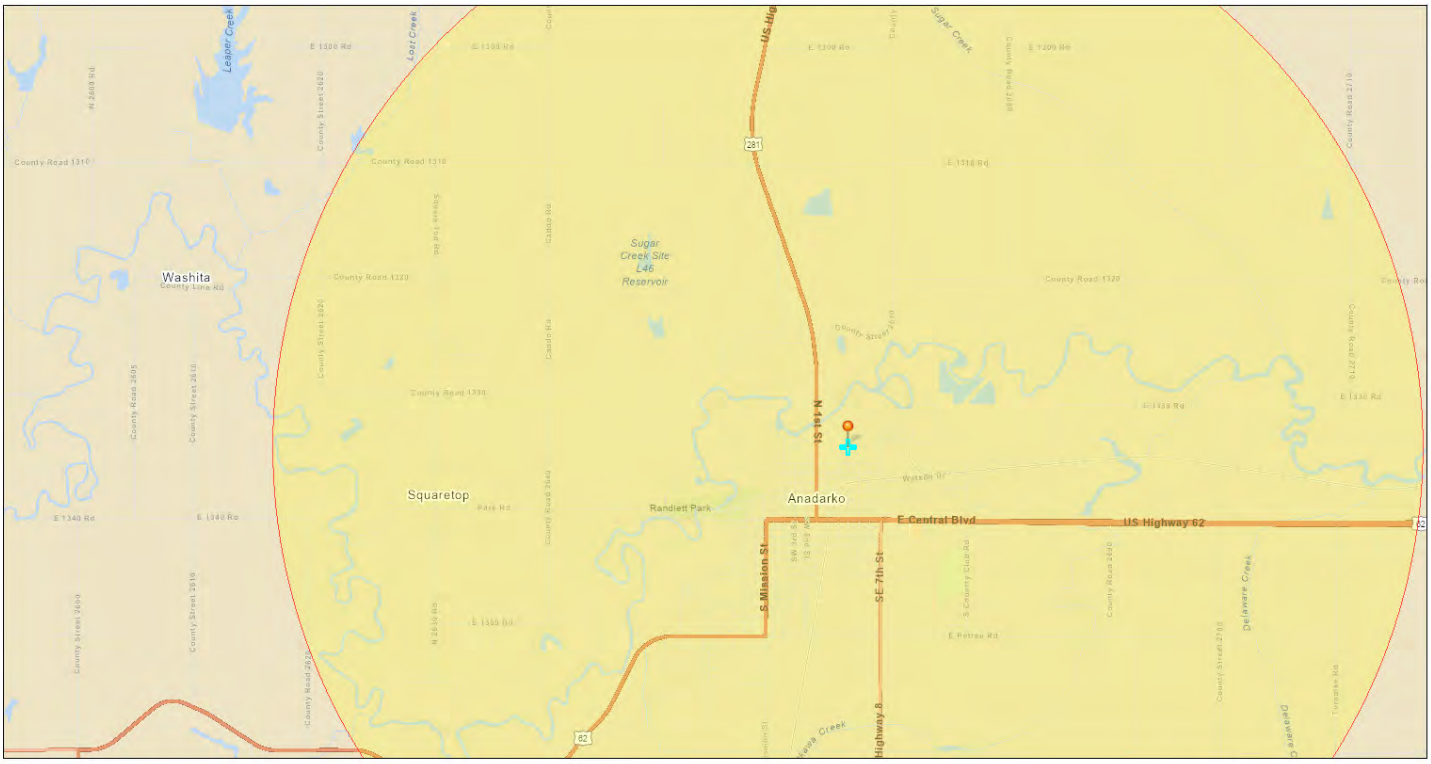
NEPAssist Report

Anadarko Power Station

A3 Landscape



March 11, 2024

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Texas Parks & Wildlife, Esri, TomTom, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, EPA, NPS, USDA, USFWS

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Within 5 miles of an Ozone 8-hr (2008 standard) Non-Attainment/Maintenance Area?	no
Within 5 miles of an Ozone 8-hr (2015 standard) Non-Attainment/Maintenance Area?	no
Within 5 miles of a Lead (2008 standard) Non-Attainment/Maintenance Area?	no
Within 5 miles of a SO2 1-hr (2010 standard) Non-Attainment/Maintenance Area?	no
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Within 5 miles of a Bureau of Land Management Area of Critical Environmental Concern?	no
Within 5 miles of an ESA-designated Critical Habitat Area per U.S. Fish & Wildlife Service?	no
Within 5 miles of an ESA-designated Critical Habitat river, stream or water feature per U.S. Fish & Wildlife Service?	no

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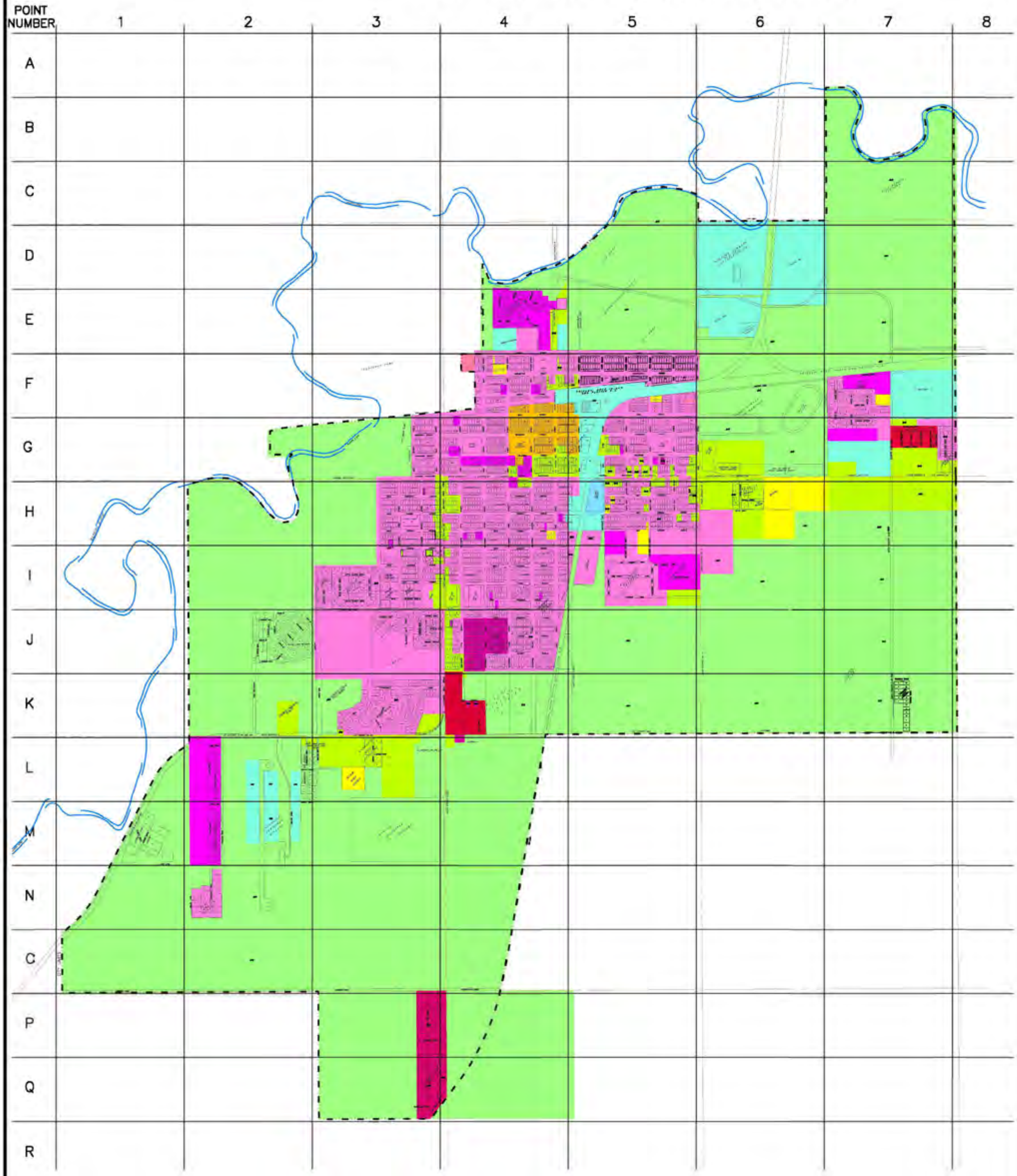
Attachment 3. City of Anadarko Zoning Map

CITY OF ANADARKO ZONING MAP



🟩 A–1–AgriculturaL

🟩 A–2

🟧 C–1

🟩 C–2–Local Highway Commercial District

🟨 C–3

🟦 I–1–Light Industrial

🟦 I–2

🟦 J–1

🟥 R–1

🟥 R–2

🟪 R–3–Single Family Residential

🟥 R–4–Mobile Home Residential

🟪 R–5–Mixed, Single Family Residential

🟪 R–6–Multi Family Residential

🟥 R–7–Planned Residential Development

The City of Anadarko disclaims any warranty or merchantability or warranty for fitness of use for a particular purpose, expressed or implied, with respect to this data. Furthermore, the City of Anadarko disclaims any responsiblity for the accuracy or completeness of this data.

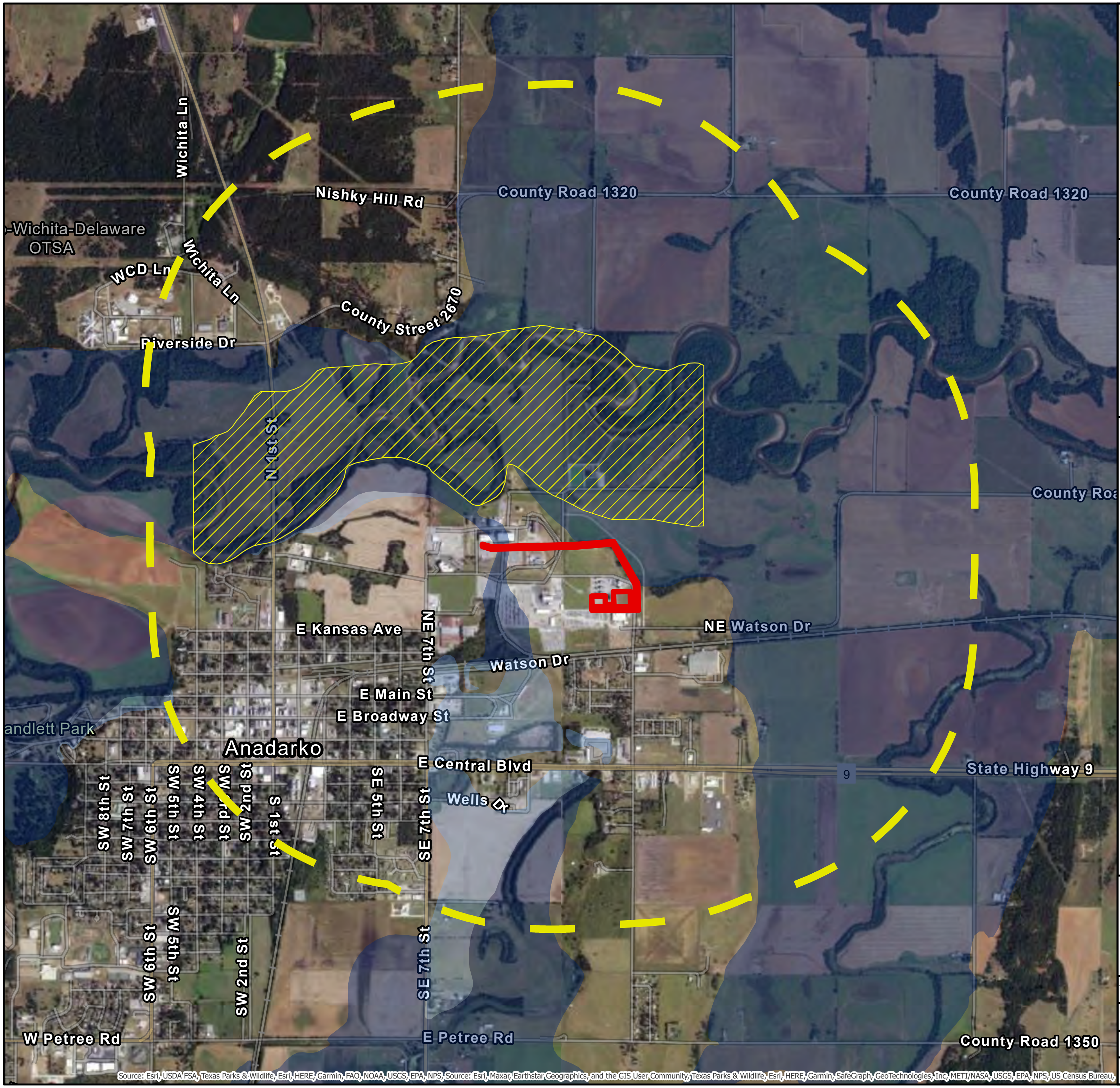
GLENN BRIGGS & ASSOCIATES, INC.
CONSULTING ENGINEERS & LAND SURVEYORS
111 SEQUOYAH LANE
ALTUS, OK 73521
P.O. BOX 458
ALTUS, OK 73522
(580) 482-3011

City of Anadarko
OKLAHOMA

2000 0 2000

Scale 1" = 2000'

Attachment 4. FEMA Floodplain Map



Source: Esri, USDA FSA, Texas Parks & Wildlife, Esri, HERE, Garmin, FAO, NOAA, USGS, EPA, NPS, Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community, Texas Parks & Wildlife, Esri, HERE, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, EPA, NPS, US Census Bureau,

Western Farmers Electric Cooperative

Combustion Turbine Project
Environmental Assessment

FEMA Floodplain Map

- Impact Area

Flood Zone Designations

- Zone AE (1% Flood Chance)
- ▨ Regulatory Floodway
- Zone A (0.2% Flood Chance)
- 🟥 Gen Tie New
- 🟥 Project Area

N

1 inch equals 2,600 feet*

0 1,000 2,000 4,000 US Feet

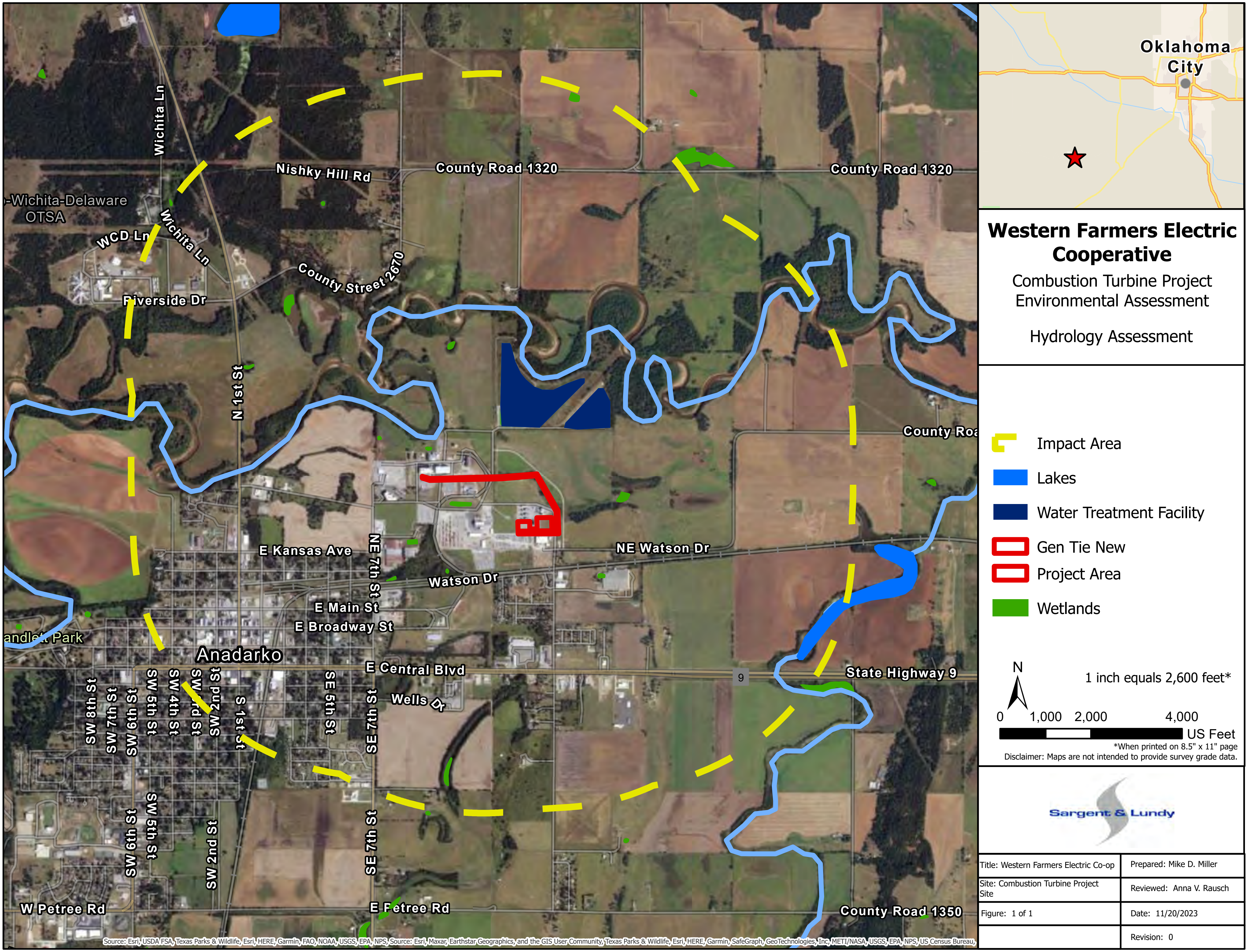
*When printed on 8.5" x 11" page

Disclaimer: Maps are not intended to provide survey grade data.

Sargent & Lundy

Title: Western Farmers Electric Co-op	Prepared: Mike D. Miller
Site: Combustion Turbine Project Site	Reviewed: Anna V. Rausch
Figure: 1 of 1	Date: 11/20/2023
	Revision: 0

Attachment 5. Area Hydrology Map



Source: Esri, USDA FSA, Texas Parks & Wildlife, Esri, HERE, Garmin, FAO, NOAA, USGS, EPA, NPS, Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community, Texas Parks & Wildlife, Esri, HERE, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, EPA, NPS, US Census Bureau,

Western Farmers Electric Cooperative

Combustion Turbine Project
Environmental Assessment

Hydrology Assessment

- Impact Area
- 🟦 Lakes
- 🟦 Water Treatment Facility
- 🟥 Gen Tie New
- 🟥 Project Area
- 🟩 Wetlands

N

1 inch equals 2,600 feet*

0 1,000 2,000 4,000 US Feet

*When printed on 8.5" x 11" page

Disclaimer: Maps are not intended to provide survey grade data.

Sargent & Lundy

Title: Western Farmers Electric Co-op	Prepared: Mike D. Miller
Site: Combustion Turbine Project Site	Reviewed: Anna V. Rausch
Figure: 1 of 1	Date: 11/20/2023
	Revision: 0

Attachment 6. General Fish, Wildlife, and Vegetation Resources

Attachment 6a. USFWS Species List

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Oklahoma Ecological Services Field Office
9014 East 21st Street
Tulsa, OK 74129-1428
Phone: (918) 581-7458 Fax: (918) 581-7467

In Reply Refer To: 03/22/2024 21:16:28 UTC
Project Code: 2024-0067157
Project Name: WFEC Anadarko SCCT Project

Subject: List of threatened and endangered species that may occur in your proposed project location or may be affected by your proposed project

To Whom It May Concern:

The enclosed species list identifies threatened, endangered, proposed and candidate species, as well as proposed and final designated critical habitat, that may occur within the boundary of your proposed project and/or may be affected by your proposed project. The species list fulfills the requirements of the U.S. Fish and Wildlife Service (Service) under section 7(c) of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 *et seq.*).

New information based on updated surveys, changes in the abundance and distribution of species, changed habitat conditions, or other factors could change this list. Please feel free to contact us if you need more current information or assistance regarding the potential impacts to federally proposed, listed, and candidate species and federally designated and proposed critical habitat. Please note that under 50 CFR 402.12(e) of the regulations implementing section 7 of the Act, the accuracy of this species list should be verified after 90 days. This verification can be completed formally or informally as desired. The Service recommends that verification be completed by visiting the IPaC website at regular intervals during project planning and implementation for updates to species lists and information. An updated list may be requested through the IPaC system by completing the same process used to receive the enclosed list.

The purpose of the Act is to provide a means whereby threatened and endangered species and the ecosystems upon which they depend may be conserved. Under sections 7(a)(1) and 7(a)(2) of the Act and its implementing regulations (50 CFR 402 *et seq.*), Federal agencies are required to utilize their authorities to carry out programs for the conservation of threatened and endangered species and to determine whether projects may affect threatened and endangered species and/or designated critical habitat.

A Biological Assessment is required for construction projects (or other undertakings having similar physical impacts) that are major Federal actions significantly affecting the quality of the human environment as defined in the National Environmental Policy Act (42 U.S.C. 4332(2)(c)). For projects other than major construction activities, the Service suggests that a biological evaluation similar to a Biological Assessment be prepared to determine whether the project may affect listed or proposed species and/or designated or proposed critical habitat. Recommended contents of a Biological Assessment are described at 50 CFR 402.12.

If a Federal agency determines, based on the Biological Assessment or biological evaluation, that listed species and/or designated critical habitat may be affected by the proposed project, the agency is required to consult with the Service pursuant to 50 CFR 402. In addition, the Service recommends that candidate species, proposed species and proposed critical habitat be addressed within the consultation. More information on the regulations and procedures for section 7 consultation, including the role of permit or license applicants, can be found in the "Endangered Species Consultation Handbook" at:

https://www.fws.gov/sites/default/files/documents/endangered-species-consultation-handbook.pdf

Migratory Birds: In addition to responsibilities to protect threatened and endangered species under the Endangered Species Act (ESA), there are additional responsibilities under the Migratory Bird Treaty Act (MBTA) and the Bald and Golden Eagle Protection Act (BGEPA) to protect native birds from project-related impacts. Any activity, intentional or unintentional, resulting in take of migratory birds, including eagles, is prohibited unless otherwise permitted by the U.S. Fish and Wildlife Service (50 C.F.R. Sec. 10.12 and 16 U.S.C. Sec. 668(a)). For more information regarding these Acts, see https://www.fws.gov/program/migratory-bird-permit/what-we-do.

The MBTA has no provision for allowing take of migratory birds that may be unintentionally killed or injured by otherwise lawful activities. It is the responsibility of the project proponent to comply with these Acts by identifying potential impacts to migratory birds and eagles within applicable NEPA documents (when there is a federal nexus) or a Bird/Eagle Conservation Plan (when there is no federal nexus). Proponents should implement conservation measures to avoid or minimize the production of project-related stressors or minimize the exposure of birds and their resources to the project-related stressors. For more information on avian stressors and recommended conservation measures, see https://www.fws.gov/library/collections/threats-birds.

In addition to MBTA and BGEPA, Executive Order 13186: *Responsibilities of Federal Agencies to Protect Migratory Birds*, obligates all Federal agencies that engage in or authorize activities that might affect migratory birds, to minimize those effects and encourage conservation measures that will improve bird populations. Executive Order 13186 provides for the protection of both migratory birds and migratory bird habitat. For information regarding the implementation of Executive Order 13186, please visit https://www.fws.gov/partner/council-conservation-migratory-birds.

We appreciate your concern for threatened and endangered species. The Service encourages Federal agencies to include conservation of threatened and endangered species into their project planning to further the purposes of the Act. Please include the Consultation Code in the header of this letter with any request for consultation or correspondence about your project that you submit to our office.

Attachment(s):

- Official Species List
- USFWS National Wildlife Refuges and Fish Hatcheries
- Bald & Golden Eagles
- Migratory Birds
- Wetlands

OFFICIAL SPECIES LIST

This list is provided pursuant to Section 7 of the Endangered Species Act, and fulfills the requirement for Federal agencies to "request of the Secretary of the Interior information whether any species which is listed or proposed to be listed may be present in the area of a proposed action".

This species list is provided by:

Oklahoma Ecological Services Field Office
9014 East 21st Street
Tulsa, OK 74129-1428
(918) 581-7458

PROJECT SUMMARY

Project Code:	2024-0067157
Project Name:	WFEC Anadarko SCCT Project
Project Type:	Power Gen - Natural Gas
Project Description:	Western Farmers is proposing to construct two (2) new natural gas-fired simple-cycle combustion turbines at its existing Anadarko Power Plant (the “Combustion Turbine Project” or the “Project”). The new combustion turbines will be installed as replacement generating capacity following the retirement of three less efficient gas-fired boilers. WFEC intends to request financing for the Project from the U.S. Department of Agriculture (USDA) Rural Utilities Service (RUS) under the RUS Electric Loan Program.

Project Location:

The approximate location of the project can be viewed in Google Maps: https://www.google.com/maps/@35.08170805,-98.22170770065298,14z

Counties: Caddo County, Oklahoma

ENDANGERED SPECIES ACT SPECIES

There is a total of 5 threatened, endangered, or candidate species on this species list.

Species on this list should be considered in an effects analysis for your project and could include species that exist in another geographic area. For example, certain fish may appear on the species list because a project could affect downstream species.

IPaC does not display listed species or critical habitats under the sole jurisdiction of NOAA Fisheries[1], as USFWS does not have the authority to speak on behalf of NOAA and the Department of Commerce.

See the "Critical habitats" section below for those critical habitats that lie wholly or partially within your project area under this office's jurisdiction. Please contact the designated FWS office if you have questions.

---

1. NOAA Fisheries, also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

MAMMALS

NAME	STATUS
Tricolored Bat *Perimyotis subflavus* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/10515	Proposed Endangered

BIRDS

NAME	STATUS
Piping Plover *Charadrius melodus* Population: [Atlantic Coast and Northern Great Plains populations] - Wherever found, except those areas where listed as endangered. There is **final** critical habitat for this species. Your location does not overlap the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/6039	Threatened
Rufa Red Knot *Calidris canutus rufa* There is **proposed** critical habitat for this species. Species profile: https://ecos.fws.gov/ecp/species/1864	Threatened
Whooping Crane *Grus americana* Population: Wherever found, except where listed as an experimental population There is **final** critical habitat for this species. Your location does not overlap the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/758	Endangered

INSECTS

NAME	STATUS
Monarch Butterfly *Danaus plexippus* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/9743	Candidate

CRITICAL HABITATS

THERE ARE NO CRITICAL HABITATS WITHIN YOUR PROJECT AREA UNDER THIS OFFICE'S JURISDICTION.

YOU ARE STILL REQUIRED TO DETERMINE IF YOUR PROJECT(S) MAY HAVE EFFECTS ON ALL ABOVE LISTED SPECIES.

USFWS NATIONAL WILDLIFE REFUGE LANDS AND FISH HATCHERIES

Any activity proposed on lands managed by the National Wildlife Refuge system must undergo a 'Compatibility Determination' conducted by the Refuge. Please contact the individual Refuges to discuss any questions or concerns.

THERE ARE NO REFUGE LANDS OR FISH HATCHERIES WITHIN YOUR PROJECT AREA.

BALD & GOLDEN EAGLES

Bald and golden eagles are protected under the Bald and Golden Eagle Protection Act[1] and the Migratory Bird Treaty Act[2].

Any person or organization who plans or conducts activities that may result in impacts to bald or golden eagles, or their habitats[3], should follow appropriate regulations and consider implementing appropriate conservation measures, as described in the links below. Specifically, please review the "Supplemental Information on Migratory Birds and Eagles".

---

1. The Bald and Golden Eagle Protection Act of 1940.
2. The Migratory Birds Treaty Act of 1918.
3. 50 C.F.R. Sec. 10.12 and 16 U.S.C. Sec. 668(a)

There are likely bald eagles present in your project area. For additional information on bald eagles, refer to Bald Eagle Nesting and Sensitivity to Human Activity

For guidance on when to schedule activities or implement avoidance and minimization measures to reduce impacts to migratory birds on your list, see the PROBABILITY OF PRESENCE SUMMARY below to see when these birds are most likely to be present and breeding in your project area.

NAME	BREEDING SEASON
Bald Eagle *Haliaeetus leucocephalus* This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities. https://ecos.fws.gov/ecp/species/1626	Breeds Oct 15 to Jul 31

PROBABILITY OF PRESENCE SUMMARY

The graphs below provide our best understanding of when birds of concern are most likely to be present in your project area. This information can be used to tailor and schedule your project activities to avoid or minimize impacts to birds. Please make sure you read "Supplemental Information on Migratory Birds and Eagles", specifically the FAQ section titled "Proper Interpretation and Use of Your Migratory Bird Report" before using or attempting to interpret this report.

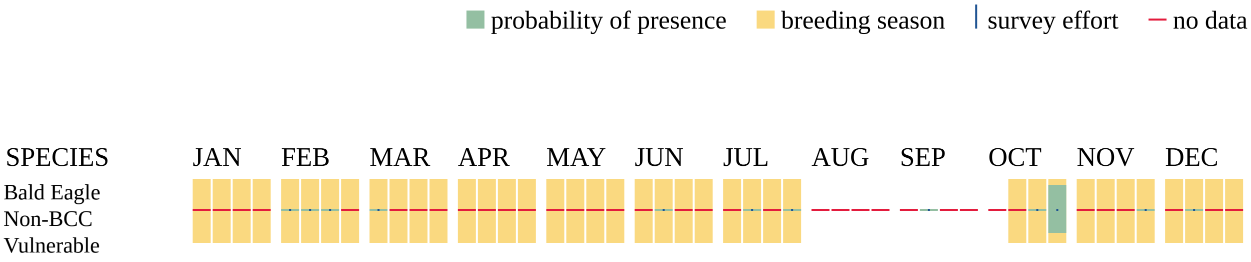
Probability of Presence (🟩)

Green bars; the bird's relative probability of presence in the 10km grid cell(s) your project overlaps during that week of the year.

Breeding Season (🟨)
Yellow bars; liberal estimate of the timeframe inside which the bird breeds across its entire range.

Survey Effort (|)
Vertical black lines; the number of surveys performed for that species in the 10km grid cell(s) your project area overlaps.

No Data (–)
A week is marked as having no data if there were no survey events for that week.



Additional information can be found using the following links:

- Eagle Management https://www.fws.gov/program/eagle-management
- Measures for avoiding and minimizing impacts to birds https://www.fws.gov/library/collections/avoiding-and-minimizing-incidental-take-migratory-birds
- Nationwide conservation measures for birds https://www.fws.gov/sites/default/files/documents/nationwide-standard-conservation-measures.pdf
- Supplemental Information for Migratory Birds and Eagles in IPaC https://www.fws.gov/media/supplemental-information-migratory-birds-and-bald-and-golden-eagles-may-occur-project-action

MIGRATORY BIRDS

Certain birds are protected under the Migratory Bird Treaty Act[1] and the Bald and Golden Eagle Protection Act[2].

Any person or organization who plans or conducts activities that may result in impacts to migratory birds, eagles, and their habitats[3] should follow appropriate regulations and consider implementing appropriate conservation measures, as described in the links below. Specifically, please review the "Supplemental Information on Migratory Birds and Eagles".

---

1. The Migratory Birds Treaty Act of 1918.
2. The Bald and Golden Eagle Protection Act of 1940.
3. 50 C.F.R. Sec. 10.12 and 16 U.S.C. Sec. 668(a)

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PROBABILITY OF PRESENCE SUMMARY

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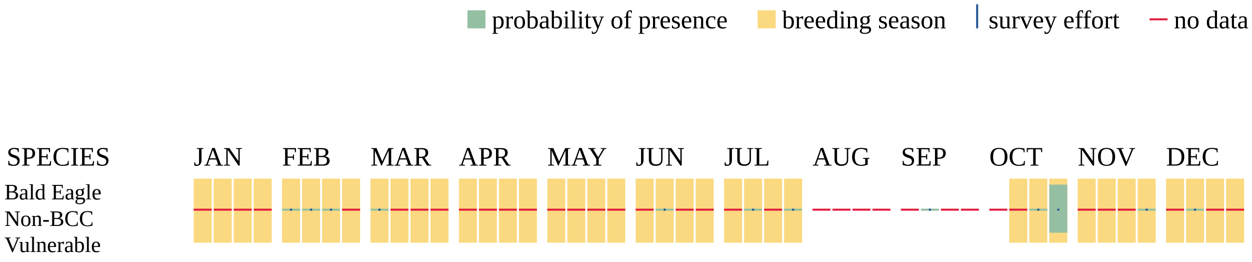
Probability of Presence (🟩)

Green bars; the bird's relative probability of presence in the 10km grid cell(s) your project overlaps during that week of the year.

Breeding Season (🟨)
Yellow bars; liberal estimate of the timeframe inside which the bird breeds across its entire range.

Survey Effort (|)
Vertical black lines; the number of surveys performed for that species in the 10km grid cell(s) your project area overlaps.

No Data (–)
A week is marked as having no data if there were no survey events for that week.



Additional information can be found using the following links:

- Eagle Management https://www.fws.gov/program/eagle-management
- Measures for avoiding and minimizing impacts to birds https://www.fws.gov/library/collections/avoiding-and-minimizing-incidental-take-migratory-birds
- Nationwide conservation measures for birds https://www.fws.gov/sites/default/files/documents/nationwide-standard-conservation-measures.pdf
- Supplemental Information for Migratory Birds and Eagles in IPaC https://www.fws.gov/media/supplemental-information-migratory-birds-and-bald-and-golden-eagles-may-occur-project-action

WETLANDS

Impacts to NWI wetlands and other aquatic habitats may be subject to regulation under Section 404 of the Clean Water Act, or other State/Federal statutes.

For more information please contact the Regulatory Program of the local U.S. Army Corps of Engineers District.

Please note that the NWI data being shown may be out of date. We are currently working to update our NWI data set. We recommend you verify these results with a site visit to determine the actual extent of wetlands on site.

THERE ARE NO WETLANDS WITHIN YOUR PROJECT AREA.

IPAC USER CONTACT INFORMATION

Agency:	Sargent & Lundy
Name:	Samantha Country
Address:	55 E Monroe Street
City:	Chicago
State:	IL
Zip:	60603
Email	samantha.m.country@sargentlundy.com
Phone:	3122696832

LEAD AGENCY CONTACT INFORMATION

Lead Agency: Rural Utilities Service

Attachment 6b. Federally Listed Threatened and Endangered Species That May Occur in the Vicinity of the Project Area

Species Type	Common Name	Scientific Name	Federal Status	Preferred Habitat Type
Mammal	Tricolored Bat	*Perimyotis subflavus*	Proposed Endangered	During the winter, tricolored bats are often found in caves and abandoned mines, although in the southern United States, where caves are sparse, tricolored bats are often found roosting in road-associated culverts where they exhibit shorter torpor bouts and forage during warm nights. During the spring, summer, and fall, tricolored bats are found in forested habitats where they roost in trees, primarily among leaves of live or recently dead deciduous hardwood trees, but may also be found in Spanish moss, pine trees, and occasionally human structures (USFWS, 2023b))
Bird	Piping Plover	*Charadrius melodus*	Threatened	The species historical range included: Alabama, Colorado, Connecticut, Delaware, Florida, Georgia, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Michigan, Minnesota, Mississippi, Missouri, Montana, Nebraska, New Hampshire, New Jersey, New York, North Carolina, North Dakota, Ohio, Oklahoma, Pennsylvania, Puerto Rico, Rhode Island, South Carolina, South Dakota, Texas, Virginia, Virgin Islands, Wisconsin, Wyoming (USFWS 2023c))
Bird	Red Knot	*Calidris canutus rufa*	Threatened	The species historical range included Alabama, Arkansas, Colorado, Connecticut, Delaware, District of Columbia, Florida, Georgia, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Michigan, Minnesota, Mississippi, Missouri, Montana, Nebraska, New Hampshire, New Jersey, New York, North Carolina, North Dakota, Ohio, Oklahoma, Pennsylvania, Puerto Rico, Rhode Island, South Carolina, South Dakota, Tennessee, Texas, Vermont, Virginia, Virgin Islands, West Virginia, Wisconsin, Wyoming (USFWS, 2023d)).
Bird	Whooping Crane	*Grus americana*	Endangered	Whooping cranes breed, migrate, winter, and forage in a variety of wetland and other habitats, including coastal marshes and estuaries, inland marshes, lakes, ponds, wet meadows and rivers, and agricultural fields. Whooping cranes breed and nest in wetland habitat in Wood-Buffalo National Park, Canada. Bulrush is the dominant vegetation type in the potholes used for nesting, although cattail, sedge, musk-grass, and other aquatic plants are common. Nest sites are primarily located in shallow diatom ponds that contain bulrush. During migration, whooping cranes use a variety of habitats; of which wetland mosaics appear to be the most suitable. For feeding, whooping cranes primarily use shallow, seasonally and semi permanently flooded palustrine wetlands for roosting, and various cropland and emergent wetlands. Wintering habitat in the Aransas National Wildlife Refuge, Texas, includes salt marshes and tidal flats on the mainland and barrier islands, dominated by salt grass, saltwort, smooth cordgrass, glasswort, and sea ox-eye (USFWS, 2023e)).
Insect	Monarch Butterfly	*Danaus plexippus*	Candidate	Individuals in temperate climates undergo long-distance migration and live for an extended period. In the fall, this species begins migrating to their respective overwintering sites. This migration can include distances over 3,000 km and last for over two months. In the early spring, individuals' mate at the overwintering sites before dispersing back to their breeding grounds. During the breeding season, eggs are laid on milkweed host plants and larvae emerge after two to five days. Monarch

Species Type	Common Name	Scientific Name	Federal Status	Preferred Habitat Type
				Butterflies breed year-round. No critical habitat has been designated for this species (USFW, 2023f))

Attachment 7. Parks and Recreational Areas within One Mile of the Site

Park/Recreation Area Name	Approximate Distance from Facility	Direction
Anadarko City Hall	1.29 mile	SW
Unity Park	1.31 mile	SW
Downtown Pocket Park	0.90 mile	SW
Unnamed Community Park (Intersection of East Broadway Street & Southeast 7th Street)	0.56 ddf	S
Washita River	0.43 mile	N, W, and SW

Attachment 8. 40 CFR Part 60 Subpart TTTT: Standards of Performance for Stationary Combustion Turbines

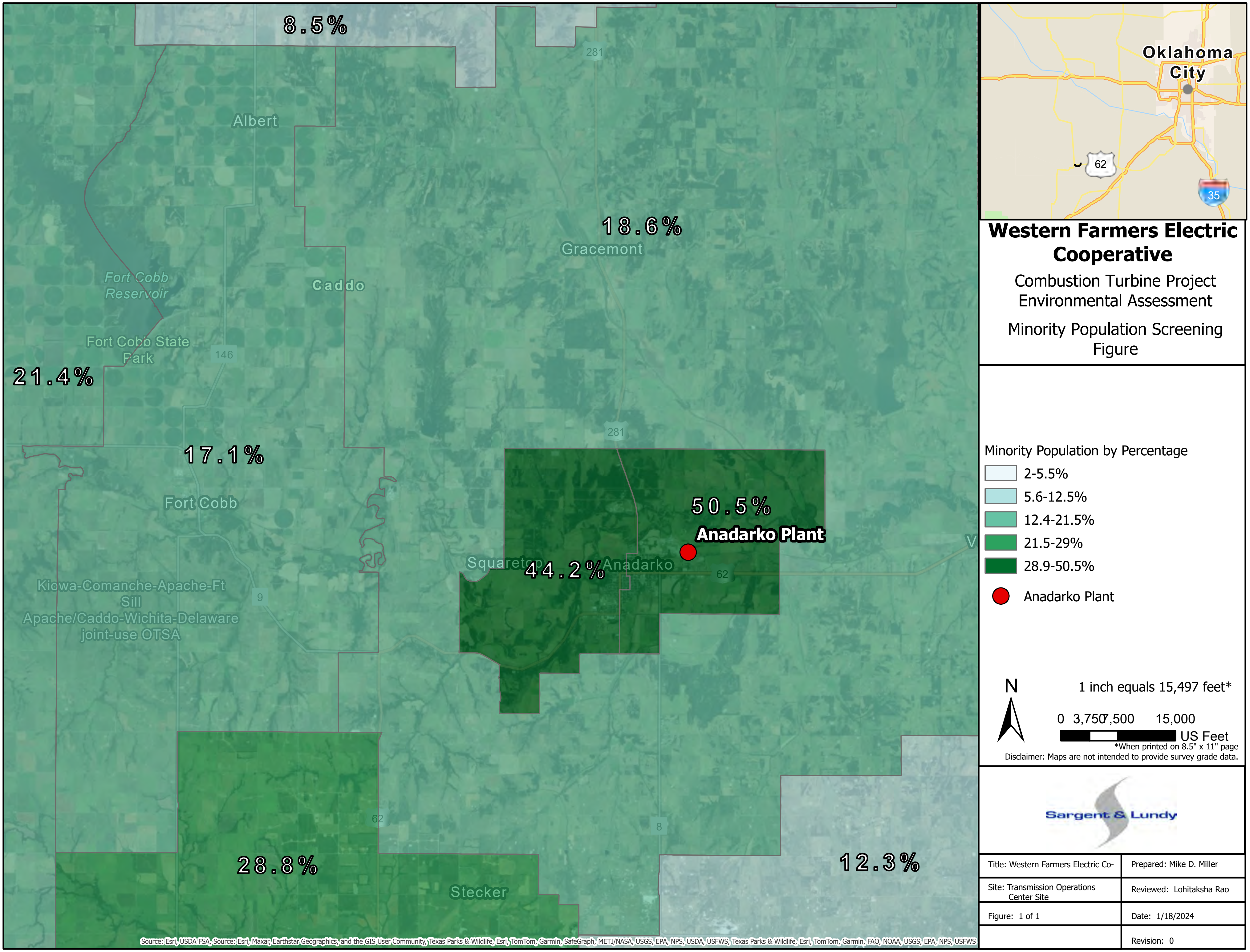
Affected Emissions Generating Unit (EGU)	CO_2 Emission Standard $^{(1,2)}$
Newly constructed or reconstructed stationary combustion turbine that supplies more than its design efficiency or 50%, whichever is less, times its potential electric output as net-electric sales on both a 12-operating month and a 3-year rolling average basis and combusts more than 90% natural gas on a heat input basis on a 12-operating month rolling average basis.	1,000 lb CO_2/MWh-gross; or 1,030 lb CO_2/MWh-net for base load natural gas-fired units
Newly constructed or reconstructed stationary combustion turbine that supplies its design efficiency or 50 percent, whichever is less, times its potential electric output or less as net-electric sales on either a 12-operating month or a 3-year rolling average basis and combusts more than 90% natural gas on a heat input basis on a 12-operating-month rolling average basis	50 kg CO_2 per gigajoule (GJ) of heat input (120 lb CO_2/MMBtu).

(1) Compliance with CO_2 emissions standards is determined on a 12-operating month rolling average basis.

(2) Numerical values of 1,000 or greater have a minimum of 3 significant figures and numerical values of less than 1,000 have a minimum of 2 significant figures.

Attachment 9. Population and Employment Resources

Attachment 9a. Minority Population Screening Figure



Source: Esri, USDA FSA, Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community, Texas Parks & Wildlife, Esri, TomTom, Garmin, SafeGraph, METI/NASA, USGS, EPA, NPS, USDA, USFWS, Texas Parks & Wildlife, Esri, TomTom, Garmin, FAO, NOAA, USGS, EPA, NPS, USFWS

Western Farmers Electric Cooperative

Combustion Turbine Project
Environmental Assessment

Minority Population Screening Figure

Minority Population by Percentage

▭	2-5.5%
▭	5.6-12.5%
🟩	12.4-21.5%
🟩	21.5-29%
🟩	28.9-50.5%
●	Anadarko Plant

1 inch equals 15,497 feet*

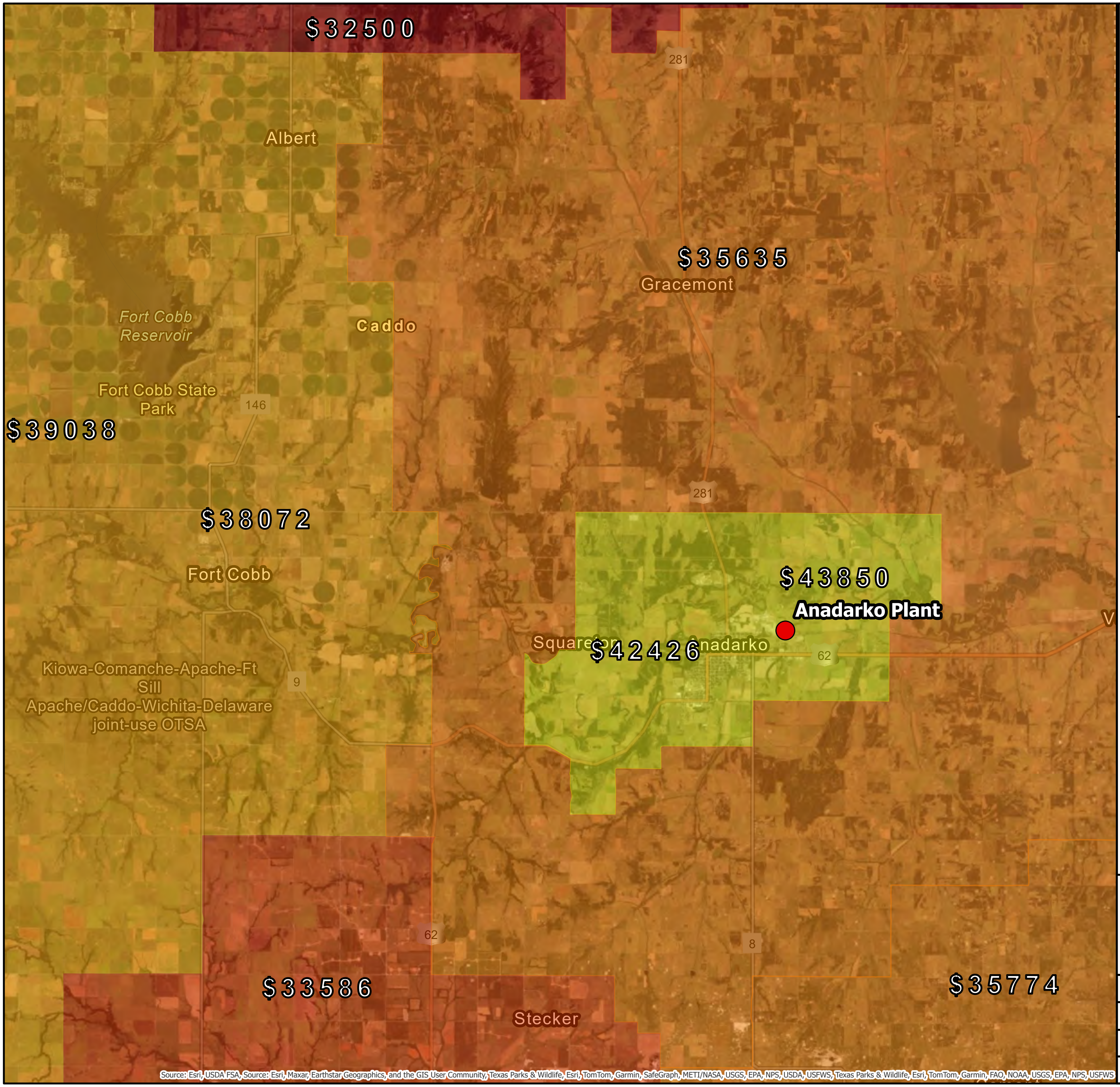
*When printed on 8.5" x 11" page

Disclaimer: Maps are not intended to provide survey grade data.

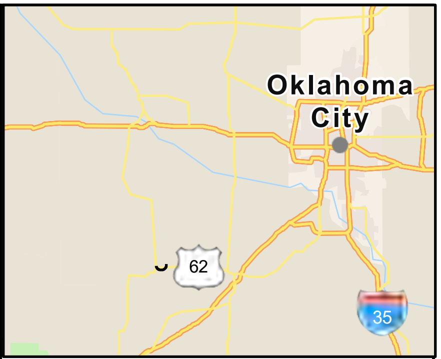
Sargent & Lundy

Title: Western Farmers Electric Co-	Prepared: Mike D. Miller
Site: Transmission Operations Center Site	Reviewed: Lohitaksha Rao
Figure: 1 of 1	Date: 1/18/2024
	Revision: 0

Attachment 9b. Median Income Screening Figure



Source: Esri, USDA FSA, Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community, Texas Parks & Wildlife, Esri, TomTom, Garmin, SafeGraph, METI/NASA, USGS, EPA, NPS, USDA, USFWS, Texas Parks & Wildlife, Esri, TomTom, Garmin, FAO, NOAA, USGS, EPA, NPS, USFWS



Western Farmers Electric Cooperative

Combustion Turbine Project
Environmental Assessment

Median Income Screening Figure

● Anadarko Plant

Median Income Screening Figure
(In Dollars)

🟥 $32500
🟧 $32501 - $33600
🟧 $33601 - $36500
🟨 $36501 - $39000
🟨 $39001 - $43850

$ = U.S. Standard Dollar

N

1 inch equals 15,497 feet*

0 3,750 7,500 15,000
US Feet

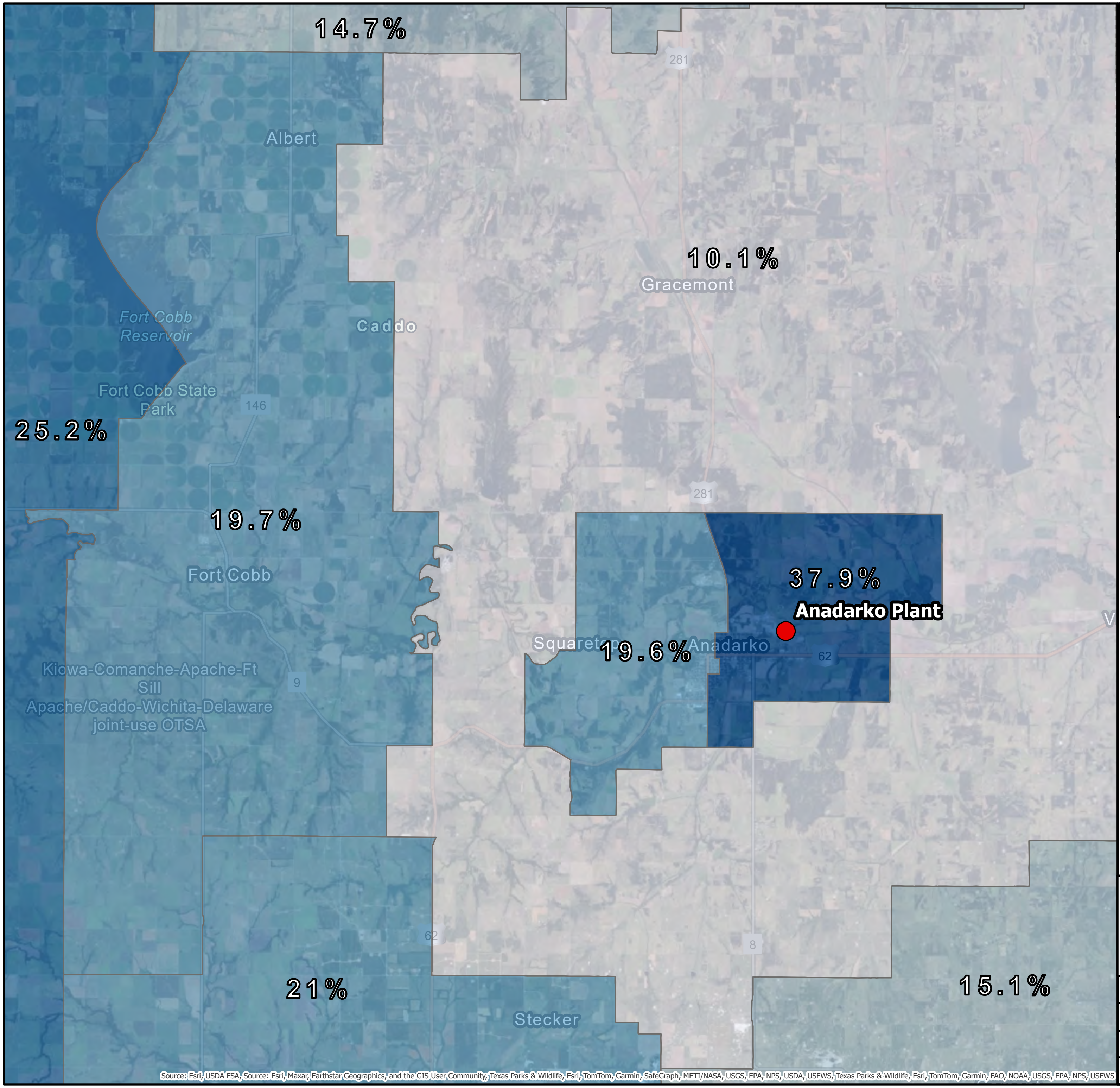
*When printed on 8.5" x 11" page

Disclaimer: Maps are not intended to provide survey grade data.

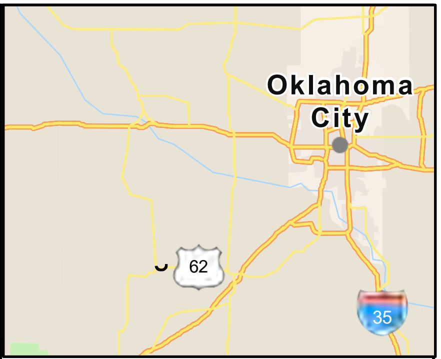
Sargent & Lundy

Title: Western Farmers Electric Co-	Prepared: Mike D. Miller
Site: Transmission Operations Center Site	Reviewed: Lohitaksha Rao
Figure: 1 of 1	Date: 1/18/2024
	Revision: 0

Attachment 9c. Poverty Population Screening Figure



Source: Esri, USDA FSA, Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community, Texas Parks & Wildlife, Esri, TomTom, Garmin, SafeGraph, METI/NASA, USGS, EPA, NPS, USDA, USFWS, Texas Parks & Wildlife, Esri, TomTom, Garmin, FAO, NOAA, USGS, EPA, NPS, USFWS



Western Farmers Electric Cooperative

Combustion Turbine Project
Environmental Assessment

Poverty Population Screening
Figure

Percentage of Total Population in Poverty

- ▭ 10.1%
- ▭ 10.2% - 15.1%
- ▭ 15.2% - 21.0%
- ▭ 21.1% - 25.2%
- ▭ 25.3% - 40%
- ● Anadarko Plant

N

1 inch equals 15,497 feet*

0 3,750 7,500 15,000
US Feet

*When printed on 8.5" x 11" page

Disclaimer: Maps are not intended to provide survey grade data.

Sargent & Lundy

Title: Western Farmers Electric Co-	Prepared: Mike D. Miller
Site: Transmission Operations Center Site	Reviewed: Lohitaksha Rao
Figure: 1 of 1	Date: 1/19/2024
	Revision: 0

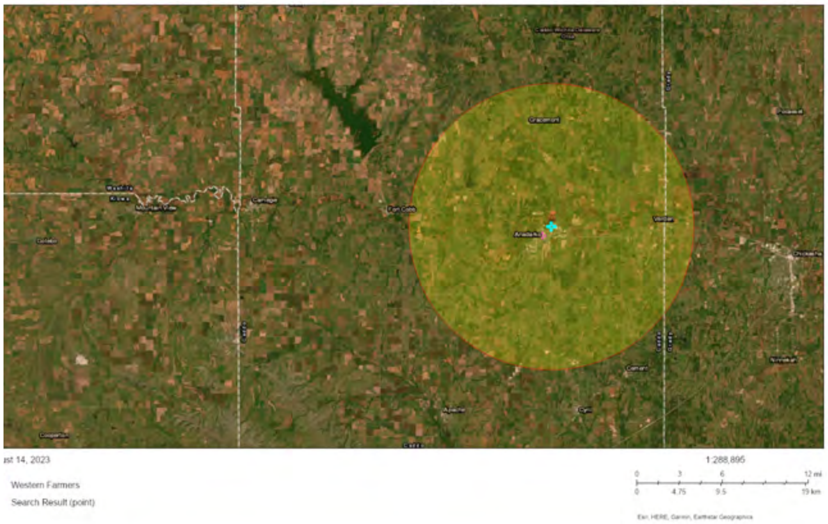
Attachment 9d. EJ Screen Community Report for 10-Mile Radius

EJScreen Community Report

This report provides environmental and socioeconomic information for user-defined areas, and combines that data into environmental justice and supplemental indexes.

Anadarko, OK

10 miles Ring Centered at 35.082899,-98.232876
Population: 8,837
Area in square miles: 314.03



COMMUNITY INFORMATION

Low income: 51 percent

People of color: 59 percent

Less than high school education: 12 percent

Limited English households: 3 percent

Unemployment: 9 percent

Persons with disabilities: 21 percent

Male: 51 percent

Female: 49 percent

76 years Average life expectancy

$21,954 Per capita income

Number of households: 2,982

Owner occupied: 64 percent

BREAKDOWN BY RACE

White: 43%

Black: 5%

Asian: 0%

Hispanic: 11%

American Indian: 35%

Hawaiian/Pacific Islander: 0%

Other race: 2%

Two or more races: 14%

BREAKDOWN BY AGE

From Ages 1 to 4	8%
From Ages 1 to 18	29%
From Ages 18 and up	71%
From Ages 65 and up	15%

LIMITED ENGLISH SPEAKING BREAKDOWN

Speak Spanish	30%
Speak Other Indo-European Languages	27%
Speak Asian-Pacific Island Languages	0%
Speak Other Languages	43%

Notes: Numbers may not sum to totals due to rounding. Hispanic popultion can be of any race. Source: U.S. Census Bureau, American Community Survey (ACS) 2017 -2021. Life expectancy data comes from the Centers for Disease Control.

LANGUAGES SPOKEN AT HOME

LANGUAGE	PERCENT
English	94%
Spanish	3%
French, Haitian, or Cajun	1%
Other and Unspecified	2%
Total Non-English	6%

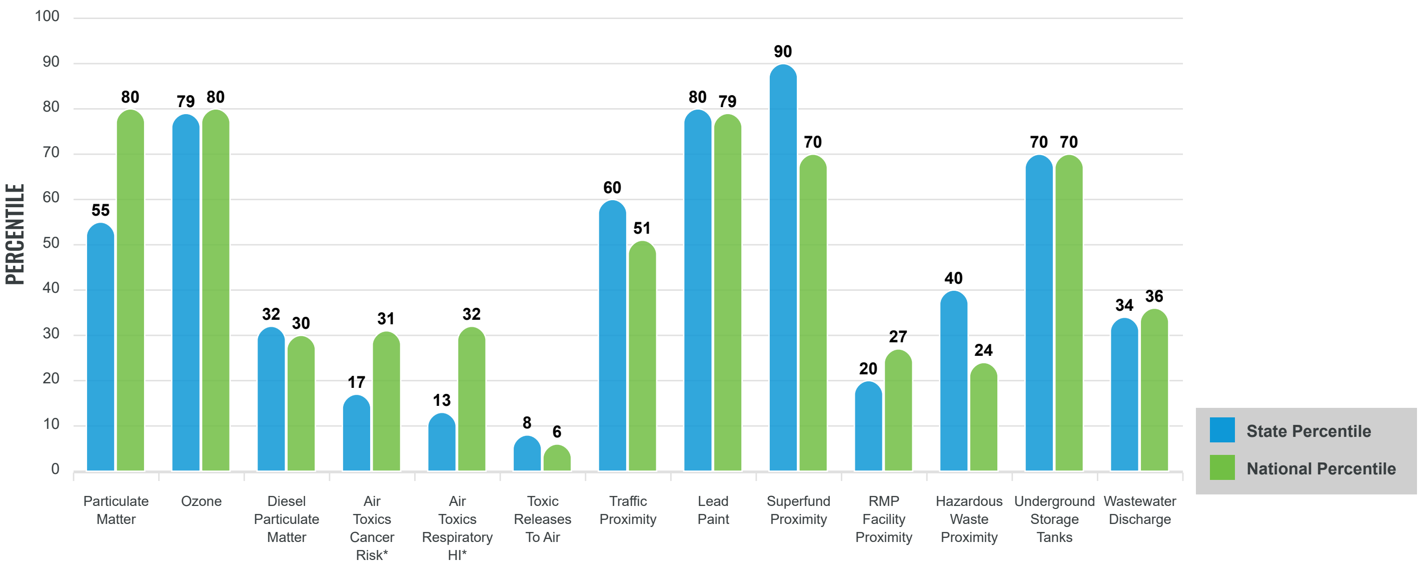
Environmental Justice & Supplemental Indexes

The environmental justice and supplemental indexes are a combination of environmental and socioeconomic information. There are thirteen EJ indexes and supplemental indexes in EJScreen reflecting the 13 environmental indicators. The indexes for a selected area are compared to those for all other locations in the state or nation. For more information and calculation details on the EJ and supplemental indexes, please visit the EJScreen website.

EJ INDEXES

The EJ indexes help users screen for potential EJ concerns. To do this, the EJ index combines data on low income and people of color populations with a single environmental indicator.

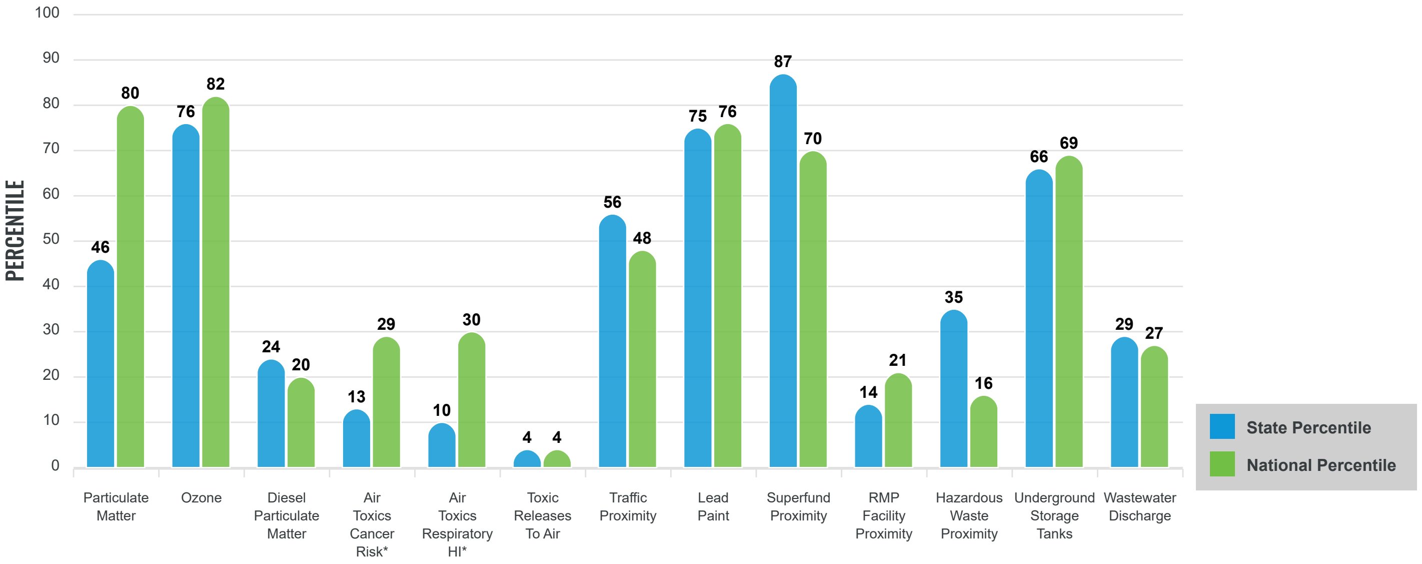
EJ INDEXES FOR THE SELECTED LOCATION



SUPPLEMENTAL INDEXES

The supplemental indexes offer a different perspective on community-level vulnerability. They combine data on percent low-income, percent linguistically isolated, percent less than high school education, percent unemployed, and low life expectancy with a single environmental indicator.

SUPPLEMENTAL INDEXES FOR THE SELECTED LOCATION



These percentiles provide perspective on how the selected block group or buffer area compares to the entire state or nation.

Report for 10 miles Ring Centered at 35.082899,-98.232876

EJScreen Environmental and Socioeconomic Indicators Data

SELECTED VARIABLES	VALUE	STATE AVERAGE	PERCENTILE IN STATE	USA AVERAGE	PERCENTILE IN USA
POLLUTION AND SOURCES					
Particulate Matter (µg/m^3)	8.62	9.03	28	8.08	62
Ozone (ppb)	62.8	62.3	55	61.6	61
Diesel Particulate Matter (µg/m^3)	0.0802	0.166	13	0.261	10
Air Toxics Cancer Risk* (lifetime risk per million)	20	29	1	28	3
Air Toxics Respiratory HI*	0.21	0.3	1	0.31	4
Toxic Releases to Air	0.49	4,100	4	4,600	3
Traffic Proximity (daily traffic count/distance to road)	26	83	40	210	28
Lead Paint (% Pre-1960 Housing)	0.31	0.25	68	0.3	59
Superfund Proximity (site count/km distance)	0.054	0.048	80	0.13	46
RMP Facility Proximity (facility count/km distance)	0.051	0.38	10	0.43	10
Hazardous Waste Proximity (facility count/km distance)	0.047	0.43	22	1.9	8
Underground Storage Tanks (count/km^2)	1.3	1.7	58	3.9	51
Wastewater Discharge (toxicity-weighted concentration/m distance)	6.9E-06	0.058	19	22	15
SOCIOECONOMIC INDICATORS					
Demographic Index	52%	36%	81	35%	76
Supplemental Demographic Index	19%	16%	72	14%	76
People of Color	55%	35%	83	39%	69
Low Income	50%	37%	73	31%	80
Unemployment Rate	8%	5%	75	6%	73
Limited English Speaking Households	3%	2%	81	5%	69
Less Than High School Education	12%	12%	60	12%	65
Under Age 5	8%	6%	69	6%	73
Over Age 64	15%	16%	49	17%	48
Low Life Expectancy	23%	22%	58	20%	80

*Diesel particulate matter, air toxics cancer risk, and air toxics respiratory hazard index are from the EPA's Air Toxics Data Update, which is the Agency's ongoing, comprehensive evaluation of air toxics in the United States. This effort aims to prioritize air toxics, emission sources, and locations of interest for further study. It is important to remember that the air toxics data presented here provide broad estimates of health risks over geographic areas of the country, not definitive risks to specific individuals or locations. Cancer risks and hazard indices from the Air Toxics Data Update are reported to one significant figure and any additional significant figures here are due to rounding. More information on the Air Toxics Data Update can be found at: https://www.epa.gov/haps/air-toxics-data-update.

Sites reporting to EPA within defined area:

Superfund	0
Hazardous Waste, Treatment, Storage, and Disposal Facilities	0
Water Dischargers	8
Air Pollution	69
Brownfields	9
Toxic Release Inventory	2

Other community features within defined area:

Schools	10
Hospitals	0
Places of Worship	21

Other environmental data:

Air Non-attainment	No
Impaired Waters	Yes

Selected location contains American Indian Reservation Lands*	Yes
Selected location contains a "Justice40 (CEJST)" disadvantaged community	Yes
Selected location contains an EPA IRA disadvantaged community	Yes

Report for 10 miles Ring Centered at 35.082899,-98.232876

EJScreen Environmental and Socioeconomic Indicators Data

HEALTH INDICATORS

INDICATOR	HEALTH VALUE	STATE AVERAGE	STATE PERCENTILE	US AVERAGE	US PERCENTILE
Low Life Expectancy	23%	22%	58	20%	80
Heart Disease	8.3	7.1	69	6.1	86
Asthma	12.2	11.1	82	10	92
Cancer	6.5	6.3	49	6.1	57
Persons with Disabilities	19.5%	16.9%	67	13.4%	84

CLIMATE INDICATORS

INDICATOR	HEALTH VALUE	STATE AVERAGE	STATE PERCENTILE	US AVERAGE	US PERCENTILE
Flood Risk	9%	8%	64	12%	61
Wildfire Risk	87%	43%	69	14%	90

CRITICAL SERVICE GAPS

INDICATOR	HEALTH VALUE	STATE AVERAGE	STATE PERCENTILE	US AVERAGE	US PERCENTILE
Broadband Internet	27%	17%	79	14%	85
Lack of Health Insurance	18%	15%	69	9%	89
Housing Burden	No	N/A	N/A	N/A	N/A
Transportation Access	Yes	N/A	N/A	N/A	N/A
Food Desert	Yes	N/A	N/A	N/A	N/A

Footnotes

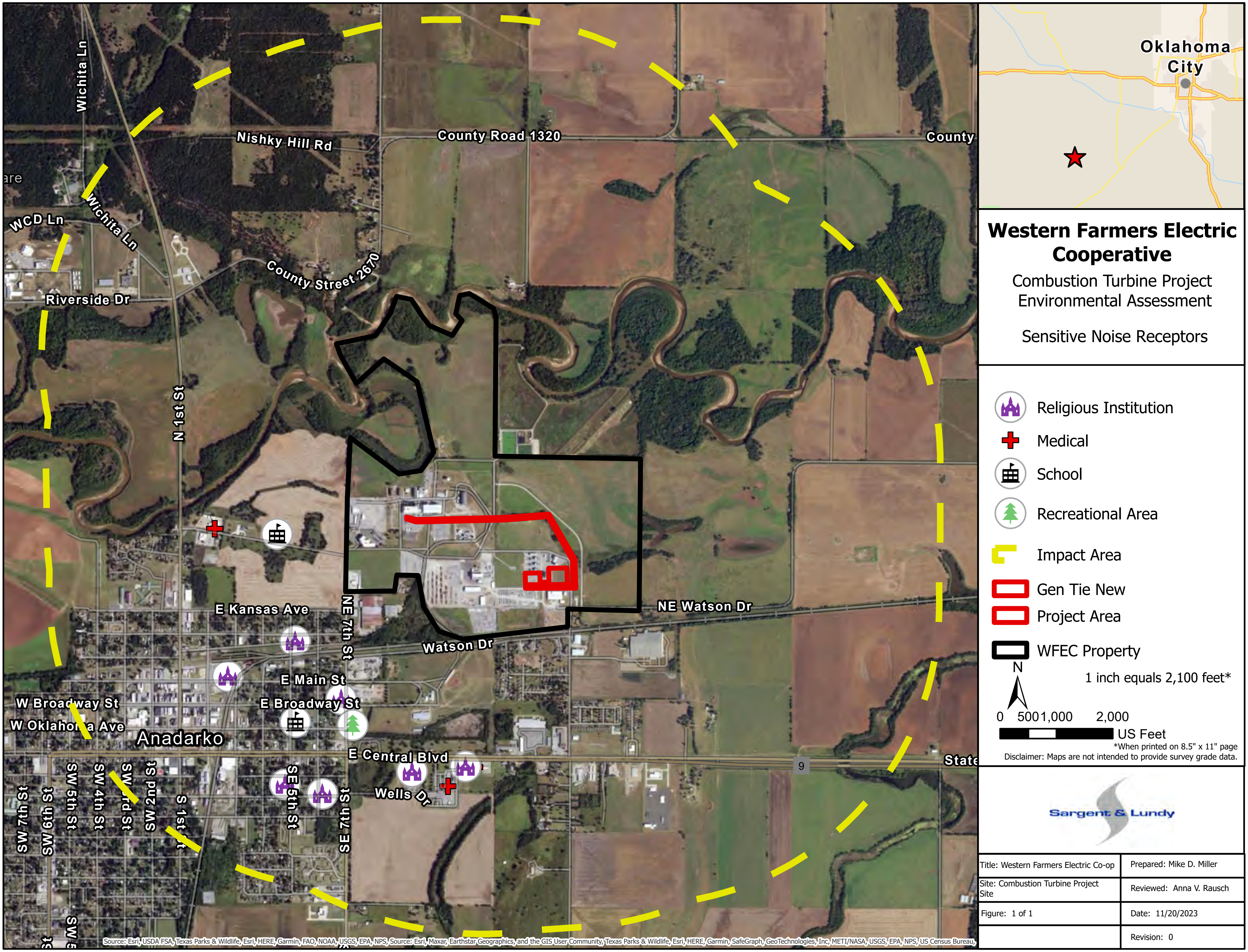
Report for 10 miles Ring Centered at 35.082899,-98.232876

Attachment 10. Noise Receptors

Attachment 10a. Schools, Medical Facilities, and Religious Facilities within One Mile of the Site

Sensitive Receptor Type	Facility Name	Approximate Distance from Site (miles)
School	Kiowa Tribe Head Start	0.26
	East Elementary School	0.47
Medical	Anadarko Indiana Health Center Pharmacy	0.45
	CareFirst Wellness Associates, Medical Clinic	0.54
	DLO Physician's Hospital of Anadarko	0.65
Religious	Greater First Baptist Church	0.24
	JJ Methvin Memorial United Methodist	0.36
	Anadarko Christian Center	0.41
	Gospel Lighthouse Church	0.56
	The Church of Jesus Christ of Latter-day Saints	0.57
	Indian Capital First Baptist Church	0.65
	Virginia Avenue Baptist Church	0.68
	Christ Gospel Church	0.73
	Grace Christian Fellowship	0.76
	First United Methodist Church	0.84
	Sand Creek Descendants Truth	0.88
	First Christian Church	0.91

Attachment 10b. Sensitive Noise Receptors Figure



Western Farmers Electric Cooperative

Combustion Turbine Project
Environmental Assessment

Sensitive Noise Receptors

1 inch equals 2,100 feet*

*When printed on 8.5" x 11" page

Disclaimer: Maps are not intended to provide survey grade data.

Sargent & Lundy

Title: Western Farmers Electric Co-op	Prepared: Mike D. Miller
Site: Combustion Turbine Project Site	Reviewed: Anna V. Rausch
Figure: 1 of 1	Date: 11/20/2023
	Revision: 0

Source: Esri, USDA FSA, Texas Parks & Wildlife, Esri, HERE, Garmin, FAO, NOAA, USGS, EPA, NPS, Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community, Texas Parks & Wildlife, Esri, HERE, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, EPA, NPS, US Census Bureau,

Attachment 11. Geology and Soils Resources

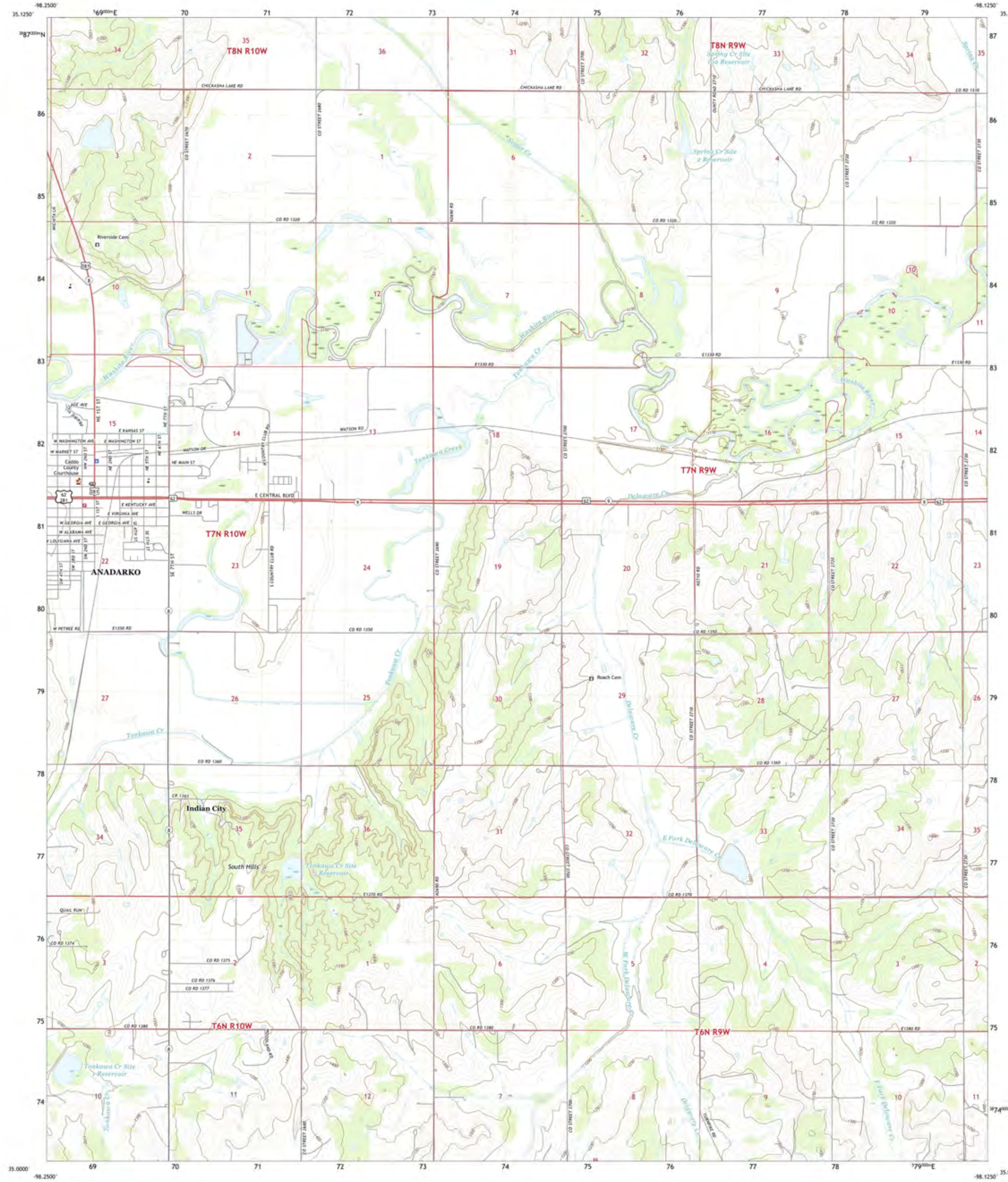
Attachment 11a. USGS Topographic Map

USGS
science for a changing world

U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

The National Map
US Topo

ANADARKO EAST QUADRANGLE
OKLAHOMA - CADDO COUNTY
7.5-MINUTE SERIES



Produced by the United States Geological Survey
North American Datum of 1983 (NAD83)
World Geodetic System of 1984 (WGS84). Projection and
1 000-meter grid:Universal Transverse Mercator, Zone 14S

This map is not a legal document. Boundaries may be generalized for this map scale. Private lands within government reservations may not be shown. Obtain permission before entering private lands.

Imagery	NAIP, May 2017 - July 2017
Roads	U.S. Census Bureau, 2015 - 2018
Names	GNIS, 1979 - 2021
Hydrography	National Hydrography Dataset, 2006 - 2018
Contours	National Elevation Dataset, 2012
Boundaries	Multiple sources; see metadata file 2019 - 2021
Public Land Survey System	BLM, 2021
Wetlands	FWS National Wetlands Inventory 1981 - 1983

UTM GRID AND 2019 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

U.S. National Grid
100,000 - m Square ID
ND
Grid Zone Designation
14S

SCALE 1:24 000

KILOMETERS 1 0.5 0 1 2
METERS 1000 500 0 1000 2000
MILES 1 0.5 0 1
FEET 1000 0 1000 2000 3000 4000 5000 6000 7000 8000 9000 10000

CONTOUR INTERVAL 10 FEET
NORTH AMERICAN VERTICAL DATUM OF 1988

This map was produced to conform with the
National Geospatial Program US Topo Product Standard.

QUADRANGLE LOCATION

1	2	3
4		5
6	7	8

ADJOINING QUADRANGLES

1 Gracemont
2 Anadarko NW
3 Anadarko NE
4 Anadarko West
5 Verden
6 Apache
7 Cyril
8 Laverty

ROAD CLASSIFICATION

Expressway	▬	Local Connector	▬
Secondary Hwy	▬	Local Road	―
Ramp	▬	4WD	┄

⛉ Interstate Route ⬠ US Route ○ State Route

ANADARKO EAST, OK
2022

Attachment 11b. Geotechnical Report

SUBSURFACE INFORMATION

for the

SIMPLE CYCLE UNITS 9, 10, and 11

ANADARKO, OKLAHOMA

for

WESTERN FARMERS ELECTRIC COOPERATIVE

THERE IS NO EXPRESS OR IMPLIED GUARANTEE AS TO THE ACCURACY OR COMPLETENESS OF THE INFORMATION AND DATA CONTAINED HEREIN, NOR OF THE INTERPRETATION THEREOF BY THE OWNER, BURNS & McDONNELL ENGINEERING COMPANY, OR ANY OF THEIR REPRESENTATIVES.

THE SUBSURFACE INFORMATION AND DATA CONTAINED HEREIN DO NOT FORM A PART OF ANY CONTRACT DOCUMENT ISSUED BY THE OWNER or BURNS & McDONNELL.

IF THIS SUBSURFACE INFORMATION IS BEING ISSUED IN ELECTRONIC (PDF) FORMAT IT SHALL ONLY BE ISSUED IN ITS ENTIRETY, CONSISTING OF THE 4-PAGE FRONT-END DOCUMENT WITH A 131-PAGE APPENDIX (FLYSHEET AND REPORT BY KLEINFELDER).

BURNS & McDONNELL
PROJECT 47268

Burns & McDonnell
Engineers-Architects-Consultants
Kansas City, Missouri

MAY 2008

TABLE OF CONTENTS

* * * * *

I. GENERAL

This subsurface information document consists of the data and results of a subsurface investigation described in a report titled *Subsurface Exploration and Geotechnical Report, Western Farmers Electric Cooperative, Simple Cycle Units 9, 10, and 11, Anadarko, Oklahoma*, dated May 22, 2008. The investigation was performed by Kleinfelder Central, Inc., of Tulsa, Oklahoma (Kleinfelder). The report, as prepared by Kleinfelder, is included in Appendix A of this document.

Drilling and laboratory testing for this investigation was performed by Kleinfelder. The drilling phase was performed from March 17 through April 8, 2008. It included the completion of eighteen (18) borings drilled to depths ranging from 30 feet to 103 feet below grade. Laboratory tests were conducted on select available samples following the completion of drilling operations. Boring logs and laboratory test results, as prepared by Kleinfelder, are included in the report in Appendix A of this document.

Samples recovered during the subsurface investigation were transported to the laboratory by Kleinfelder. Kleinfelder was not compensated to store the samples after testing and reporting beyond their customary retention period prior to disposal.

II. DESIGN NOTES

Geotechnical design notes as prepared by Burns & McDonnell pertinent to the current project are available for inspection at Burns & McDonnell's Kansas City office upon prior written request.

III. WATER LEVEL INFORMATION

Water levels were observed by Kleinfelder, see Appendix A. It should be noted by the reader that fluctuations in water levels may occur over more prolonged periods of readings and can be influenced by various outside factors. It may take groundwater several days to reach its hydrostatic levels in holes in cohesive soils.

Seasonal variations in rainfall, changes to on-site conditions, and changes to off-site conditions can affect groundwater levels. Fluctuations in groundwater levels from those noted in logs should be anticipated during construction. Water levels observed and recorded by others reflect only those conditions that existed at the time of investigation and may vary from true phreatic groundwater levels.

IV. ADDITIONAL SUBSURFACE INFORMATION

Burns & McDonnell has requested from Western Farmers Electric Cooperative (Owner) additional subsurface information in the vicinity of the Site. Burns & McDonnell was provided with the information as listed below. This information is available for review at Burns & McDonnell's office upon prior written request.

1. *Investigation of Soil Conditions and Foundation Recommendations, Combined Cycle Unit (Oklahoma 32 Comanche), Western Farmers Electric Cooperative, Anadarko, Oklahoma*; prepared by Brucker and Associates, Consulting Engineers, Brentwood, Missouri; dated May 1975.

Burns & McDonnell is aware that a significant amount of construction activity has been undertaken in the near vicinity of the Site. Additional information in the form of geotechnical reports and/or construction records may exist. Requests for additional information should be directed to the Owner.

Burns & McDonnell is not aware of any additional subsurface information in the vicinity of the Site. Requests for additional subsurface information should be directed to the Owner.

V. LIMITATIONS

A. DOCUMENT USE

The information provided in Appendix A has been prepared for the use of Burns & McDonnell for design purposes. No other warranty, express or implied, is made as to the information included in this document. In the event that conclusions and recommendations based on data contained in this document are made by others, such conclusions and recommendations are the responsibility of others.

The information gathered and presented in this document was not obtained for an environmental audit nor to evaluate the potential for hazardous materials at the Site. The equipment, techniques, and personnel used to perform geoenvironmental exploration differ substantially from those applied in soil and foundation engineering. The purpose of this document is not intended as preparation for a Geotechnical Baseline Report, nor to provide information for use in developing construction cost estimates.

B. VARIATIONS

The subsurface information submitted in this document is based upon data obtained from test borings completed at the approximate locations indicated on Figure 2 of Appendix A. This document does not reflect variations which may occur between test borings. The nature and extent of variations between the test borings may not become evident until excavation is performed. If during construction, soil, rock, and/or groundwater conditions appear to be different from those described herein, Burns & McDonnell should be advised at once so that recommendations made may be evaluated and modified, if necessary. Water levels, as described in this document, reflect only those conditions that existed at the time that this particular subsurface investigation was performed by Kleinfelder. Fluctuations or changes in water levels and groundwater conditions can be influenced by sources outside the site investigated, by seasonal rainfall, and by changes in drainage conditions in and around the Site. Fluctuations can occur and should be anticipated between the time of investigation and the time of construction.

* * * * *

APPENDIX A

Subsurface Exploration and Geotechnical Report, Western Farmers Electric Cooperative, Simple Cycle Units 9, 10, and 11, Anadarko, Oklahoma; **prepared by Kleinfelder Central, Inc., dated May 22, 2008.**

SUBSURFACE EXPLORATION AND GEOTECHNICAL REPORT
WESTERN FARMERS ELECTRIC COOPERATIVE
SIMPLE CYCLE UNITS 9, 10, AND 11
ANADARKO, OKLAHOMA

May 22, 2008
File No. 92254

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May 22, 2008

Mr. Michael J. Butler, P.E.
Burns & McDonnell Engineering Company
9400 Ward Parkway
Kansas City, MO 64114

Subject: **Subsurface Exploration and Geotechnical Report**
Western Farmers Electric Cooperative
Simple Cycle Units 9, 10, and 11
Anadarko, Oklahoma
File No. 92254

Dear Mr. Butler:

Kleinfelder has completed the authorized subsurface exploration and geotechnical engineering evaluation for the Western Farmers Electric Cooperative Simple Cycle Units 9, 10, and 11 in Anadarko, Oklahoma. The purpose of the geotechnical study was to explore and evaluate the subsurface conditions at eighteen boring locations, and develop geotechnical design and construction recommendations for the proposed project. The attached Kleinfelder report contains a description of the findings of our field exploration and laboratory testing program, our engineering interpretation of the results with respect to the project characteristics, and our geotechnical site development and foundation design recommendations as well as construction guidelines for the planned project.

Recommendations provided herein are contingent on the provisions outlined in the ADDITIONAL SERVICES and LIMITATIONS sections of this report. The project Owner should become familiar with these provisions in order to assess further involvement by Kleinfelder and other potential impacts to the proposed project.

We appreciate the opportunity to be of service to you on this project and are prepared to provide the recommended additional services. Please call us if you have any questions concerning this report.

Respectfully submitted,
KLEINFELDER CENTRAL, INC.
Certificate of Authorization #3036 Exp. 6/30/09

BRIAN K.
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Senior Project Engineer

BKM/DLK:hm

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SUBSURFACE EXPLORATION AND GEOTECHNICAL REPORT
WESTERN FARMERS ELECTRICAL COOPERATIVE
SIMPLE CYCLE UNITS 9, 10, AND 11
ANADARKO, OKLAHOMA

1. INTRODUCTION

1.1 GENERAL

Kleinfelder has completed the authorized subsurface exploration and geotechnical engineering evaluation for the proposed expansion of the Western Farmers Electrical Cooperative in Anadarko, Oklahoma. The scope of services does not include any environmental assessment or investigation for the presence of hazardous or toxic materials in the soil, surface water, groundwater or air, on or below or around the site.

This report includes our recommendations related to the geotechnical aspects of the project design and construction. Conclusions and recommendations presented in the report are based on the subsurface information encountered at the location of our exploration and the provisions and requirements outlined in the ADDITIONAL SERVICES and LIMITATIONS sections of this report. In addition, an article prepared by The Association of Engineering Firms Practicing in the Geosciences (ASFE), *Important Information About Your Geotechnical Engineering Report*, has been included in APPENDIX D. We recommend that all individuals read the report limitations along with the included ASFE document.

1.2 PROPOSED CONSTRUCTION

As we understand the project, the proposed expansion consists of construction of three (3) new combustion turbine generator units, exhaust stacks, water tanks, and other associated structures. The following information was provided:

1. LM6000 Combustion Turbine Generator Units – 600 kips maximum operating load, preferred supported by mat foundation with approximate dimensions of 60 feet by 19 feet. Total settlements should be limited to a maximum of about 1-inch with ¼ inch differential settlement. The mats are anticipated to be 7 feet thick founded at depths of approximately 6.5 feet below grade. The anticipated gross bearing pressure (static load only) of 1,576 pounds per square foot (psf), anticipated gross applied pressure

(DL + LL + operating load) of 1,770 psf, and a gross applied pressure including transient loading of 2,400 psf.

2. Exhaust Stacks – Preferred foundations system is a mat foundation with approximately dimensions of 20 feet by 20 feet. Typical mats are 4 feet thick founded at approximately 3 feet below grade. Gross bearing pressure is anticipated to be 2,000 psf. Transient loading is anticipated to increase stress by approximately 1/3.
3. Substation – 30 feet tall steel structure with a 3.6 kip horizontal load applied at top of structure.
4. Generator Step-Up Transformers – Three transformers with a gross weight of 75 kips each. Preferred foundation system is a mat foundation.
5. Demineralized Water Tank – 42 feet diameter, 48 feet in height steel tank. Anticipated applied bearing pressure is estimated to be 3,000 psf. The preferred foundation is a mat foundation, 2.5 to 3.5 feet thick, and founded at depths of 2 to 3 feet below final grade.
6. Service Water Tank. – 74 feet diameter, 32 feet in height steel tank with an anticipated applied bearing pressure of 2,000 psf. The preferred foundation is a mat foundation, 2.5 to 3.5 feet thick, and founded at depths of 2 to 3 feet below final grade.
7. Elevated Pipe Racks – Elevated utility and electrical pipe racks are to be supported on columns extending to shallow drilled shafts. Maximum foundation loads are anticipated to be on the order of approximately 30 kips axial, 4 kips uplift, and 4 kips lateral.
8. Pre-engineered Buildings – Several single story pre-engineered buildings. Preferred foundation system is shallow foundations with slab-on-grade floor slabs.
9. Electric Transmission Pole – A major angle transmission pole will be constructed near the northwest corner of the stie.
10. Miscellaneous Structures – Various, minor, isolated equipment structures are planned at the site. These structures will be supported on shallow spread footings or mat-type foundations.

A site grading plan has not been developed at the time of the preparation of this proposal. Maximum cut and fills generally less than 5 feet are anticipated at the site to achieve a balanced site during earthwork operations.

2. SITE CONDITIONS

2.1 SITE DESCRIPTION

The project site is located northeast of Anadarko, Oklahoma. The general location of the project site is shown in Figure 1, Site Location Diagram.

The project site is located in crop land. The ground surface at the site was generally covered with winter wheat and bare ground. The site was relatively level. A grade differential of less than 2 feet was noted between the boring locations. Several high pressure gas lines are located within the project site. Other underground utility lines may be located within or near the project site.

2.2 SUBSURFACE CONDITIONS

Kleinfelder explored the subsurface conditions at the site by drilling and sampling eighteen (18) borings on March 17 through 22, March 30, and April 8, 2008. The approximate locations of the borings, labeled B-1 through B-18 are shown on Figure 2. The field exploration and laboratory testing programs are presented in APPENDIX A and APPENDIX B, respectively. Elevations shown on the boring logs are the approximate elevations at the boring locations. The field exploration and laboratory testing programs are presented in APPENDIX A and APPENDIX B, respectively.

Table 1 – Boring Schedule

Boring Designation	Latitude	Longitude
B-1	35.08204	-98.22295
B-2	35.08208	-98.22264
B-3	35.08208	-98.22246
B-4	35.08208	-98.22236
B-5	35.08176	-98.22294
B-6	35.08181	-98.22264
B-7	35.08181	-98.22246
B-8	35.08191	-98.22236

Table 1 – Boring Schedule		
Boring Designation	Latitude	Longitude
B-9	35.08149	-98.22294
B-10	35.08153	-98.22264
B-11	35.08153	-98.22246
B-12	35.08153	-98.22236
B-13	35.08134	-98.22197
B-14	35.08216	-98.22185
B-15	35.08219	-98.22154
B-16	35.08192	-98.22154
B-17	35.08228	-98.22280
B-18	35.08235	-98.22307

2.3 REGIONAL GEOLOGY

We have reviewed the local geology in preparing the report. Based on this review, the Anadarko power plant is located just to the south of the Washita River. The following are the units that the plant is underlain by:

Alluvium (Qal): Stream-laid deposits of sand, silt, clay, and gravel, and volcanic ash; thickness ranges from 0 to about 170 feet.

Terrace Deposits (Qt): Stream-laid deposits of sand, silt, clay, gravel, and volcanic ash; thickness ranges from 0 to about 120 feet.

Whitehorse Group (Pwh):

> Rush Springs Formation (Pr): Orange-brown, cross-bedded, fine-grained sandstone with some dolomite and gypsum beds. Thickness, about 300 feet, thinning northward to about 186 feet.
>
> Marlow Formation (Pm): Orange-brown, fine-grained sandstone and siltstone, about 100 to 130 feet thick, thinning northward. This formation has 2 gypsum and (or) dolomite beds in upper 20 feet — the Emanuel Bed (at top) and the Relay Creek Bed (20 feet below the top). Two thin, pink shales occur; the first is 1 foot below the top (Gracemont) and the second is 55 feet above the base (unnamed).

Faults are not located across the site; however a syncline exists approximately 5.8 miles southwest of the site. This syncline trends northwest, approximately 350 degrees.

2.4 SUBSURFACE CONDITIONS

The following presents a general summary of the major strata encountered during our subsurface exploration and includes a discussion of the results of the field and laboratory tests conducted. Specific subsurface conditions encountered at the boring locations are presented on the boring logs in APPENDIX A. The stratification lines shown on the logs represent the approximate boundaries between material types; in-situ, the transitions may vary or be gradual.

The borings encountered approximately 4 to 6 inches thick layer of topsoil at the ground surface underlain by alluvial soils. The alluvial soils consisted of interbedded fine and coarse grained soils. The fine grained soils had varying amounts of coarse grained material, and the coarse grained materials had varying amounts of fines. The clay soils had consistencies ranging from very soft to hard, and were various combinations of red, brown, reddish brown in color. The coarse grained soils had relative densities ranging from very loose to medium dense, and were various combinations of reddish brown, brown, and tan in color.

The soils were underlain by bedrock which was encountered at depths ranging from 45.2 to greater than 50 feet below the existing ground surface. The bedrock consisted of interbedded shale/siltstone/claystone bedrock. The bedrock was generally red, brown and white in color. The upper portion of the bedrock was generally weathered. The degree of weathering generally decreased with depth. The bedrock had relative hardness ranging from soft to hard.

Atterberg limits tests performed on representative samples indicated liquid limit (LL) values ranging from 18 to 51, plastic limit (PL) values ranging from 16 to 24, and plasticity index (PI) values ranging from 2 to 27. The moisture content of the samples ranged from approximately 2 to 27 percent. Unit weights of representative soil samples ranged from 93 to 115 pounds per cubic foot (pcf). Unconfined compressive strength on representative soil samples ranged from 716 to 7,336 pounds per square foot (psf).

2.5 GROUNDWATER OBSERVATIONS

Groundwater observations were made during and after completion of drilling operations. Borings in which groundwater seepage was observed and the depth at which groundwater was encountered are listed in Table 2. The materials encountered in the test borings have a wide range of permeabilities and observations over an extended period of time through use of piezometers or cased borings would be required to better define groundwater conditions.

Table 2 – Groundwater Measurements

Boring Designation	While Drilling (feet)	After Drilling (feet)
B-1	10.9	21.2
B-2	17	Not Available
B-3	23.1	11.2
B-4	22.8	18.3
B-5	23.2	14.6**
B-6	23.1	18.9**
B-7	22.6	18.5
B-8	23.2	16.2**
B-9	22.0	19.8
B-10	24.1	Not Available
B-11	22.4	18.3
B-12	23.2	17.7**
B-13	21.4	19.2
B-14	21.3	16.8**
B-15	28.4	16.6
B-16	22.3	12.8
B-17	21.9	21.7
B-18	22.6	21.2

** Borehole caved.

Water was introduction into all of the borings as drilling fluid was required during wash bore drilling techniques and limited further observation of groundwater conditions. The groundwater depths at completion of drilling presented above and on the boring logs may have been influenced by the drilling fluid.

The materials encountered in the test borings have a wide range of permeabilities and observations over an extended period of time through use of piezometers or cased borings would be required to better define groundwater conditions. Fluctuations of groundwater levels can occur due to seasonal variations in the amount of rainfall, runoff, river level, and other factors not evident at the time the borings were performed. The possibility of groundwater level fluctuations should be considered when developing the design and construction plans for the project, primarily due to the close proximity of the Washita River.

3. CONCLUSIONS AND RECOMMENDATIONS

3.1 GENERAL

Based on the results of our evaluation, it is our professional opinion that the project site can be developed for the proposed Western Farmers Electrical Cooperative expansion project of Simple Cycle Units 9, 10, and 11 using conventional grading and foundation construction techniques. The primary geotechnical concerns for this project are the presence of high silt and sand content soils at the ground surface, and the lower consistency of a portion of the site soils. A limited amount of structural loading information was provided for the preparation of this report. Recommendations addressing the primary geotechnical concerns as well as general recommendations regarding geotechnical aspects of the project design and construction are presented below.

The recommendations submitted herein are based, in part, upon data obtained from our subsurface exploration. The nature and extent of subsurface variations that may exist at the proposed project site will not become evident until construction. If variations appear evident, then the recommendations presented in this report should be evaluated. In the event that any changes in the nature, design, or location of the proposed project are planned, the conclusions and recommendations contained in this report will not be considered valid unless the changes are reviewed and our recommendations modified in writing.

3.2 PRIMARY GEOTECHNICAL CONCERNS

3.2.1 High Silt and Sand Content

A portion of the near surface soils appear to have a significant silt and sand content. Soils with high silt and sand contents are moisture sensitive and are prone to becoming unstable with slight increases in soil moisture content levels. Depending upon precipitation levels prior to and during construction, these soils could pump and could easily be disturbed when subjected to construction traffic, or with slight increases in moisture content. Prior to placement of structural fill, undercutting of unstable soils should be anticipated.

3.2.2 Lower Consistency Soils

Lower consistency clay soils were encountered in the borings to depth ranging from 2 to 4 feet below the ground surface in a portion of the borings. Undercutting and replacement of these lower consistency soils is recommended to provide uniform support of foundations and slabs on grade.

3.3 SITE DEVELOPMENT

3.3.1 Stripping

Site preparation should commence with stripping of all vegetation and topsoil located within the construction area. Stripping depths required will likely vary and should be adjusted to remove all vegetation and root systems. A representative of Kleinfelder should monitor the stripping operations to observe that all unsuitable materials have been removed. Soils removed during site stripping operations could be used for final site grading outside the proposed building area within proposed green areas. Care should be exercised to separate these materials to avoid incorporation of the organic matter in structural fill sections.

3.3.2 Existing Utility Trenches

Relocation of any existing utility lines within the zone of influence of proposed construction areas should also be completed as part of the site preparation. The lines should be relocated to areas outside of the proposed construction. Excavations created by removal of the existing lines should be cut wide enough to allow for use of heavy construction equipment to compact the backfill. In addition, the base of the excavations should be thoroughly evaluated by a geotechnical engineer or engineering technician prior to placement of backfill. All backfill should be placed in accordance with the recommendations presented in the STRUCTURAL FILL section of this report.

Existing utility lines may be located within the proposed construction areas. The depth of the lines or lateral extent of the backfill is currently unknown. It is anticipated that much of the material has relatively low consistencies and densities. If the lines are to be left in place, thorough evaluation of the backfill will be required. Evaluation should consist of excavating test pits into the backfill to determine the condition and composition of this material. If unsuitable material is encountered, it should be undercut and replaced with controlled structural fill.

3.3.3 Undercutting, Scarification, Moisture Conditioning, and Compaction

All soft/loose and/or unstable existing soils within construction areas should be undercut to stable material. The undercut area should extend a minimum of 5 feet outside the footprint of the structure. Suitable soil removed during undercutting could be moisture conditioned and placed as structural fill.

Prior to placement of structural fill, the moisture content of the exposed soils should be evaluated. Depending on the in-situ moisture content of the soils exposed, moisture conditioning of the exposed grade may be required prior to proofrolling and/or fill placement. The moisture content of the exposed grade should be adjusted to within the range recommended for structural fill, to allow the exposed material to be compacted to a minimum of 95 percent of the standard Proctor density. Extremely wet or unstable areas that hamper compaction of the subgrade may require undercutting and replacement with structural fill or other stabilization techniques. If the soils are desiccated and have a high swell potential, additional undercutting may also be required. Suitable structural fill should be placed to design grade as soon as practical after reworking the subgrade to avoid moisture changes in the underlying soils.

3.3.4 Proofrolling

Following any required undercutting or moisture conditioning and prior to placement of structural fill, where possible, the exposed grade should be proofrolled. Proofrolling of the subgrade aids in identifying soft or disturbed areas. Unsuitable areas identified by the proofrolling operation should be undercut and replaced with structural fill. Proofrolling can be accomplished through use of a fully-loaded, tandem-axle dump truck or similar equipment providing an equivalent subgrade loading.

3.4 CLIMATIC CONDITIONS

Weather conditions will influence the site preparation required. In spring and late fall, following periods of rainfall, the moisture content of the near surface soils may be significantly above the optimum moisture content. This condition could seriously impede grading by causing an unstable subgrade condition. Typical remedial measures include aerating the wet subgrade, removal of the wet materials and replacing them with dry materials, or treating the material with lime, cement, or Class "C" fly ash.

If site grading commences during summer months, moisture contents may be low and the clay soils could have a high swell potential. Typically discing and moisture conditioning of the exposed subgrade materials to the moisture content criteria outlined in the STRUCTURAL FILL section will reduce this swell potential of the dry materials. As an alternative, the dry materials could be undercut and replaced with structural fill.

If construction of the project is to be performed during winter months, appropriate steps should be taken to prevent the soils from freezing. Frozen materials should be removed and replaced with a suitable material. Frozen materials should not be included in any compacted fills.

3.5 TEMPORARY EXCAVATIONS

3.5.1 General

It is anticipated that excavations for the proposed structures and utilities will be in controlled structural fill or native soils. Excavation of the controlled structural fill and the native soils should be possible with appropriately sized conventional equipment such as backhoes, loaders, etc. Typical temporary dewatering techniques are anticipated to be sufficient to remove any water seepage that may be encountered in shallow excavations.

3.5.2 Slopes

Excavations should be cut to a stable slope or be temporarily braced, depending on the excavation depths and the subsurface conditions encountered. ***Temporary construction slopes should be designed in strict compliance with the most recent governing regulations.*** The contractor should also be aware that slope height, slope inclination or excavation depths (including utility trench excavations) should in no case exceed those specified in local, state and/or federal safety regulations, such as OSHA Health and Safety Standard for Excavations, 29 CFR Part 1926, or successor regulations

Construction slopes should be closely observed for signs of mass movement: tension cracks at the crest, bulging at the toe, etc. If potential stability problems are observed, a geotechnical engineer should be contacted immediately. ***The responsibility for excavation safety and stability of temporary construction slopes lie solely with the contractor.*** Shoring, bracing or underpinning, may be required to provide structural stability and to protect personnel working within the excavation.

3.5.3 Construction Considerations

Stockpiles should be placed well away from the edge of the excavation and their height should be controlled so they do not surcharge the sides of the excavation. Surface drainage should be carefully controlled to prevent flow of water into the excavations.

The silty and sandy soils encountered at this site are highly susceptible to erosion. Excavations in this material that are left open for even short durations may experience some form of failure such as sloughing of the sides of the excavation. Measures should be taken to stabilize the vertical sides and/or sloping face of the excavations. Such measures may include interception and diversion of surface water, placing a fabric over the material and/or bracing the sides of the excavation. If side slopes are not stabilized, reworking of the excavations should be anticipated.

3.6 CONSTRUCTION DEWATERING

Groundwater was encountered at approximate depths ranging from approximately 11 to 24 feet at the boring locations. Pumps or well points may be necessary to keep the water table below the bottom of the below grade excavation if they extend below the groundwater surface. Groundwater should be maintained a minimum of 2 feet below the excavation bottom throughout construction to maintain bottom stability. Attempts to dewater the excavation by pumping directly from the excavation should be carefully monitored as water flowing from the soils could erode the soils and potentially create voids behind any retention systems and/or destabilize slopes.

3.7 STRUCTURAL FILL

3.7.1 Materials

All structural fill required to achieve design grades should consist of approved materials, free of organic matter and debris. All structural fill placed within the footprint of the structures should consist of lower plasticity, clayey sand, lean clay, or sandy lean clay type of soil with a Plasticity Index (PI) within a range of 12 to 22 percent, as determined by the Atterberg limits test ASTM D 4318, wet preparation procedure. If clay soils with a PI in excess of 22 are used within the building footprint movements in excess of 1-inch may occur.

3.7.2 Existing Site Soils

Based on subsurface conditions encountered at this site, it appears a portion of the soils encountered at the site would not be suitable for use as low plasticity structural fill within the building footprint unless chemically modified/stabilized. Stabilization recommendations are included in the following section of this report. Additional testing of bulk samples of the near surface soils at the time of construction should be performed to further evaluate the suitability of these materials.

3.7.3 Chemical Stabilization/Modification

Consideration should be given to stabilizing the onsite soils with Cement Kiln Dust (CKD), Portland Cement, or Class "C" fly ash to provide a more stable work site, less subject to disturbance due to moisture variations and construction traffic.

If Cement Kiln Dust (CKD) is used as the stabilizing agent, a CKD content of 10 to 12 percent on a dry weight basis is generally sufficient to achieve the desired stabilization. Laboratory tests will be necessary to determine the actual amount required. Laboratory tests should be completed with the specific CKD that will be used for construction. The CKD should be placed, mixed, and compacted in general accordance with ODOT "Standard Specifications for Highway Construction, Section 317" (1999).

If Portland Cement is used as the stabilizing agent, a Portland Cement content of 4 to 6 percent on a dry weight basis is generally sufficient to achieve the desired stabilization. Laboratory tests will be necessary to determine the actual amount required. Laboratory tests should be completed with the specific Portland Cement that will be used for construction. The Portland Cement should be placed, mixed, and compacted in general accordance with ODOT "Standard Specifications for Highway Construction, Section 312."

If Class "C" fly ash is used as the stabilizing agent, a fly ash content of 14 to 16 percent on a dry weight basis is generally sufficient to achieve the desired stabilization. Laboratory tests will be necessary to determine the actual amount required. The fly ash should be placed, mixed, and compacted in accordance with ODOT "Standard Specifications for Highway Construction, Section 317" (1999). Specifications for fly ash stabilization should be included in the project specifications.

The producer of the proposed stabilizing agent should submit chemical analysis sheets to Kleinfelder for review and approval prior to beginning construction.

3.7.4 Compaction Criteria

Fill should be placed in lifts having a maximum loose lift thickness of 9 inches. All fill should be compacted to a minimum of 95 percent of the material's maximum dry density as determined by ASTM D 698 (standard Proctor compaction). If the plasticity index of the soils is greater than 12, the moisture content of the fill at time of compaction should be within a range of 0 percent to 4 percent above optimum moisture content as defined by the standard Proctor compaction procedure. If the plasticity index of the soils is less than 12, the moisture content of the fill at time of compaction should be within a range of 2 percent below to 2 percent above optimum moisture content.

3.7.5 Organic Soils

The more highly organic soils removed during site preparation could be utilized in the upper portion of the fill sections in landscaped areas of the site. Depth of organic fill and degree of compaction should be established to provide a stable surface that will be conducive to growth of grass cover.

3.8 SHALLOW FOUNDATIONS

3.8.1 STRIP/ISOLATED FOOTINGS

3.8.1.1 Allowable Bearing Pressures

For the purpose of this report shallow foundations are defined as a continuous footing or an isolated footing support, which supports up to three structural elements. With the recommended site preparation procedures, the site should be suitable for support of lightly loaded structures on conventional shallow spread footings founded in controlled structural fill or approved native soils. Footings founded in the recommended material may be proportioned for a maximum net allowable bearing pressure of 2,500 pounds per square foot (psf).

Continuous wall footings should have a minimum width of 16 inches and isolated spread footings should have a minimum width of 24 inches. All exterior footings and footings founded in unheated areas should be supported a minimum of 24 inches below final exterior grade to provide protection against frost penetration. All foundations should be earth-formed, poured in neat excavations.

The maximum allowable bearing capacity for dead plus sustained live loads provided contains a factor of safety of 3 against general bearing capacity failure. For transient loads (i.e, wind, seismic, etc.) the factor of safety can be reduced to 2.25 against general bearing capacity failure.

3.8.1.2 Estimated Settlements

The design criteria of limiting settlements to less than 1 inch, controls the isolated spread footing dimensions and bearing capacity. In order to limit settlement to less than 1 inch, isolated spread footings should be limited in size to 10 feet by 10 feet, and should not be placed (center to center) closer than 2 times the footing width. Differential settlement should be ½ inch or less. If larger footing sizes are required, a reduction in the bearing capacity, or increases in allowable settlement would be warranted. The following table provides some general guidelines to limit settlement of structural elements that are closer than the recommended spacing. If more accurate settlements are required, the foundation systems will need to be evaluated on a case-by-case basis.

Table 3: Shallow Foundation Spacing and Associated Estimated Settlement

Foundation Spacing Center – to – Center	Bearing Pressure Reduction Factor
>/= 2	1
1 - 2	0.9
0.5 - 1	0.8
< 0.5	0.6

3.8.2 MAT FOUNDATIONS

It is our understanding that the majority of the larger structures at the project site will utilize mat foundations. It is our understanding that the cyclical loading due to the mechanical equipment of the combustion turbine generators may induce a loading condition equivalent to approximately 2,200 psf. The combustion turbine generators will not experience classical bearing capacity failure based upon a static loading condition of 2,200 psf. However, it should be noted that the amount of settlement induce by cyclical loading would be in addition to the amount of settlement presented in the following sections.

3.8.2.1 Allowable Bearing Pressures and Estimated Settlements

A mat foundation is defined as a foundation system supporting three or more structural elements of the same structure or an entire structure. Based on the subsurface conditions encountered during our fieldwork, the site should be suitable for support of structures on mat foundations. It is our understanding that the base of the mat foundations will be at a minimum depth of approximately 2.5 feet below the existing grades founded in controlled structural fill or native soils. The existing geostatic stresses at 2.5 feet are approximately 275 psf. Table 4 provides an estimate of the amount of settlement for various square mat foundation sizes and net allowable bearing pressures. When evaluating mat foundations, settlement is controlled by the least dimension of the mat foundation. Table 5 provides an estimate of the amount of settlement for specific structures.

Table 4 – Mat Foundation Estimated Settlements (Inches)

Least Dimension of Mat Size (Feet)	**Allowable Net Bearing Pressure (psf)**			
	2,500	2,000	1,500	1,000
10	1	¾	¾	½
15	1 ¼	1	¾	½
20	1 ¼	1	1	¾
25	1 ½	1 ¼	1	¾
30	1 ½	1 ¼	1	¾
35	1 ½	1 ¼	1	1
60	2 ½	2 ½	2	1 ¾

**Table 5 – Mat Foundation Estimated Settlements (Inches)
For Specific Structures**

Structure	Anticipated Mat Size (Feet)	Anticipated Bearing Depth	Anticipated Net Bearing Pressure (psf)	Estimated Settlements (Inches)
Combustion Turbine Generator	60 by 19	6.5	861	¾
Exhaust Stacks	20 by 20	3	2,000	1
Demineralized Water Tank	42 feet Diameter	3	3,000	3
Service Water Tank	78 feet Diameter	3	2,000	2 ½

Differential settlement across the mat foundations could approach approximately fifty percent of total settlement. The net allowable bearing pressure provides a factor of safety of 3 for dead load plus sustained live loads. For transient loads (i.e., wind, seismic, etc.) the factor of safety can be reduced to 2.25 against general bearing capacity failure.

3.8.3 CONSTRUCTION CONSIDERATIONS AND OBSERVATIONS

The base of all footing excavations should be free of all water and loose soil prior to placing concrete. Concrete should be placed as soon as possible after excavating so that excessive drying or disturbance of bearing materials does not occur. Should the soils at bearing level become excessively dry, saturated or disturbed, we recommend that the effected soils be removed prior to placing concrete.

It is recommended that all footing excavations be evaluated and tested by the geotechnical engineer immediately prior to placement of foundation concrete. Unsuitable areas identified at this time should be corrected. Corrective procedures would be dependent upon conditions encountered and may include deepening of foundation elements, or undercutting of unsuitable materials and replacement with controlled structural fill.

It is our understanding that the mat foundation excavation could be exposed for a period of time that could last as long as several weeks. Consideration should be given to constructing a mud mat in the bottom of the mat foundation excavations to help reduce the impact on the bearing material due to construction activities and the effects of wetting/drying cycles on the bearing material.

3.8.4 MACHINE FOUNDATION DESIGN PARAMETERS

Field crosshole seismic tests were performed at two locations (Unit 9 and 11). The field crosshole seismic tests were performed in accordance with ASTM D4428. The following table summarizes the results of the crosshole seismic tests. For more detail, refer to Appendix C of this report.

Table 6 – Crosshole Seismic Test Summary

Soil Type	Shear Velocity (Average, ft/sec)	P-Wave Velocity (Average, ft/sec)	Shear Modulus (ksi)	Poisson Ratio	Young's Modulus (ksi)
Boring B-2					
Fat Clay	613 - 712	1,287 – 1,763	10 - 13	0.35 – 0.40	27 - 39
Clay Sand	661 - 860	944 – 2,753	12 - 20	0.02 – 0.45	25 - 56
Weathered Shale Bedrock	1,939 – 5-346	3,993 – 10,427	175 – 911	0.29 – 0.44	322 – 2,270
Boring B-10					
Lean Clay	638 – 815	1,037 – 1,837	11 – 18	0.19 – 0.38	26 – 50
Silty Sand – Sand	1,015 – 1,108	1,654 – 2,491	28 – 33	0.20 – 0.38	67 – 91
Silt	761 – 1,230	1,345 – 2,535	16 – 42	0.26 – 0.35	41 – 114
Sand	618 – 1,501	1,359 – 3,725	10 – 65	0.37 – 0.40	29 – 185
Weathered Shale Bedrock	1,544 – 3,616	3,388 – 8,817	76 - 446	0.36 – 0.47	208 – 1,201

3.9 DRILLED PIER FOUNDATIONS

3.9.1 Drilled Pier Design

Structural elements having high, concentrated loads or that will be subjected to high uplift loads could be supported on drilled piers socketed into the underlying weathered bedrock. General design parameters and construction considerations are presented in the following sections.

3.9.2 Drilled Pier Design Parameters

Based upon the subsurface conditions encountered and previously obtained subsurface information at the site, the subsurface conditions are suitable for support of the proposed structures on drilled piers. To develop the allowable skin friction and allowable end bearing for the shale bedrock noted in Table 7, drilled piers should be socketed a minimum of 3 feet or one pier diameter into the weathered bedrock. The bedrock was encountered at approximate depths of ranging from 45.2 to greater than 50 feet below the existing ground surface at the boring locations. The drilled pier foundations can be proportioned based upon the design parameters provided in Table 7.

Table 7 – Drilled Piers Design Parameters

Bearing Material	Bedrock Penetration (Feet)	Allowable End Bearing Pressure (ksf)	Allowable Skin Friction (ksf)
Clays	N/A	N/A	0.5
Sands	N/A	N/A	0.6
Weathered Bedrock	3 - 8	12	0.6
Weathered Bedrock	Greater than 8	25	2.0

The allowable skin friction values presented in Table 6 may be used for the circumferential area for that portion of the pier imbedded in the bedrock beyond a depth of 1 pier diameter or three feet into the bedrock material. A factor of safety of 3 has been applied to both end bearing and skin friction. The factor of safety may be reduced to 2.25 for transient loads.

Drilled piers for this project should have a minimum shaft diameter of 18 inches to facilitate cleaning and observation of the bearing materials. Direct observation of the bearing materials at the bottom of smaller piers is not possible and pier excavations must be evaluated based on auger cuttings and drilling characteristics.

3.9.3 Construction Considerations

Excavations for the drilled piers will encounter existing and/or structural fill, native soils, weathered shale/siltstone/claystone, and shale bedrock. Conventional drilling equipment should be able to penetrate the soil. A portion, if not all, of the drilled pier excavations are anticipated to be below the groundwater surface; water seepage, hole caving, and sloughing should be anticipated during the installation of drilled piers and the use of temporary casing or slurry drilling methods will be required. The drilling contractor should be provided the opportunity to review the boring logs to assess the excavation methods required to complete the excavations at the site. It is also recommended that temporary casing be installed when personnel are required to enter a drilled pier excavation to clean or observe the bearing surface.

The bedrock depths provided herein are intended to aid in design, planning, and bidding of the proposed project. It should be noted that required bearing elevations vary across the site and may be lowered or raised in the field depending on the subsurface conditions encountered. We recommend that Kleinfelder be provided the opportunity to review the final plans prior to bidding and/or construction in order to determine that our recommendations were properly incorporated into the drilled pier designs.

Drilled pier excavations should be observed by an experienced geotechnical engineer to evaluate the suitability of the bearing material. Should isolated areas of unsuitable material be encountered at planned depths, it will be necessary to deepen the drilled piers to suitable bearing material. The base of all drilled pier excavations should be free of water and loose material prior to placement of concrete. A sufficient head of plastic concrete should be maintained within the casing at all times during its extraction to overcome the hydrostatic groundwater pressure outside the casing and to prevent necking of the pier.

3.9.4 Estimated Settlements

Long-term structural settlement for drilled pier foundations designed and constructed as outlined above should be minor, i.e. ½ inch or less.

3.10 LATERAL LOADED DEEP FOUNDATIONS

Recommended geotechnical parameters for use in the evaluation of lateral load capacity and deflection of a drilled pier foundation are presented in Table 8. The parameters provided are based on input requirements of LPILE Plus for Windows, Version 3 by Ensoft, Inc. (1997). We have included parameters including: the effective angle of internal friction (ϕ'), the effective unit weight (γ'), the static horizontal soil modulus parameter (k), the undrained shear strength (S_u), and the strain at 50 percent of peak strength (E_{50}) value. The values given in Table 8 are based on our analysis of the existing subsurface conditions and were estimated, or calculated, based on generally accepted engineering correlations. Design parameters for other methods of analysis can be provided, should a different method of analyzing lateral pile capacity be chosen for this design. The values presented in the table assume that all soft and unstable material has been overexcavated and replaced with controlled structural fill. Pile analysis was beyond the scope of services for this project.

Table 8 – Geotechnical Parameters

Material	*Material Type	Allowable Skin Friction Uplift (psf)	Effective Angle of Internal Friction ϕ,' (degrees)	Undrained Shear Strength S_u, (psf)	E_{50} Value	Effective Unit Weight γ', (pcf)	Static Soil Modulus Parameter k, (pci)
Fat Clay	3	0	0	1,000	0.01	105	200
Lean Clay	3	0	0	1,500	0.007	110	275
Silty Sand	4	250	26	N/A	N/A	115	250
Loose Sands	4	400	26	N/A	N/A	115	250
Medium Dense Sands	4	500	30	N/A	N/A	120	300
Sandy Gravels	4	750	32	N/A	N/A	125	350
Highly Weathered Shale	3	500	0	3,000	0.005	115	1,000
Weathered Shale	9	400	NA	**150 psi	0.0005[1]	115	****75,000 psi
Shale	9	1,500	NA	**1,000 psi	0.0005[1]	125	****75,000 psi

* 1-Soft Clay, 2-Stiff Clay with Free Water, 3-Stiff Clay without Free Water, 4-Sand, 5-Linear Interpolation (p-y curves), 6-Hard Rock, 7-Silt, 8-API Sand, 9-Weak Rock

** Shear strength of rock

*** Unconfined compressive strength of rock

**** Estimated Young's Modulus, required by program in place of k for weak rock model.

[1] Krm value for weak rock

Lateral resistance within three feet of the ground surface should be ignored due to freeze/thaw and possible disturbance due to construction activities or future construction activity.

3.11 SEISMIC CONSIDERATIONS

The project site is located in Anadarko, Oklahoma, which is an area of low seismic activity. Based on the information collected in the boring and the fact that bedrock exists at relatively shallow depths, the site is classified as Site Class C as per Table 1615.1 of the 2003 International Building Code. Site class C is defined as a soil profile consisting of stiff soils where the upper 100 feet of the soil profile has an average shear wave velocity between 1,200 ft/s and 2,500 ft/s, and SPT N-value greater than 50 or SU greater than 2,000 psf. The site is classified as S_C as per Table 16-J of the 1997 Unified Building Code. Site class S_C is defined as a soil profile consisting of very dense soils where the upper 100 feet of the soil profile has an average shear wave velocity between 1,200 ft/s and 2,500 ft/s, and SPT N-value greater than 50 or SU greater than 2,000 psf

3.12 LATERAL EARTH PRESSURES

Below grade walls should be designed to resist lateral earth pressures equivalent to those induced by the surcharge of adjacent structures and the appropriate soil material. In most cases, lateral earth pressure can be assumed to increase linearly with depth and may be represented as the effective unit weight of the soil times the appropriate coefficient of lateral earth pressure times the thickness of the overlying soil. The parameters listed in Table 9 may be used for determining lateral earth pressures at this site. The design parameters presented in the flowing table due not take into consideration any hydrostatic pressures. If proper drainage for below grade structures can not be provided, it is recommended that the below grade walls be designed for hydrostatic pressures.

TABLE 9 – LATERAL EARTH PRESSURE PARAMETERS

Material Type	Total Stress (Undrained) Parameters (1)			Effective Stress (Drained) Parameters (1)			Total Unit Weight (1) γ, pcf
	C_u, psf	Φ, degrees	Lateral Earth Pressure Coefficients	C', psf	Φ', degrees	Lateral Earth Pressure Coefficients	
Controlled Structural Fill	1,500	0	$K_a = 1.0$ $K_o = 1.0$	300	18	$K_a = 0.55$ $K_o = 0.70$	110
Native Clay Soils Above Groundwater	1,500	0	$K_a = 1.0$ $K_o = 1.0$	200	18	$K_a = 0.55$ $K_o = 0.70$	110
Native Clay Soils Below Groundwater	450 or 500	0	$K_a = 0.35$ $K_o = 0.55$	100	16	$K_a = 0.57$ $K_o = 0.72$	100
Coarse Granular Fill	0	30	$K_a = 0.33$ $K_o = 0.50$	0	30	$K_a = 0.33$ $K_o = 0.50$	120

(1) Based on previous experience with materials of this classification
C = Cohesion
Φ = Internal Friction Angle
γ = Effective Unit Weight above Groundwater Table
K_a = Active Earth Pressure Coefficient
K_o = At-Rest Earth Pressure Coefficient

The parameters for granular fill should be used only if laboratory tests have confirmed the internal friction angle of the fill material. If these criteria are not met, than the appropriate parameters of the natural soil should be used.

Retaining walls that are laterally supported and can be expected to undergo only a slight amount of deflection (i.e., less than 0.1 percent of wall height for granular soils or less than 1.0 percent of wall height for clay soils) should be designed for lateral loadings based on lateral earth pressure computed using the at-rest lateral earth pressure coefficient.

Below grade walls that can deflect sufficiently to mobilize the full active earth pressure condition should be designed for smaller active lateral earth pressure computed using the active. Walls designed for such loading must be detailed and specified such that the hydrostatic pressure cannot develop and the compactive effort used on backfill is limited to that required to achieve 92 to 95 percent of the standard Proctor maximum dry density. Lift thickness should be reduced and light compaction equipment should be used to limit the forces o the wall while achieving the recommended degree of compaction.

A factor of safety of at least 1.5 should be used with stability calculations involving lateral earth pressures. The safety factor should be computed as the sum of resisting forces or moments divided by the sum of driving forces or moments.

Equivalent fluid pressures have been requested for this project. Based on our experience with materials similar to the overburden soils encountered at the site, walls subjected to lateral earth pressure should be designed for the at-rest stress condition (i.e., no wall rotation is allowed) using an ultimate, equivalent fluid unit weight of 55 pounds per cubic foot (pcf). Walls designed for an active stress condition (i.e. wall rotation is allowed) should use an ultimate equivalent fluid unit weight of 45 pcf. These load distributions include neither factors of safety nor the influence of hydrostatic loading on the walls. Also, these stress distributions do not include the influence of foundations, pavements, or other surcharges located in or adjacent to wall backfill, and/or sloping backfill. In addition, an equivalent fluid pressure has been requested for cases where hydrostatic forces are present. Walls subjected to lateral earth pressure including hydrostatic forces should be designed for the at-rest stress condition using an ultimate, equivalent fluid unit weight of 95 pounds per cubic foot (pcf) or where wall rotation is allowed (active condition), an ultimate equivalent fluid unit weight of 85 pounds per cubic foot (pcf) can be utilized.

Pressures created by the retained soil and surcharges may be resisted by a combination of sliding friction on the base of the wall footing and by the passive resistance of the soil acting on the edge of the footing. For design purposes, the resistance due to base sliding friction and passive soil pressure can be assumed to develop simultaneously. An equivalent fluid unit weight of 200 pounds per cubic foot (pcf) can be utilized for the ultimate passive earth pressure acting on the face of the retaining wall foundation in native soils or compacted structural fill. For concrete foundations poured in good contact with the native soils or compacted structural fill an ultimate coefficient of friction of 0.25 could be used. No Factor of Safety has been applied to the above parameters.

Where foundations are earth formed, the allowable passive earth pressure acting on the vertical edge of the base of the footing may be calculated using the values presented in the previous paragraph. Passive earth pressure should be ignored within 2 feet of finished grade for design, due to possible disturbance of the adjacent soils during and after construction activities.

3.12.1 Wall Drainage

To prevent hydrostatic loading on below grade walls, it is recommended that a perforated drain line be installed at the base of the walls. The drain line should be sloped to provide positive gravity drainage outside the retaining wall area or should extend to a sump where water can be collected and removed. The drain line should be wrapped with filter fabric to prevent intrusion of fines. The drain line should be backfilled with free-draining granular material extending vertically above the drain line to within 2 feet of final grade. The remaining portion of the excavation should be backfilled with cohesive soils to minimize the infiltration of surface water. The grade behind the wall backfill should be sloped to provide positive drainage and minimize the infiltration of surface water into the wall backfill.

3.12.2 Backfill Placement

The granular section behind the wall should have a minimum width of 2 feet and should be encapsulated in a suitable filter fabric to minimize intrusion of fines. The use of a prefabricated drainage blanket on the below grade walls could also be considered to prevent hydrostatic loading. Drainage blankets should be installed in accordance with the manufacturer's recommendations.

3.13 CORROSION POTENTIAL

Steel and concrete elements in contact with soil, whether part of a foundation or part of the supported structure, are subject to degradation due to corrosion or chemical attack. Therefore, buried steel and concrete elements should be designed to resist corrosion and degradation based on accepted practices.

Two selected samples were submitted to an outside agency, Accurate Environmental Laboratories of Stillwater, Oklahoma, to conduct chemical testing. The chemical laboratory testing program consisted of soil pH, electrical resistivity, chloride content, sulfide content, sulfate content, and Redox. The results of these tests are summarized in Table 10. The test results submitted to us from Accurate Environmental Laboratories are included in APPENDIX B.

TABLE 10: Corrosivity Test Results

Sample Identification	Chlorides (mg/kg)	pH	Resistivity (Ω-cm)	Sulfates (mg/kg)	Sulfides (mg/kg)	Redox
Composite B-7 & B-8 2.5 to 3.5 feet	62.9	7.88	3,480	629	BPQL	256
Composite B-9 & B-10 13.5 to 20 feet	123	8.02	3,250	1,700	BPQL	249
B-13 28.5 to 30 feet	BPQL	7.84	6,540	105	BPQL	272
Composite B-15 & B-16 43.5 to 50 feet	68.7	8.10	1,960	1,410	BPQL	258
B-18 2.5 to 10 feet	BPQL	8.33	3,920	140	BPQL	297

Note: Ω-cm = ohm-cms, mg/kg = milligrams per kilograms, mV = millivolts
BPQL – Below Practical Quantitation Limits

Corrosion is a major factor in the life of steel elements in contact with soil. Corrosion is caused by migration of electrons from the steel into the surrounding soil. Three measurable soil properties that indicate the corrosion potential for steel in contact with soil are chloride ion concentration, pH and electrical resistivity. It is generally accepted that corrosion of steel is most likely in environments that have chloride ions (even in low concentrations), low pH and/or low resistivity.

The American Concrete Institute (ACI) considers the likelihood for corrosion attack of reinforcing steel in good quality concrete adjacent to soils exhibiting pH values exceeding 3.5 as unlikely and of little concern. The site soils had pH test results ranging from 7.84 to 8.33. These results indicate the soils are slightly to moderately alkaline. The resistivity test results ranged from 1,960 to 6,540 Ω-cm, which indicated a slightly to moderately corrosive environment.

The degradation of concrete is caused by chemical agents in the soil or groundwater that react with concrete to either dissolve the cement paste or precipitate larger compounds that cause cracking or flaking. The concentration of water-soluble sulfates in the soils is a good indicator of the potential for chemical attack of concrete. Sulfate attack of concrete results in spalling and deterioration of exposed concrete, promoting corrosion of internal reinforcing steel.

The laboratory tests performed on two soil samples taken at the site indicated that the concentration of water-soluble sulfates ranged from 105 and 1,700 mg/kg. Interpretation of these test results, using Table 4.3.1 from ACI 318-95 indicates that the samples of the on-site clay soils have negligible to moderately sulfate exposure characteristics. Based on these results, the use of sulfate resistant concrete may be warranted in some instances.

It should be noted that the results of the chemical laboratory tests are based on representative samples of soils encountered at the site. These results do not take into account potential variability of the natural soils or fill materials encountered across the entire project site, which may not be encountered until construction operations commence. Furthermore, we have assumed that proper drainage of the site will exist at completion of construction activities.

3.14 FIELD RESISTIVITY TEST RESULTS

Field soil resistivity tests were completed using a Nilsson Model 400 soil resistance meter in a Wenner Array in general accordance with ASTM G-57. The approximate locations of the tests were performed at Borings B-1, B-12, and B-16. The electrode "a" spacing of 2, 5, 10, 20, and 50 feet was used for each test. The following table presents the field resistivity test results.

Table 11 - Field Resistivity Test Results

Boring B-1				
Run No. 1 (North)				
Pin Spacing (feet)	**Dial Reading**	**Multiplier**	**Resistance**	**Resistivity**
2.5	6.5	1	6.5	3112
5	2.5	1	2.5	2394
10	0.9	1	0.9	1628
20	4.8	0.1	0.5	1819
50	2.7	0.1	0.3	2585
Run No. 2 (South)				
Pin Spacing (feet)	**Dial Reading**	**Multiplier**	**Resistance**	**Resistivity**
2.5	6.7	1	6.7	3208
5	2.5	1	2.5	2346
10	1.0	1	1.0	1819
20	4.7	0.1	0.5	1800
50	2.3	0.1	0.2	2202

Table 11 - Field Resistivity Test Results

Run No. 3 (East)

Pin Spacing (feet)	Dial Reading	Multiplier	Resistance	Resistivity
2.5	6.5	1	6.5	3112
5	2.4	1	2.4	2250
10	0.9	1	0.9	1724
20	4.3	0.1	0.4	1628
50	3.9	0.1	0.4	3734

Run No. 4 (West)

Pin Spacing (feet)	Dial Reading	Multiplier	Resistance	Resistivity
2.5	6.9	1	6.9	3279
5	2.5	1	2.5	2394
10	0.9	1	0.9	1724
20	4.0	0.1	0.4	1532
50	2.2	0.1	0.2	2107

Boring B-12

Run No. 1 (North)

Pin Spacing (feet)	Dial Reading	Multiplier	Resistance	Resistivity
2.5	5.6	1	5.6	2657
5	2.7	1	2.7	2537
10	1.9	1	1.9	3639
20	1.4	1	1.4	5362
50	8.0	0.1	0.8	7612

Run No. 2 (South)

Pin Spacing (feet)	Dial Reading	Multiplier	Resistance	Resistivity
2.5	6.2	1	6.2	2968
5	3.0	1	3.0	2873
10	2.1	1	2.1	4022
20	0.5	1	0.5	1724
50	7.2	0.1	0.7	6894

Run No. 3 (East)

Pin Spacing (feet)	Dial Reading	Multiplier	Resistance	Resistivity
2.5	5.1	1	5.1	2442
5	3.1	1	3.1	2968
10	2.4	1	2.4	4500
20	1.9	1	1.9	7277
50	1.1	1	1.1	10054

Run No. 4 (West)

Pin Spacing (feet)	Dial Reading	Multiplier	Resistance	Resistivity
2.5	5.7	1	5.7	2705
5	2.7	1	2.7	2537
10	1.8	1	1.8	3351
20	1.2	1	1.2	4596
50	5.1	0.1	0.5	4883

Boring B-16

Run No. 1 (North)

Pin Spacing (feet)	Dial Reading	Multiplier	Resistance	Resistivity
2.5	10.1	1	10.1	4835
5	5.7	1	5.7	5458

Table 11 - Field Resistivity Test Results

10	3.8	1	3.8	7277
20	2.2	1	2.2	8426
50	8.0	0.1	0.8	7660
Run No. 2 (South)				
Pin Spacing (feet)	**Dial Reading**	**Multiplier**	**Resistance**	**Resistivity**
2.5	10.2	1	10.2	4883
5	6.2	1	6.2	5937
10	3.7	1	3.7	7086
20	2.4	1	2.4	9192
50	0.8	1	0.8	7660
Run No. 3 (East)				
Pin Spacing (feet)	**Dial Reading**	**Multiplier**	**Resistance**	**Resistivity**
2.5	10.1	1	10.1	4835
5	5.9	1	5.9	5601
10	3.6	1	3.6	6894
20	2.0	1	2.0	7660
50	Area was wet			
Run No. 4 (West)				
Pin Spacing (feet)	**Dial Reading**	**Multiplier**	**Resistance**	**Resistivity**
2.5	10.2	1	10.2	4859
5	6.2	1	6.2	5889
10	4.0	1	4.0	7660
20	2.6	1	2.6	9958
50	1.1	1	1.1	10533

3.15 CONCRETE SLABS SUPPORTED ON-GRADE

3.15.1 Subgrade Preparation

Recommendations outlined in the SITE DEVELOPMENT and STRUCTURAL FILL sections of this report are intended to produce subgrades that are suitable for support of the floor slabs. The moisture content of the subgrade soils should be maintained within the range recommended for structural fill until the floor slab is completed. Depending upon weather conditions, periodic wetting may be required.

Immediately prior to construction of the building floor slab, it is recommended that the exposed subgrade be evaluated to determine whether moisture contents are within the recommended range and to identify areas disturbed by construction operations. Unsuitable or disturbed areas should be reworked prior to placement of the granular leveling course and construction of the floor slab.

Details regarding proper backfill of utility trenches below building floor slabs should be planned. Suitable low to moderate plasticity clays or granular material should be used as backfill materials. The backfill should be placed and compacted in accordance with the recommendations previously discussed.

3.15.2 Low Volume Change Material

The recommendations presented in this report state that **all** fill placed within the building footprint should meet the requirements of low plasticity structural fill.

3.15.3 Aggregate Capillary Break/Leveling Course

We recommend that a granular leveling course, having a minimum thickness of 4 inches, be used below building floor slabs supported on soil subgrades. The granular leveling course should not be considered to be part of the low plasticity fill section. The granular section provides a capillary moisture break and acts as a leveling course. Clean, crushed limestone gravel with a nominal size of ½- to ¾-inch would be the recommended material for the leveling course.

3.15.4 Construction Considerations

Subsurface moisture and moisture vapor naturally migrate upward through the soil and, where the soil is covered by a building, this subsurface moisture will collect. To reduce the impact of this subsurface moisture and the potential impact of future induced moisture (such as landscape irrigation or precipitation) a vapor retarder is sometimes utilized below the compacted crushed limestone layer. This membrane typically consists of visquene or polyvinyl plastic sheeting. It should be noted that although vapor retarder systems are frequently utilized, this system may not be completely effective in preventing floor slab moisture problems. These systems will not necessarily assure that floor slab moisture transmission rates will meet floor covering manufacturer standards and that indoor humidity levels will be appropriate to inhibit mold growth. The design and construction of such systems are totally dependent on the proposed use and design of the proposed building and all elements of building design and function should be considered in the slab-on-grade floor design. Building design and construction may have a greater role in perceived moisture problems since sealed buildings/rooms or inadequate ventilation may produce excessive moisture in a building and affect indoor air quality.

Various factors such as surface grades, adjacent planters, the quality of slab concrete and the permeability of the on-site soils affect slab moisture and can influence future floor and moisture conditions. In many cases, floor moisture problems are the result of either improper curing of floor slabs or improper application of floor adhesives. We recommend contacting a flooring consultant experienced in the area of concrete slab-on-grade floors or the floor covering manufacturer for specific recommendations regarding your proposed flooring applications.

Special precautions must be taken during the placement and curing of all concrete slabs. Excessive slump (high water-cement ratio) of the concrete and/or improper curing procedures used during either hot or cold weather conditions could lead to excessive shrinkage, cracking or curling of the slabs. High water-cement ratio and/or improper curing also greatly increase the water vapor permeability of the concrete. We recommend that all concrete placement and curing operations be performed in accordance with the American Concrete Institute (ACI) Manual.

3.16 PAVEMENTS

3.16.1 General

Standard duty and heavy duty pavement areas will be constructed as part of this project. No traffic information has been provided at this time; however, we anticipate that the parking lot and drive areas will be subjected to automobile and light truck traffic and occasional delivery trucks. Typical pavement sections are provided. If anticipated traffic information is provided, a detailed pavement design can be performed.

3.16.2 Pavement Subgrade Preparation

Pavement subgrades should be prepared in accordance with the recommendations presented in the SITE DEVELOPMENT and STRUCTURAL FILL sections of this report. Construction scheduling, involving paving and grading by separate contractors, typically results in a time lapse between the end of grading operations and the commencement of paving. Disturbance, desiccation, and/or wetting of the subgrade between grading and paving can result in deterioration of the previously completed subgrade. A non-uniform subgrade can result in poor pavement performance and local failures relatively soon after pavements are constructed.

We recommend that the pavement subgrades be proofrolled and the moisture content and density of the top 12 inches of the subgrade be checked within two days prior to commencement of actual paving operations. Proofrolling should be accomplished with multiple passes of a fully-loaded, tandem-axle dump truck or similar equipment providing an equivalent subgrade loading. If any significant event, such as precipitation, occurs after proofrolling, the subgrade should be reviewed by qualified geotechnical engineering personnel immediately prior to placing the pavement. The subgrade should be in its finished form at the time of the final review.

It is our understanding that consideration is being given to utilizing a 12-inch and 6-inch thick layer dense graded aggregate base as a pavement section at the project site to be used both during and post construction activities for drive areas and parking areas, respectively. The proposed dense graded aggregate base thicknesses should be adequate. However; it should be noted that heavily loaded tractor-trailers will likely degrade the performance of the dense graded aggregate base drive areas during the construction phase of the project, and that periodical regarding of the drive areas should be anticipated during construction and following completion of construction.

3.16.3 Typical Pavement Sections

Table 12: Typical Pavement Sections

Pavement Area	**Minimum Asphaltic Concrete (AC) Design Thickness, inches**	**Minimum Portland Cement Concrete (PCC) Design Thickness, inches**
Standard Duty (Parking Areas)	AC with Granular Base 4.0 AC Surface Course[1] 6.0 Crushed Limestone Base[3] 8.0 Stabilized Subgrade AC with Stabilized Subgrade 4.0 AC Surface Course[1] 16.0 Stabilized Subgrade[4] AC with Granular Base and Geogrid 4.0 AC Surface Course[1] 10.0 Crushed Limestone Base[3] Tensar BX-1200 Geogrid or Equivalent	5.0 PCC 4.0 Clean Gravel 8.0 Stabilized Subgrade
Heavy Duty (Access Lanes)	AC with Granular Base 2.0 AC Surface Course[1] 4.0 AC Base Course[2] 6.0 Crushed Limestone Base[3] 8.0 Stabilized Subgrade AC with Stabilized Subgrade 2.0 AC Surface Course[1] 4.0 AC Base Course[2] 16.0 Stabilized Subgrade[4] AC with Granular Base and Geogrid 2.0 AC Surface Course[1] 4.0 AC Base Course[2] 10.0 Crushed Limestone Base[3] Tensar BX-1200 Geogrid or Equivalent	6.0 PCC 4.0 Clean Gravel 8.0 Stabilized Subgrade
Heavy Truck Usage (Trash Receptacle Pads, Service Drives, and Approaches, etc.)	Not Applicable	7.0 PCC 4.0 Clean Gravel 8.0 Stabilized Subgrade

[1] ODOT "Standard Specifications for Highway Construction" Section 708, Type B or C
[2] ODOT "Standard Specifications for Highway Construction" Section 708, Type A
[3] ODOT "Standard Specifications for Highway Construction" Section 703.01, Type A
[4] In accordance with the appropriate ODOT Specification listed in Section 3.6.3

A geogrid reinforced pavement subgrade option has been provided. Reinforcement of the base course section could be accomplished by placing geogrid reinforcement directly below the aggregate base course at completion of site grading. The geogrids, a Tensar BX1200 or similar product, are polymer grids with a high tensile modulus and high flexural rigidity. When placed below aggregate base, the open-grid geometry interlocks with aggregate to create a reinforced soil structure that acts as a unit. This unit, now stiffer in composition, will reduce the stresses transferred to the underlying poor subgrade materials and provide a more stable subbase. Installation of the geogrids should be in accordance with the manufacturer's recommendations.

Consideration should be given to placing a separator fabric between the granular base and soil subgrade to limit the intrusion of fines into the granular base. Additional maintenance consisting of periodic seal coats and one intermediate mill and overlay, in addition to regular crack maintenance, may be required to achieve the service life.

All pavements should be sloped approximately 1/4 inch per foot to provide rapid surface drainage. This includes the underlying subgrade soils since the granular base material readily transmits water. Appropriate subdrainage or other connection to a suitable gravity outfall be provided to remove water from the granular subbase. Water allowed to pond on or adjacent to the pavement could saturate the subgrade and cause premature pavement deterioration. The edges of the pavement sections should be protected by the use of curbs and gutters or thickened edge pavement sections.

3.16.4 Pavement Materials

Aggregate Base Materials. Aggregate base course material should consist of a crushed limestone meeting the requirements for Aggregate Type A, as set forth in Section 703.01 of the ODOT Standard Specifications for Highway Construction (1999). Aggregate base course materials should be compacted to a minimum of 95% of the material's maximum dry density determined in accordance with the procedures outlined in ASTM D 698 (standard Proctor compaction).

Asphaltic Concrete Mixtures. Asphaltic concrete surface course and base course mixtures should be in accordance with the requirements for Type A, B, and C mixtures, respectively, referenced in Sections 411 and 708 of the of the ODOT Standard Specifications for Highway Construction (1999).

Portland Cement Concrete Mixtures. The Portland cement concrete pavement mixture should be in accordance the requirements referenced in Sections 414 and 701 of the ODOT Standard Specifications for Highway Construction (1999).

Pavement Subgrade Stabilization. Depending upon the site development procedures at the site, the pavement subgrade soils may need to be stabilized/modified with Cement Kiln Dust (CKD), Portland Cement, or Class "C" fly ash. Stabilization recommendations are included in Section 3.7.3 of this report.

The producer of the proposed stabilizing/modifying agent should submit chemical analysis sheets to Kleinfelder for review and approval prior to beginning construction.

3.16.5 Pavement Construction Considerations

Proper drainage below the pavement section helps prevent softening of the subgrade and has a significant impact on pavement performance and pavement life of all pavement types. Therefore, we recommend that a granular blanket drain be constructed at all storm sewer inlets within the pavement areas. The blanket drain should consist of clean, crushed stone aggregate extending a minimum of 6 inches below pavement subgrade level. The blanket drains should extend a minimum of 8 feet away from the curb at all storm sewer inlets, and should be a minimum of 8 feet wide. The grade within the blanket drain should be sloped toward the storm sewer inlet, and weep holes should be drilled through the inlet to provide drainage of the granular section into the inlet. Placement of geotextile filter fabric across the weep holes could be considered to prevent loss of soil through the weep holes.

Construction traffic on the pavements has not been considered in the design. If construction scheduling dictates the pavements will be subject to traffic by construction equipment/vehicles, the designs should be reconsidered to include the effects of the additional traffic loading.

4. ADDITIONAL SERVICES

4.1 PLANS AND SPECIFICATIONS REVIEW

We recommend that Kleinfelder conduct a general review of the final plans and specifications to evaluate that our foundation recommendations have been properly interpreted and implemented during design. In the event Kleinfelder is not retained to perform this recommended review, we will assume no responsibility for misinterpretation of our recommendations.

4.2 CONSTRUCTION OBSERVATION AND TESTING

We recommend that all foundation excavations be monitored by a representative from Kleinfelder. The purpose of these services would be to provide Kleinfelder the opportunity to observe the soil conditions encountered during construction, evaluate the applicability of the recommendations presented in this report to the soil conditions encountered, and recommend appropriate changes in design or construction procedures if conditions differ from those described herein.

5. LIMITATIONS

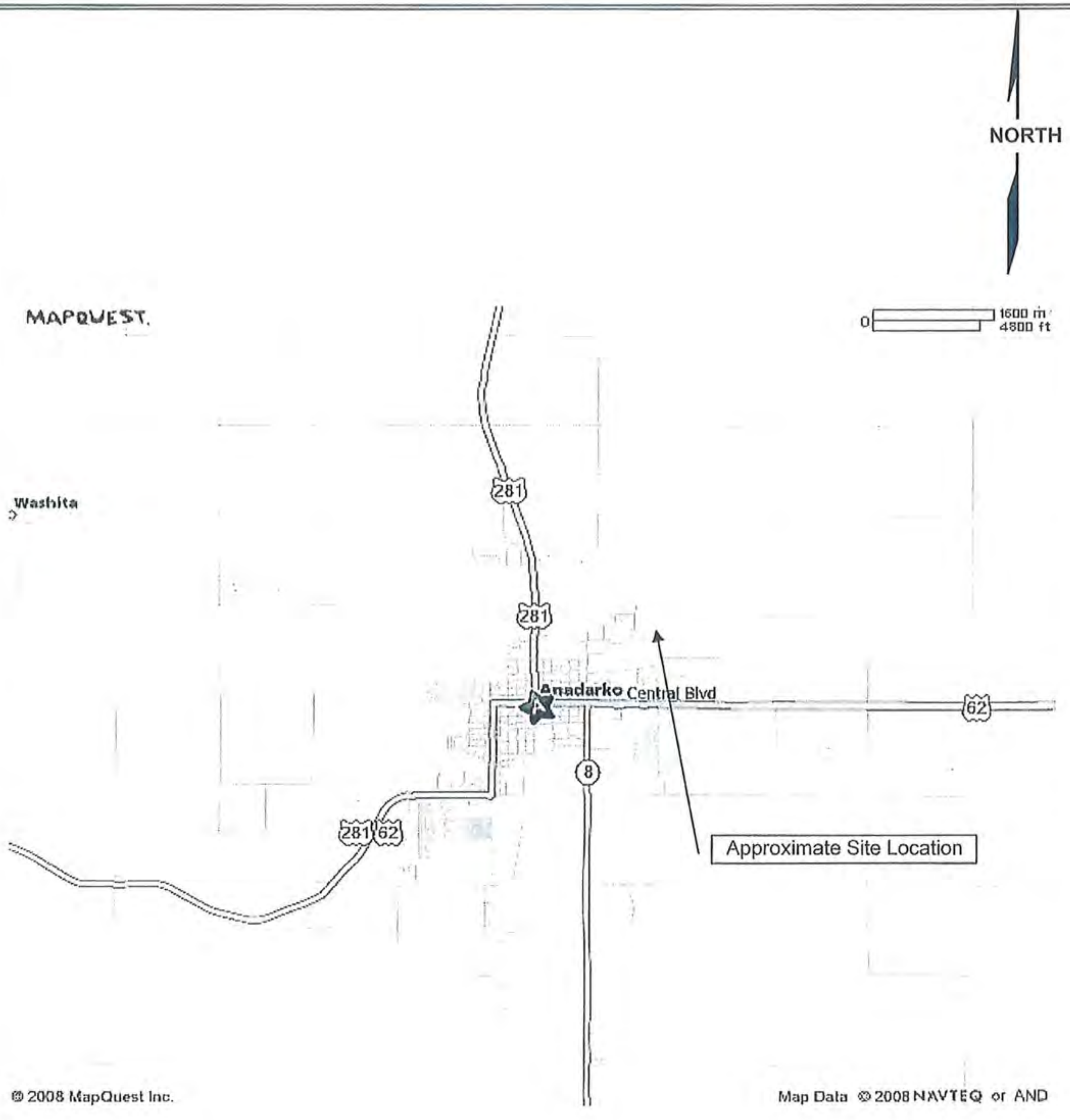
Recommendations and conclusions contained in this report are based on our field observations and subsurface explorations, available subsurface information, limited laboratory tests, and our present knowledge of the proposed construction. It is possible that subsurface conditions could vary between or beyond the points explored. If subsurface conditions are encountered during construction that differ from those described herein, we should be notified immediately in order that a review may be made and any supplemental recommendations provided. If the scope of the proposed construction, including the proposed loads or structural locations, changes from that described in this report, our recommendations should also be reviewed.

We have prepared this report in substantial accordance with the generally accepted geotechnical engineering practice as it exists in the site area at the time of our study. No warranty is expressed or implied. The recommendations provided in this report are based on the assumption that an adequate program of tests and observations will be conducted by Kleinfelder during the construction phase in order to evaluate compliance with our recommendations. The scope of our services did not include any environmental assessment or exploration for the presence of hazardous or toxic materials in the soil, surface water, groundwater or air, on, below or around this site.

This report may be used only by the client and only for the purposes stated, within a reasonable time from its issuance, but in no event later than three years from the date of report. Land use, site conditions (both on-site and off-site), regulations, or other factors may change over time, and additional work may be required with the passage of time. Any party other than the client who wishes to use this report shall notify Kleinfelder of such intended use. Based on the intended use of the report, Kleinfelder may require that additional work be performed and that an updated report be issued. Non-compliance with any of these requirements by the client or anyone else will release Kleinfelder from any liability resulting from the use of this report by any unauthorized party and client agrees to defend, indemnify and hold harmless Kleinfelder from any claim or liability associated with such unauthorized or non-compliance.

FIGURES

FIGURE 1. SITE LOCATION DIAGRAM
FIGURE 2. BORING LOCATION DIAGRAM



Approximate Site Location

Site Location Diagram

Figure 1

Western Farmers Electric Cooperative
Simple Cycle Units 9, 10, and 11
Anadarko, Oklahoma

Approved By: BKM | **Project No: 92254**

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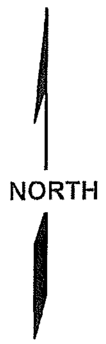

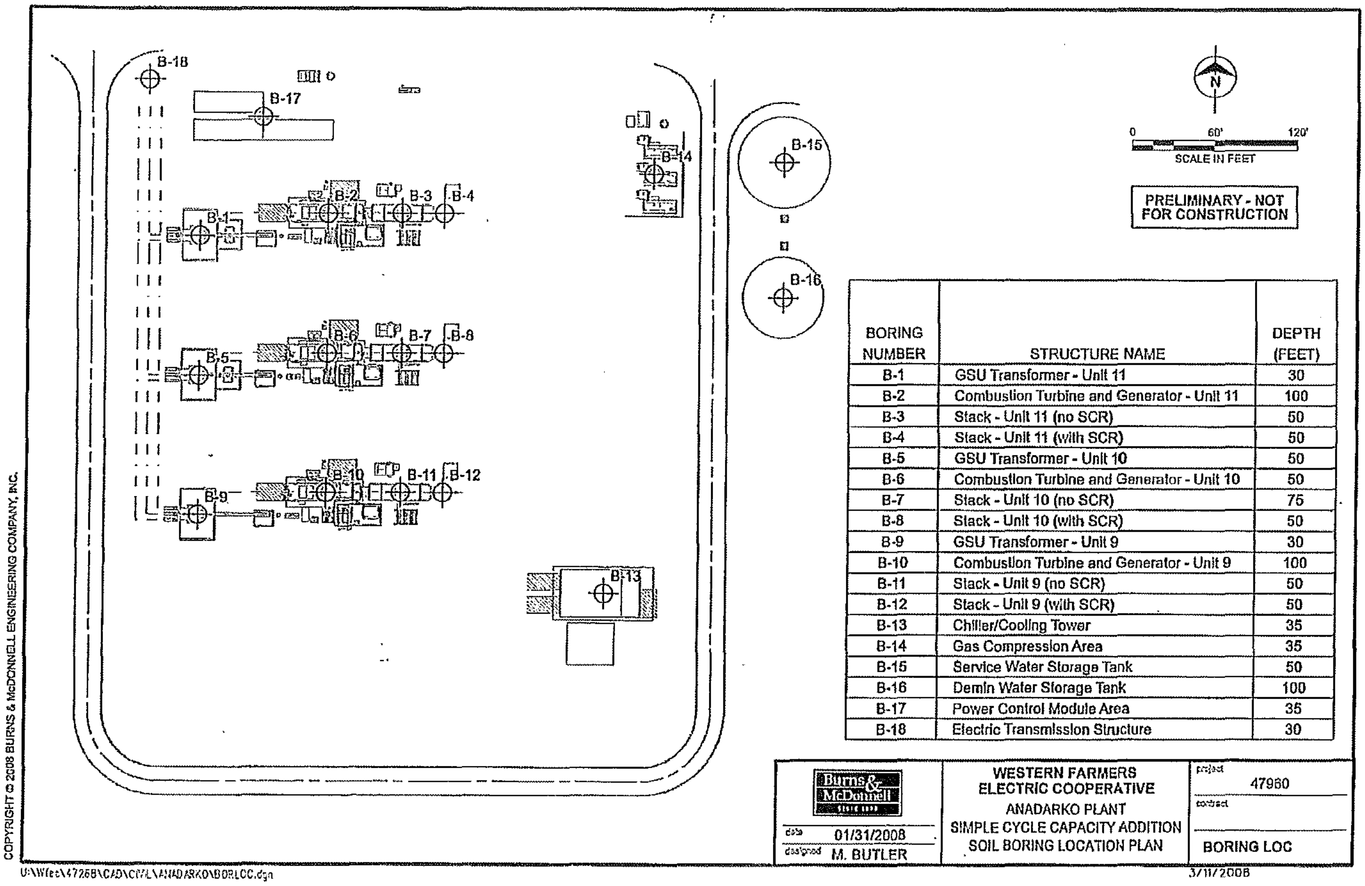

BORING NUMBER	STRUCTURE NAME	DEPTH (FEET)
B-1	GSU Transformer - Unit 11	30
B-2	Combustion Turbine and Generator - Unit 11	100
B-3	Stack - Unit 11 (no SCR)	50
B-4	Stack - Unit 11 (with SCR)	50
B-5	GSU Transformer - Unit 10	50
B-6	Combustion Turbine and Generator - Unit 10	50
B-7	Stack - Unit 10 (no SCR)	75
B-8	Stack - Unit 10 (with SCR)	50
B-9	GSU Transformer - Unit 9	30
B-10	Combustion Turbine and Generator - Unit 9	100
B-11	Stack - Unit 9 (no SCR)	50
B-12	Stack - Unit 9 (with SCR)	50
B-13	Chiller/Cooling Tower	35
B-14	Gas Compression Area	35
B-15	Service Water Storage Tank	50
B-16	Demin Water Storage Tank	100
B-17	Power Control Module Area	35
B-18	Electric Transmission Structure	30

Burns & McDonnell
date 01/31/2008
designed M. BUTLER

WESTERN FARMERS
ELECTRIC COOPERATIVE
ANADARKO PLANT
SIMPLE CYCLE CAPACITY ADDITION
SOIL BORING LOCATION PLAN

project 47980
contract
BORING LOC

NOTE: BM IS LOCATED APPROXIAMTELY 800 FEET WEST OF BORING B-01. JUST SOUTH OF ACCESS ROAD OF EXISTING CELL TOWER.

Boring Location Diagram Not to Scale Figure 2

Western Farmers Electric Cooperative
Simple Cycle Units 9, 10, and 11
Anadarko, Oklahoma

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Approved By: BKM | Project No: 92254

APPENDIX A

FIELD EXPLORATION PROGRAM
BORING LOGS
GENERAL NOTES

FIELD EXPLORATION PROGRAM

DRILLING & SAMPLING PROCEDURES

Kleinfelder conducted the fieldwork for this study on March 17 through March 22, March 30, and April 8, 2008. The exploration consisted of eighteen (18) borings extending to approximate depths of 35 to 103 feet below the existing ground surface level.

The boring locations were located in the field by representatives of Kleinfelder using a hand held GPS unit. Elevations at the boring locations, which are noted near the top right hand corner of the boring logs, were determined through use of an engineer's level and were referenced to the sanitary sewer manhole cover located in the northwest portion of the project site. The approximate location of the temporary benchmark (BM) is shown on Figure 2. The elevation of the temporary benchmark was assumed to be 100.00 feet, based on information presented on the site plan provided to us. Locations and elevations of the borings should be considered accurate only to the degree implied by the methods used to obtain them.

The borings were performed with a truck-mounted (CME 55) rotary drill rig using hollow-stem augers to advance the borings. Representative samples were obtained by Shelby tube and split-barrel sampling procedures in accordance with ASTM Specifications D 1587 and D 1586, respectively. The Shelby tube sampling procedure utilizes a thin-walled, steel tube with a sharp cutting edge that is pushed hydraulically into the bottom of the boring to obtain relatively undisturbed samples of cohesive or moderately cohesive soils. The split-barrel sampling procedure utilizes a standard 2-inch O.D. split-barrel sampler that is driven into the bottom of the boring with a 140-pound hammer falling a distance of 30 inches. The number of blows required to advance the sampler the last 12 inches of a normal 18-inch penetration is recorded as the Standard Penetration Resistance Value (N). These "N" values are indicated on the boring logs at their depth of occurrence and provide an indication of the consistency of cohesive soils and relative hardness of the bedrock.

The boring logs, included in this APPENDIX, present such data as soil and bedrock descriptions, consistency evaluations, depths, approximate ground surface elevations, sampling intervals and observed groundwater conditions. Conditions encountered in the borings were monitored and recorded by the drill crew. The field logs included visual classification of the materials encountered during drilling, as well as drilling characteristics. Our final boring logs, represent the engineer's interpretation of the field logs combined with laboratory observation and testing of the samples. Stratification boundaries indicated on the boring logs were based on observations during our field work, an extrapolation of information obtained by examining samples from the boring and comparisons of soils with similar engineering characteristics. Locations of these boundaries are approximate, and the transitions between material types may be gradual rather than clearly defined.

LOG OF BORING NO. B-01

Page 1 of 2

OWNER/CLIENT
Burns & McDonnell Engineering Company

ARCHITECT/ENGINEER

PROJECT NAME
Western Farmers Electric Cooperative

LOCATION
Anadarko Simple Cycle Units 9, 10, and 11
Anadarko, Oklahoma

SAMPLE NO.	SAMPLE TYPE	RECOVERY	***STANDARD PENETRATION BLOWS/FT.	UNCONFINED STRENGTH PSF	DRY DENSITY PCF	MOISTURE CONTENT, %	UNIFIED SOIL SYMBOL	GRAPHIC LOG
	PA							
1	SS	3	4			18.5	CL	
	PA							
2	ST	23		7336	109	19.5	CH	
	PA							
3	SS	13	17			23.5	CH	
	PA							
4	ST	24		7098	105	22.4	CH	
	PA							
5	SS	14	9			22.8	ML	
	PA							
6	SS	18	2			23.9	CL	
	PA							
7	SS	18	5			23.2	CL	
	PA							
8	SS	12	14			24.2	SC	

***CME Automatic Hammer

DEPTH, FT.: 10, 20, 30

DESCRIPTION

Approximate Surface Elevation: **99.4**

0.2	TOPSOIL	99.2
	LEAN CLAY, soft, brown with red	
3.2		96.2
	FAT CLAY, very stiff, reddish brown	
10.9	∇	88.5
	SANDY SILT, loose, brown with red	
14.1		85.3
	LEAN CLAY, stiff, brown with red	
17.9		81.5
	SANDY LEAN CLAY, very soft, reddish tan	
	▼	
22.6		76.8
	LEAN CLAY, medium stiff, reddish brown	
27.1		72.3
	CLAYEY SAND, medium dense, reddish brown	
30.0		69.4
	BOTTOM OF BORING	

The stratification lines represent the approximate boundary lines between soil and rock types. In-situ the transition may be gradual.

WATER LEVEL OBSERVATIONS

∇ **10.9 W.D.**

▼ **21.2 A.B.**

Backfilled @ Completion

BORING STARTED	**3-17-08**		
BORING COMPLETED	**3-17-08**		
DRILL RIG	**CME 55**	DRILLER	**PV**
APPROVED	**JS**	JOB NO.	**92254**

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LOG OF BORING NO. B-01

Page 2 of 2

OWNER/CLIENT **Burns & McDonnell Engineering Company**	PROJECT NAME **Western Farmers Electric Cooperative**
ARCHITECT/ENGINEER	LOCATION **Anadarko Simple Cycle Units 9, 10, and 11** **Anadarko, Oklahoma**

SAMPLE NO.	SAMPLE TYPE	RECOVERY	***STANDARD PENETRATION BLOWS/FT.	UNCONFINED STRENGTH PSF	DRY DENSITY PCF	MOISTURE CONTENT, %	UNIFIED SOIL SYMBOL	GRAPHIC LOG	DEPTH, FT.	DESCRIPTION

ATTERBERG LIMITS

Sample 3, Depth 5.5-7 feet

LL	PL	PI
51	24	27

ATTERBERG LIMITS

Sample 6, Depth 18.5-20 feet

LL	PL	PI
23	17	6

Percent Fines = 62.7%

ATTERBERG LIMITS

Sample 8, Depth 28.5-30 feet

LL	PL	PI
44	20	24

Percent Fines = 44.0%

***CME Automatic Hammer

The stratification lines represent the approximate boundary lines between soil and rock types. In-situ the transition may be gradual.

WATER LEVEL OBSERVATIONS	BORING STARTED **3-17-08**		KLEINFELDER Bright People. Right Solutions.
∇ **10.9 W.D.**	BORING COMPLETED **3-17-08**		
▼ **21.2 A.B.**	DRILL RIG **CME 55**	DRILLER **PV**	
Backfilled @ Completion	APPROVED **JS**	JOB NO. **92254**	

LOG OF BORING NO. B-02

OWNER/CLIENT **Burns & McDonnell Engineering Company**

ARCHITECT/ENGINEER

PROJECT NAME **Western Farmers Electric Cooperative**

LOCATION **Anadarko Simple Cycle Units 9, 10, and 11**
Anadarko, Oklahoma

SAMPLE NO.	SAMPLE TYPE	RECOVERY	***STANDARD PENETRATION BLOWS/FT.	UNCONFINED STRENGTH PSF	DRY DENSITY PCF	MOISTURE CONTENT, %	UNIFIED SOIL SYMBOL	GRAPHIC LOG	DEPTH, FT.	DESCRIPTION
	PA									0.5 TOPSOIL
1	SS	13	5			17.1	CL			LEAN CLAY, medium stiff, reddish brown
	PA									2.5
2	SS	3	23			19.1	CH			FAT CLAY, stiff to very stiff, reddish brown
	PA									
3	SS	13	19			20.0	CH			
	PA									
4	SS	16	11			23.8	CH		10	
	PA									14.0
5	SS	6	8			12.3	CL			SANDY LEAN CLAY, medium stiff, reddish brown
	PA									17.0 ▽
										CLAYEY SAND, fine grained, very loose to loose, reddish brown
6	SS	18	1			16.3	SC		20	
	PA									
7	SS	18	4			23.1	SC			
	PA									
8	SS	18	8			19.3	SC		30	
	PA									
9	SS	18	7			17.6	SC			

***CME Automatic Hammer

The stratification lines represent the approximate boundary lines between soil and rock types. In-situ the transition may be gradual.

WATER LEVEL OBSERVATIONS

▽ **17 W.D.**

▼ **A.B.**

Backfilled @ Completion

BORING STARTED	**3-30-08**		
BORING COMPLETED	**3-30-08**		
DRILL RIG **CME 75**		DRILLER **AT**	
APPROVED **JS**		JOB NO. **92254**	

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LOG OF BORING NO. B-02

OWNER/CLIENT **Burns & McDonnell Engineering Company**	PROJECT NAME **Western Farmers Electric Cooperative**
ARCHITECT/ENGINEER	LOCATION **Anadarko Simple Cycle Units 9, 10, and 11** **Anadarko, Oklahoma**

SAMPLE NO.	SAMPLE TYPE	RECOVERY	***STANDARD PENETRATION BLOWS/FT.	UNCONFINED STRENGTH PSF	DRY DENSITY PCF	MOISTURE CONTENT, %	UNIFIED SOIL SYMBOL	GRAPHIC LOG	DEPTH, FT.	DESCRIPTION
	WB									
10	SS	12	20			16.6	SP		40	39.0 SAND with trace gravel, fine grained, medium dense, reddish brown
	WB									
11	SS	14	58			13.0	SP			44.8
	WB									45.0 FAT CLAY, very stiff, reddish brown 46.5 GRAVEL **WEATHERED SHALE, soft, reddish brown
12	SS	6	50/5.5"			18.0			50	
	WB									53.0
13	SS	3	50/3"			17.6				**WEATHERED SHALE with gypsum seams, moderately hard, reddish brown
	WB									
14	SS	3	50/3.5"			19.1			60	
	WB									63.5
15	SS	2	50/2"			19.0				**WEATHERED SHALE, hard, reddish brown
	WB									
16	SS	2	50/2"			23.8				

***CME Automatic Hammer

The stratification lines represent the approximate boundary lines between soil and rock types. In-situ the transition may be gradual.

WATER LEVEL OBSERVATIONS	BORING STARTED **3-30-08**		
∇ **17 W.D.**	BORING COMPLETED **3-30-08**		
▼ **A.B.**	DRILL RIG **CME 75**	DRILLER **AT**	
Backfilled @ Completion	APPROVED **JS**	JOB NO. **92254**	

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LOG OF BORING NO. B-02

Page 3 of 4

OWNER/CLIENT **Burns & McDonnell Engineering Company**	PROJECT NAME **Western Farmers Electric Cooperative**
ARCHITECT/ENGINEER	LOCATION **Anadarko Simple Cycle Units 9, 10, and 11** **Anadarko, Oklahoma**

SAMPLE NO.	SAMPLE TYPE	RECOVERY	***STANDARD PENETRATION BLOWS/FT.	UNCONFINED STRENGTH PSF	DRY DENSITY PCF	MOISTURE CONTENT, %	UNIFIED SOIL SYMBOL	GRAPHIC LOG	DEPTH, FT.	DESCRIPTION
	WB									
17	SS	1	50/1.5"			15.9				
										76.8 **WEATHERED SHALE, moderately hard, reddish brown
	WB									
18	SS	3	50/3"			21.3				
									80	
	WB									
19	SS	3	50/3			20.3				
	WB									
										86.7 **WEATHERED SHALE with gypsum seams, moderately hard, red
20	SS	4	50/4"			18.0				
									90	
	WB									
21	SS	3	50/3"			13.3				
	WB									
										96.8 **SHALE, moderately hard, red
22	SS	3	50/3"			13.5				
									100	
	WB									
										103.0
										BOTTOM OF BORING

***CME Automatic Hammer

The stratification lines represent the approximate boundary lines between soil and rock types. In-situ the transition may be gradual.

WATER LEVEL OBSERVATIONS	BORING STARTED **3-30-08**	
∇ **17 W.D.**	BORING COMPLETED **3-30-08**	
▼ **A.B.**	DRILL RIG **CME 75** DRILLER **AT**	KLEINFELDER Bright People. Right Solutions.
Backfilled @ Completion	APPROVED **JS** JOB NO. **92254**	

AUTO HAMMER 92254-RESTORED 4.3.08.GPJ GEOSYSTM.GDT 5/12/08

LOG OF BORING NO. B-02

Page 4 of 4

OWNER/CLIENT **Burns & McDonnell Engineering Company**	PROJECT NAME **Western Farmers Electric Cooperative**
ARCHITECT/ENGINEER	LOCATION **Anadarko Simple Cycle Units 9, 10, and 11** **Anadarko, Oklahoma**

SAMPLE NO.	SAMPLE TYPE	RECOVERY	***STANDARD PENETRATION BLOWS/FT.	UNCONFINED STRENGTH PSF	DRY DENSITY PCF	MOISTURE CONTENT, %	UNIFIED SOIL SYMBOL	GRAPHIC LOG	DEPTH, FT.	DESCRIPTION
										**Rock classification is based on drilling characteristics and visual observation of disturbed samples. Core samples would be required for exact classification.

ATTERBERG LIMITS

Sample 1, Depth 0.5-2 feet

LL	PL	PI
31	22	9

SIEVE ANALYSIS

Sample 7, Depth 23.5-25 feet

Percent Fines = 31.9%

***CME Automatic Hammer

The stratification lines represent the approximate boundary lines between soil and rock types. In-situ the transition may be gradual.

WATER LEVEL OBSERVATIONS	BORING STARTED **3-30-08**	
▽ **17 W.D.**	BORING COMPLETED **3-30-08**	
▼ **A.B.**	DRILL RIG **CME 75**	DRILLER **AT**
Backfilled @ Completion	APPROVED **JS**	JOB NO. **92254**

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LOG OF BORING NO. B-03

Page 1 of 2

OWNER/CLIENT
Burns & McDonnell Engineering Company

ARCHITECT/ENGINEER

PROJECT NAME
Western Farmers Electric Cooperative

LOCATION **Anadarko Simple Cycle Units 9, 10, and 11**
Anadarko, Oklahoma

SAMPLE NO.	SAMPLE TYPE	RECOVERY	***STANDARD PENETRATION BLOWS/FT.	UNCONFINED STRENGTH PSF	DRY DENSITY PCF	MOISTURE CONTENT, %	UNIFIED SOIL SYMBOL	GRAPHIC LOG	DEPTH, FT.
	PA								
1	ST	24		1513	100	20.2	CL		
2	SS	12	9			21.9	CL		
	PA								
3	ST	24		1989	101	22.0	CL		
	PA								
4	SS	11	11			22.6	CL		10
	PA								
5	SS	11	10			10.8	SC		
	PA								
6	SS	7	7			5.5	SP		20
	PA								
7	SS	15	12			16.6	SP		
	PA								
8	SS	15	6			17.3	SP		30
	WB								
9	SS	12	10			20.9	SP		

***CME Automatic Hammer

DESCRIPTION

Approximate Surface Elevation: 99.5

Depth	Description	Elevation
0.3	TOPSOIL	99.2
	LEAN CLAY, medium stiff to stiff, brown	
4.5		95.0
	LEAN CLAY, medium stiff to stiff, reddish brown	
11.7	▼	87.8
	CLAYEY SAND, medium dense, reddish brown	
16.6		82.9
	SAND, fine grained, loose to medium dense, tan	
	∇	
27.6		71.9
	SAND, medium grained, loose, tan	
32.7		66.8
	SAND, fine grained, medium dense, tan	

The stratification lines represent the approximate boundary lines between soil and rock types. In-situ the transition may be gradual.

WATER LEVEL OBSERVATIONS	BORING STARTED **3-19-08**	
∇ **23.1 W.D.**	BORING COMPLETED **3-19-08**	
▼ **11.2 A.B.**	DRILL RIG **CME 55**	DRILLER **PV**
Backfilled @ Completion	APPROVED **JS**	JOB NO. **92254**

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LOG OF BORING NO. B-03

OWNER/CLIENT **Burns & McDonnell Engineering Company**	PROJECT NAME **Western Farmers Electric Cooperative**
ARCHITECT/ENGINEER	LOCATION **Anadarko Simple Cycle Units 9, 10, and 11** **Anadarko, Oklahoma**

SAMPLE NO.	SAMPLE TYPE	RECOVERY	***STANDARD PENETRATION BLOWS/FT.	UNCONFINED STRENGTH PSF	DRY DENSITY PCF	MOISTURE CONTENT, %	UNIFIED SOIL SYMBOL	DEPTH, FT.	DESCRIPTION
	WB								37.9 — 61.6 POORLY GRADED SAND with silt, loose, red
10	SS	14	9			25.3	SP	40	
	WB								41.7 — 57.8 SANDY GRAVEL, medium dense, tan
11	SS	13	25			24.7	GP		44.5 — 55.0 SANDY SILT, medium dense, reddish brown
	WB								46.4 — 53.1 **WEATHERED CLAYSTONE with sand, moderately hard, reddish brown
12	SS	3	50/4"			20.3			48.9 — 50.6

BOTTOM OF BORING

**Rock classification is based on drilling characteristics and visual observation of disturbed samples. Core samples would be required for exact classification.

SIEVE ANALYSIS
Sample 5, Depth 13.5-15 feet

Percent Fines = 28.1%

SIEVE ANALYSIS
Sample 10, Depth 38.5-40 feet

Percent Fines = 11.3%

***CME Automatic Hammer

The stratification lines represent the approximate boundary lines between soil and rock types. In-situ the transition may be gradual.

WATER LEVEL OBSERVATIONS			
∇ 23.1 W.D.	BORING STARTED 3-19-08		
▼ 11.2 A.B.	BORING COMPLETED 3-19-08		
	DRILL RIG CME 55	DRILLER PV	
Backfilled @ Completion	APPROVED JS	JOB NO. 92254	

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LOG OF BORING NO. B-04

Page 1 of 2

OWNER/CLIENT **Burns & McDonnell Engineering Company**	PROJECT NAME **Western Farmers Electric Cooperative**
ARCHITECT/ENGINEER	LOCATION **Anadarko Simple Cycle Units 9, 10, and 11 Anadarko, Oklahoma**

SAMPLE NO.	SAMPLE TYPE	RECOVERY	***STANDARD PENETRATION BLOWS/FT.	UNCONFINED STRENGTH PSF	DRY DENSITY PCF	MOISTURE CONTENT, %	UNIFIED SOIL SYMBOL	GRAPHIC LOG	DEPTH, FT.	DESCRIPTION **Approximate Surface Elevation: 99.6**
	PA									0.2 TOPSOIL 99.4
1	SS	14	5			19.6	CL ML			SILTY CLAY, soft, brown
	PA									2.3 97.3
2	ST	22		2378	102	20.2	CL			LEAN CLAY, medium stiff to stiff, reddish brown
	PA									
3	SS	11	11			21.0	CL			
	PA									7.6 92.0
4	ST	18		3669	115	11.9	SC		10	CLAYEY SAND, medium dense, reddish brown
	PA									11.8 87.8 SAND trace silt, fine to medium grained, loose, tan
5	SS	15	7			9.8	SP			
	PA									▼
6	SS	14	8			8.8	SP		20	
	PA									▽
7	SS	12	6			19.9	SP			
	WB									
8	SS	18	3			16.6	SP		30	
	WB									
9	SS	10	8			21.6	SP			

***CME Automatic Hammer

The stratification lines represent the approximate boundary lines between soil and rock types. In-situ the transition may be gradual.

WATER LEVEL OBSERVATIONS	BORING STARTED	3-19-08	
▽ 22.8 W.D.	BORING COMPLETED	3-19-08	
▼ 18.3 A.C.R.	DRILL RIG CME 55	DRILLER PV	
Backfilled @ Completion	APPROVED JS	JOB NO. 92254	

KLEINFELDER
Bright People. Right Solutions.

AUTO HAMMER 92254-RESTORED 4.3.08.GPJ GEOSYSTM.GDT 5/12/08

LOG OF BORING NO. B-04

OWNER/CLIENT	PROJECT NAME
Burns & McDonnell Engineering Company	**Western Farmers Electric Cooperative**
ARCHITECT/ENGINEER	LOCATION **Anadarko Simple Cycle Units 9, 10, and 11** **Anadarko, Oklahoma**

SAMPLE NO.	SAMPLE TYPE	RECOVERY	***STANDARD PENETRATION BLOWS/FT.	UNCONFINED STRENGTH PSF	DRY DENSITY PCF	MOISTURE CONTENT, %	UNIFIED SOIL SYMBOL	GRAPHIC LOG	DEPTH, FT.	DESCRIPTION
	WB									
10	SS	11	11			18.6	SP		40	- gravel @ 39.3 feet
	WB									42.3 57.3 SANDY GRAVEL, medium dense, tan
11	SS	13	25			16.8	GP			45.2 54.4 **WEATHERED SANDY SHALE, soft, reddish brown
	WB									
12	SS	4	50/5"			16.5			50	50.0 49.6

BOTTOM OF BORING

**Rock classification is based on drilling characteristics and visual observation of disturbed samples. Core samples would be required for exact classification.

ATTERBERG LIMITS
Sample 2, Depth 2.5-4.5 feet

LL	PL	PI
44	22	22

SIEVE ANALYSIS
Sample 4, Depth 8-10 feet

Percent Fines = 38.0%

SIEVE ANALYSIS
Sample 8, Depth 28.5-30 feet

Percent Fines = 2.8%

***CME Automatic Hammer

The stratification lines represent the approximate boundary lines between soil and rock types. In-situ the transition may be gradual.

WATER LEVEL OBSERVATIONS			
∇ **22.8 W.D.**	BORING STARTED **3-19-08**		
▼ **18.3 A.C.R.**	BORING COMPLETED **3-19-08**		
Backfilled @ Completion	DRILL RIG **CME 55**	DRILLER **PV**	
	APPROVED **JS**	JOB NO. **92254**	

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AUTO HAMMER 92254-RESTORED 4.3.08.GPJ GEOSYSTM.GDT 5/12/08

LOG OF BORING NO. B-05

Page 1 of 2

OWNER/CLIENT **Burns & McDonnell Engineering Company**

PROJECT NAME **Western Farmers Electric Cooperative**

ARCHITECT/ENGINEER

LOCATION **Anadarko Simple Cycle Units 9, 10, and 11**
Anadarko, Oklahoma

SAMPLE NO.	SAMPLE TYPE	RECOVERY	***STANDARD PENETRATION BLOWS/FT.	UNCONFINED STRENGTH PSF	DRY DENSITY PCF	MOISTURE CONTENT, %	UNIFIED SOIL SYMBOL	GRAPHIC LOG	DEPTH, FT.
	PA							▨	
1	SS	9	4			19.8	CL	▨	
	PA							▨	
2	ST	24		1662	96.1	18.9	CL	▨	
	PA							▨	
3	SS	14	12			21.7	CL	▨	
	PA							▨	
4	ST	24		1979	95.1	25.9	CH	▩	10
	PA							▩ ░	
5	SS	13	5			18.3	ML	░	
	PA							▨	
6	SS	18	1			19.8	ML	‖	20
	PA							‖	
7	SS	18	6			19.3	ML	‖	
	PA							‖	
8	SS	18	5			28.1	ML	‖	30
	WB							‖	
9	SS	18	0			20.1	ML	‖	

***CME Automatic Hammer

DESCRIPTION

Approximate Surface Elevation: 99.2

0.3	TOPSOIL	98.9
	LEAN CLAY, soft to stiff, brown with red	
8.0		91.2
	FAT CLAY, medium stiff, brown with red	
11.9		87.3
	SANDY SILT, loose, brown	
14.8	▼	84.4
	LEAN CLAY, soft, brown	
16.8		82.4
	SILT with sand, very loose to loose, brown	
	∇	

The stratification lines represent the approximate boundary lines between soil and rock types. In-situ the transition may be gradual.

WATER LEVEL OBSERVATIONS			
∇ 23.2 W.D.	BORING STARTED 3-20-08		
▼ 14.6 B.C.R.	BORING COMPLETED 3-20-08		
	DRILL RIG CME 55	DRILLER PV	
Backfilled @ Completion	APPROVED JS	JOB NO. 92254	

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AUTO HAMMER 92254-RESTORED 4.3.08.GPJ GEOSYSTM.GDT 5/12/08

LOG OF BORING NO. B-05

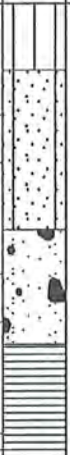
Page 2 of 2

OWNER/CLIENT
Burns & McDonnell Engineering Company

PROJECT NAME
Western Farmers Electric Cooperative

ARCHITECT/ENGINEER

LOCATION
Anadarko Simple Cycle Units 9, 10, and 11
Anadarko, Oklahoma



SAMPLE NO.	SAMPLE TYPE	RECOVERY	***STANDARD PENETRATION BLOWS/FT.	UNCONFINED STRENGTH PSF	DRY DENSITY PCF	MOISTURE CONTENT, %	UNIFIED SOIL SYMBOL	GRAPHIC LOG	DEPTH, FT.	DESCRIPTION
	WB									37.1 — 62.1 SILTY SAND, loose, reddish brown
10	SS	17	5			17.1	SM		40	
	WB									42.1 — 57.1 SANDY GRAVEL, medium dense, tan
11	SS	13	36			17.6	GP			45.7 — 53.5 **WEATHERED CLAYSTONE with sand, soft, reddish brown
	WB									
12	SS	4	50/5"			22.4				49.0 — 50.2

BOTTOM OF BORING

**Rock classification is based on drilling characteristics and visual observation of disturbed samples. Core samples would be required for exact classification.

ATTERBERG LIMITS

Sample 2, Depth 2.5-4 feet

LL	PL	PI
39	21	18

Sample 4, Depth 8-10 feet

LL	PL	PI
51	26	25

SIEVE ANALYSIS

Sample 6, Depth 18.5-20 feet

Percent Fines = 75.4%

***CME Automatic Hammer

The stratification lines represent the approximate boundary lines between soil and rock types. In-situ the transition may be gradual.

WATER LEVEL OBSERVATIONS	BORING STARTED **3-20-08**		
∇ **23.2 W.D.**	BORING COMPLETED **3-20-08**		
▼ **14.6 B.C.R.**	DRILL RIG **CME 55**	DRILLER **PV**	
Backfilled @ Completion	APPROVED **JS**	JOB NO. **92254**	

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AUTO HAMMER 92254-RESTORED 4.3.08.GPJ GEOSYSTM.GDT 5/12/08

LOG OF BORING NO. B-06

Page 1 of 2

OWNER/CLIENT **Burns & McDonnell Engineering Company**	PROJECT NAME **Western Farmers Electric Cooperative**
ARCHITECT/ENGINEER	LOCATION **Anadarko Simple Cycle Units 9, 10, and 11** **Anadarko, Oklahoma**

SAMPLE NO.	SAMPLE TYPE	RECOVERY	***STANDARD PENETRATION BLOWS/FT.	UNCONFINED STRENGTH PSF	DRY DENSITY PCF	MOISTURE CONTENT, %	UNIFIED SOIL SYMBOL	GRAPHIC LOG	DEPTH, FT.
	PA								
1	ST	13		2124	101	22.3	CL		
2	SS	10	8			16.6	CL		
	PA								
3	ST	13		3963	105	22.0	CL		
	PA								
4	SS	9	8			22.8	CL		10
	PA								
5	SS	12	7			10.2	ML		
	PA								
6	SS	12	7			10.9	SP		20
	PA								
7	SS	18	7			13.6	SP		
	PA								
8	SS	14	2			18.9	SM		30
	WB								
9	SS	11	19			21.9	SP		

***CME Automatic Hammer

DESCRIPTION

Approximate Surface Elevation: 98.9

Depth	Description	Elevation
0.2	TOPSOIL	98.7
	LEAN CLAY, stiff, brown with red	
11.6	SANDY SILT, loose, brown	87.3
17.1	SAND, fine to medium grained, loose, tan ▼ ▽	81.8
24.2	SILTY SAND, loose, reddish brown	74.7
32.6	POORLY GRADED SAND with silt, medium dense, reddish brown	66.3

The stratification lines represent the approximate boundary lines between soil and rock types. In-situ the transition may be gradual.

WATER LEVEL OBSERVATIONS			
▽ 23.1 W.D.	BORING STARTED 3-20-08		
▼ 18.9 B.C.R.	BORING COMPLETED 3-20-08		
	DRILL RIG **CME 55**	DRILLER **PV**	
Backfilled @ Completion	APPROVED **JS**	JOB NO. **92254**	

KLEINFELDER
Bright People. Right Solutions.

LOG OF BORING NO. B-06

Page 2 of 2

OWNER/CLIENT **Burns & McDonnell Engineering Company**	PROJECT NAME **Western Farmers Electric Cooperative**
ARCHITECT/ENGINEER	LOCATION **Anadarko Simple Cycle Units 9, 10, and 11** **Anadarko, Oklahoma**

SAMPLE NO.	SAMPLE TYPE	RECOVERY	***STANDARD PENETRATION BLOWS/FT.	UNCONFINED STRENGTH PSF	DRY DENSITY PCF	MOISTURE CONTENT, %	UNIFIED SOIL SYMBOL	GRAPHIC LOG	DEPTH, FT.	DESCRIPTION
	WB									37.6 61.3 SAND, medium grained, medium dense, tan
10	SS	12	14			15.4	SP		40	
	WB									42.3 56.6 SANDY GRAVEL, very dense, tan
11	SS	7	31/6" 50/4"			15.3	GP			
	WB									48.5 50.4
12	SS		31/6" 50/5"			16.8				49.5 **SANDY SHALE, reddish brown 49.4

BOTTOM OF BORING

**Rock classification is based on drilling characteristics and visual observation of disturbed samples. Core samples would be required for exact classification.

ATTERBERG LIMITS
Sample 3, Depth 5-7 feet

LL	PL	PI
34	18	16

SIEVE ANALYSIS
Sample 7, Depth 23.5-25 feet

Percent Fines = 22.1%

SIEVE ANALYSIS
Sample 9, Depth 33.5-35 feet

Percent Fines = 10.5%

***CME Automatic Hammer

The stratification lines represent the approximate boundary lines between soil and rock types. In-situ the transition may be gradual.

WATER LEVEL OBSERVATIONS	BORING STARTED	**3-20-08**	KLEINFELDER Bright People. Right Solutions.
▽ **23.1 W.D.**	BORING COMPLETED	**3-20-08**	
▼ **18.9 B.C.R.**	DRILL RIG **CME 55**	DRILLER **PV**	
Backfilled @ Completion	APPROVED **JS**	JOB NO. **92254**	

LOG OF BORING NO. B-07

OWNER/CLIENT **Burns & McDonnell Engineering Company**	PROJECT NAME **Western Farmers Electric Cooperative**
ARCHITECT/ENGINEER	LOCATION **Anadarko Simple Cycle Units 9, 10, and 11** **Anadarko, Oklahoma**

SAMPLE NO.	SAMPLE TYPE	RECOVERY	***STANDARD PENETRATION BLOWS/FT.	UNCONFINED STRENGTH PSF	DRY DENSITY PCF	MOISTURE CONTENT, %	UNIFIED SOIL SYMBOL	GRAPHIC LOG	DEPTH, FT.
	PA								
1	SS	12	5			19.6	CL		
	PA								
2	ST	18		4509	106	21.1	CL		
	PA								
3	SS	13	18			22.4	CL		
	PA								
4	ST	23		1255	102	14.4	SC		10
	PA								
5	SS	10	8			2.6	SP		
	PA								
6	SS	10	19			15.1	SP		20
	PA								
7	SS	13	11			16.0	SM		
	PA								
8	SS	16	2			20.5	SM		30
	WB								
9	SS	12	18			21.5	SM		

***CME Automatic Hammer

DESCRIPTION

Approximate Surface Elevation: **98.9**

0.3	TOPSOIL	98.6
	LEAN CLAY, medium stiff, brown	
2.8		96.1
	LEAN CLAY, stiff to very stiff, reddish brown	
7.8		91.1
	CLAYEY SAND, loose, brown	
12.6		86.3
	SAND, fine to medium grained, loose. tan and yellow	
16.8		82.1
	SAND, fine grained with medium grained seams, medium dense, tan ▼	
22.8	∇	76.1
	SILTY SAND, loose to medium dense, red	

The stratification lines represent the approximate boundary lines between soil and rock types. In-situ the transition may be gradual.

WATER LEVEL OBSERVATIONS	BORING STARTED **3-20-08**		
∇ **22.6 W.D.**	BORING COMPLETED **3-21-08**		
▼ **18.5 A.C.R.**	DRILL RIG **CME 55**	DRILLER **PV**	
Backfilled @ Completion	APPROVED **JS**	JOB NO. **92254**	

KLEINFELDER
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AUTO HAMMER 92254-RESTORED 4.3.08.GPJ GEOSYSTM.GDT 5/12/08

LOG OF BORING NO. B-07

Page 2 of 3

OWNER/CLIENT **Burns & McDonnell Engineering Company**	PROJECT NAME **Western Farmers Electric Cooperative**
ARCHITECT/ENGINEER	LOCATION **Anadarko Simple Cycle Units 9, 10, and 11** **Anadarko, Oklahoma**

SAMPLE NO.	SAMPLE TYPE	RECOVERY	***STANDARD PENETRATION BLOWS/FT.	UNCONFINED STRENGTH PSF	DRY DENSITY PCF	MOISTURE CONTENT, %	UNIFIED SOIL SYMBOL	GRAPHIC LOG	DEPTH, FT.	DESCRIPTION
	WB									37.2 61.7 SAND, medium grained, medium dense, tan
10	SS	15	11			20.7	SP		40	
	WB									41.8 57.1 SANDY GRAVEL, very dense, tan
11	SS	12	28			18.9	GP			44.0 54.9 LEAN CLAY with sand, hard, red 46.1 52.8 **WEATHERED SHALE with sand, soft, red
	WB									
12	SS	6	50/6"			19.4				
	WB								50	
13	SS	4	50/5"			17.2				
	WB									57.1 41.8 **WEATHERED SHALE, moderately hard, red
14	SS	4	50/4"			13.8				
	WB								60	62.7 36.2 **SHALE, hard, red
15	SS	1	50/1"			16.5				
	WB									
16	SS	2	50/2"			15.7				

***CME Automatic Hammer

The stratification lines represent the approximate boundary lines between soil and rock types. In-situ the transition may be gradual.

WATER LEVEL OBSERVATIONS	BORING STARTED **3-20-08**		KLEINFELDER *Bright People. Right Solutions.*
∇ **22.6 W.D.**	BORING COMPLETED **3-21-08**		
▼ **18.5 A.C.R.**	DRILL RIG **CME 55**	DRILLER **PV**	
Backfilled @ Completion	APPROVED **JS**	JOB NO. **92254**	

LOG OF BORING NO. B-07

Page 3 of 3

OWNER/CLIENT **Burns & McDonnell Engineering Company**	PROJECT NAME **Western Farmers Electric Cooperative**
ARCHITECT/ENGINEER	LOCATION **Anadarko Simple Cycle Units 9, 10, and 11** **Anadarko, Oklahoma**

SAMPLE NO.	SAMPLE TYPE	RECOVERY	***STANDARD PENETRATION BLOWS/FT.	UNCONFINED STRENGTH PSF	DRY DENSITY PCF	MOISTURE CONTENT, %	UNIFIED SOIL SYMBOL	GRAPHIC LOG	DEPTH, FT.	DESCRIPTION
	WB									
17	SS		50/2"			14.7				73.6 25.3
										BOTTOM OF BORING

**Rock classification is based on drilling characteristics and visual observation of disturbed samples. Core samples would be required for exact classification.

ATTERBERG LIMITS

Sample 4, Depth 8-10 feet

LL	PL	PI
25	16	9

Percent Fines = 43.8%

SIEVE ANALYSIS

Sample 8, Depth 28.5-30 feet

Percent Fines = 23.6%

SIEVE ANALYSIS

Sample 11, Depth 43.5-45 feet

Percent Fines = 85.5%

***CME Automatic Hammer

The stratification lines represent the approximate boundary lines between soil and rock types. In-situ the transition may be gradual.

WATER LEVEL OBSERVATIONS				
∇ 22.6 W.D.	BORING STARTED	3-20-08		
▼ 18.5 A.C.R.	BORING COMPLETED	3-21-08		
Backfilled @ Completion	DRILL RIG	CME 55	DRILLER	PV
	APPROVED	JS	JOB NO.	92254

KLEINFELDER
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AUTO HAMMER 92254-RESTORED 4.3.08.GPJ GEOSYSTM.GDT 5/12/08

LOG OF BORING NO. B-08

Page 1 of 2

OWNER/CLIENT
Burns & McDonnell Engineering Company

ARCHITECT/ENGINEER

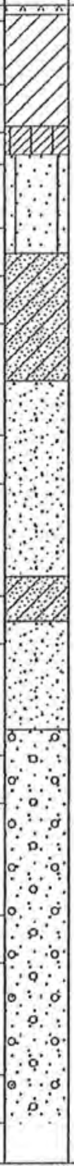
PROJECT NAME
Western Farmers Electric Cooperative

LOCATION
Anadarko Simple Cycle Units 9, 10, and 11
Anadarko, Oklahoma

SAMPLE NO.	SAMPLE TYPE	RECOVERY	***STANDARD PENETRATION BLOWS/FT.	UNCONFINED STRENGTH PSF	DRY DENSITY PCF	MOISTURE CONTENT, %	UNIFIED SOIL SYMBOL
	PA						
1	ST	20		2850	103	22.5	CL
2	SS	11	11			20.6	CL
	PA						
3	ST	24		1841	107	14.4	SM
	PA						
4	SS	14	12			15.3	SC
	PA						
5	SS	15	9			7.3	SP
	PA						
6	SS	14	11			21.9	SC
	PA						
7	SS	15	13			22.2	SP
	PA						
8	SS	14	3			18.1	SP
	WB						
9	SS	13	18			26.6	SP

***CME Automatic Hammer

GRAPHIC LOG



DEPTH, FT.

DESCRIPTION

Approximate Surface Elevation: 99.0

0.3	TOPSOIL	98.7
	LEAN CLAY, medium stiff to stiff, brown	
3.8		95.2
4.7	CLAYEY SILT, medium dense, reddish brown	94.3
	SILTY SAND, loose, reddish brown	
7.8		91.2
	CLAYEY SAND, medium dense, tan	
11.8		87.2
	SAND, fine to medium grained, loose, tan ▼	
17.9		81.1
	CLAYEY SAND, medium dense, tan and brown	
19.3		79.7
	SAND, fine to medium grained, loose, tan	
22.7		76.3
	POORLY GRADED SAND with silt, loose to medium dense, reddish brown ▽	

The stratification lines represent the approximate boundary lines between soil and rock types. In-situ the transition may be gradual.

WATER LEVEL OBSERVATIONS

▽ 23.2 W.D.

▼ 16.2 B.C.R.

Backfilled @ Completion

BORING STARTED	3-21-08		
BORING COMPLETED	3-21-08		
DRILL RIG	CME 55	DRILLER	PV
APPROVED	JS	JOB NO.	92254

KLEINFELDER
Bright People. Right Solutions.

AUTO HAMMER 92254-RESTORED 4.3.08.GPJ GEOSYSTM.GDT 5/12/08

LOG OF BORING NO. B-08

Page 2 of 2

OWNER/CLIENT **Burns & McDonnell Engineering Company**	PROJECT NAME **Western Farmers Electric Cooperative**
ARCHITECT/ENGINEER	LOCATION **Anadarko Simple Cycle Units 9, 10, and 11** **Anadarko, Oklahoma**

SAMPLE NO.	SAMPLE TYPE	RECOVERY	***STANDARD PENETRATION BLOWS/FT.	UNCONFINED STRENGTH PSF	DRY DENSITY PCF	MOISTURE CONTENT, %	UNIFIED SOIL SYMBOL	GRAPHIC LOG	DEPTH, FT.	DESCRIPTION	
	WB									37.1 SAND, fine grained with medium grained seams, medium dense, tan	61.9
10	SS	12	12			18.6	SP		40		
	WB									41.8 SANDY GRAVEL, very dense, tan	57.2
11	SS	18	10/6" 19/6" 50/6"			21.1	CL			43.9 LEAN CLAY with trace sand, hard, red with gray	55.1
	WB										
12	SS	12	16/6" 50/6"			18.0	CL			49.5	49.5

BOTTOM OF BORING

**Rock classification is based on drilling characteristics and visual observation of disturbed samples. Core samples would be required for exact classification.

SIEVE ANALYSIS
Sample 4, Depth 8.5-10 feet

Percent Fines = 45.0%

SIEVE ANALYSIS
Sample 9, Depth 33.5-35 feet

Percent Fines = 5.6%

***CME Automatic Hammer

The stratification lines represent the approximate boundary lines between soil and rock types. In-situ the transition may be gradual.

WATER LEVEL OBSERVATIONS	BORING STARTED	**3-21-08**	
∇ **23.2 W.D.**	BORING COMPLETED	**3-21-08**	
▼ **16.2 B.C.R.**	DRILL RIG **CME 55**	DRILLER **PV**	KLEINFELDER Bright People. Right Solutions.
Backfilled @ Completion	APPROVED **JS**	JOB NO. **92254**	

LOG OF BORING NO. B-09

Page 1 of 2

OWNER/CLIENT
Burns & McDonnell Engineering Company

ARCHITECT/ENGINEER

PROJECT NAME
Western Farmers Electric Cooperative

LOCATION
Anadarko Simple Cycle Units 9, 10, and 11
Anadarko, Oklahoma

SAMPLE NO.	SAMPLE TYPE	RECOVERY	***STANDARD PENETRATION BLOWS/FT.	UNCONFINED STRENGTH PSF	DRY DENSITY PCF	MOISTURE CONTENT, %	UNIFIED SOIL SYMBOL
	PA						
1	SS	8	4			21.9	CL
	PA						
2	ST	24		4812	108	19.3	CL
	PA						
3	SS	8	7			16.9	ML
	PA						
4	SS	14	5			18.8	ML
	PA						
5	SS	15	5			13.5	ML
	PA						
6	SS	17	4			13.5	ML
	PA						
7	SS	18	5			17.8	SM
	PA						
8	SS	7	6			21.6	SM

***CME Automatic Hammer

DESCRIPTION

Approximate Surface Elevation: 98.6

DEPTH, FT.	DESCRIPTION	
0.2	TOPSOIL	98.4
	SANDY LEAN CLAY, medium stiff to stiff, reddish brown	
5.1		93.5
	SILT with trace sand, loose, reddish brown	
7.8		90.8
	SANDY SILT, loose, reddish brown	
11.7		86.9
	SILT with sand, loose, brown	
	▼	
22.3	▽	76.3
	SILTY SAND, loose, reddish brown	
30.0		68.6
	BOTTOM OF BORING	

The stratification lines represent the approximate boundary lines between soil and rock types. In-situ the transition may be gradual.

WATER LEVEL OBSERVATIONS

▽ 22.0 W.D.

▼ 19.8 A.B.

Backfilled @ Completion

BORING STARTED	3-22-08		
BORING COMPLETED	3-22-08		
DRILL RIG	CME 55	DRILLER	PV
APPROVED	JS	JOB NO.	92254

KLEINFELDER
Bright People. Right Solutions.

LOG OF BORING NO. B-09

OWNER/CLIENT **Burns & McDonnell Engineering Company**	PROJECT NAME **Western Farmers Electric Cooperative**
ARCHITECT/ENGINEER	LOCATION **Anadarko Simple Cycle Units 9, 10, and 11** **Anadarko, Oklahoma**

SAMPLE NO.	SAMPLE TYPE	RECOVERY	***STANDARD PENETRATION BLOWS/FT.	UNCONFINED STRENGTH PSF	DRY DENSITY PCF	MOISTURE CONTENT, %	UNIFIED SOIL SYMBOL	GRAPHIC LOG	DEPTH, FT.	DESCRIPTION
										ATTERBERG LIMITS Sample 2, Depth 2.5-4.5 feet LL 35 PL 21 PI 14 **SIEVE ANALYSIS** Sample 7, Depth 23.5-25 feet Percent Fines = 43.9%

***CME Automatic Hammer

The stratification lines represent the approximate boundary lines between soil and rock types. In-situ the transition may be gradual.

WATER LEVEL OBSERVATIONS	BORING STARTED **3-22-08**	
∇ **22.0 W.D.**	BORING COMPLETED **3-22-08**	
▼ **19.8 A.B.**	DRILL RIG **CME 55** DRILLER **PV**	KLEINFELDER Bright People. Right Solutions.
Backfilled @ Completion	APPROVED **JS** JOB NO. **92254**	

LOG OF BORING NO. B-10

Page 1 of 4

OWNER/CLIENT **Burns & McDonnell Engineering Company**	PROJECT NAME **Western Farmers Electric Cooperative**
ARCHITECT/ENGINEER	LOCATION **Anadarko Simple Cycle Units 9, 10, and 11** **Anadarko, Oklahoma**

SAMPLE NO.	SAMPLE TYPE	RECOVERY	***STANDARD PENETRATION BLOWS/FT.	UNCONFINED STRENGTH PSF	DRY DENSITY PCF	MOISTURE CONTENT, %	UNIFIED SOIL SYMBOL	GRAPHIC LOG	DEPTH, FT.	DESCRIPTION
	PA									0.3 TOPSOIL
1	SS	12	6			15.3	CL			LEAN CLAY with sand, medium stiff to very stiff, reddish brown
	PA									
2	SS	13	14			14.7	CL			
	PA									
3	SS	13	28			21.0	CL			
	PA									
4	SS	14	5			20.0	CL			9.6
	PA								10	SANDY SILT, loose, brown 13.3
5	SS	18	17			14.6	SM			SILTY SAND, medium dense, tan
	PA									16.7 SILTY SAND, medium grained, medium dense, brown
6	SS	18	15			10.5	SM		20	
	PA									21.8 SILT with sand, medium dense, reddish brown
7	SS	18	13			22.0	ML			∇
	WB									28.0 SILTY SAND, medium dense, reddish brown
8	SS	13	19			18.0	SM		30	
	WB									
9	SS	13	15			19.9	SM			

***CME Automatic Hammer

The stratification lines represent the approximate boundary lines between soil and rock types. In-situ the transition may be gradual.

WATER LEVEL OBSERVATIONS		
∇ 24.1 W.D	BORING STARTED 4-8-08	
▼ A,B	BORING COMPLETED 4-8-08	
	DRILL RIG CME 75	DRILLER AT
Backfilled @ Completion	APPROVED JS	JOB NO. 92254

KLEINFELDER
Bright People. Right Solutions.

AUTO HAMMER 92254-RESTORED 4.3.08.GPJ GEOSYSTM.GDT 5/12/08

LOG OF BORING NO. B-10

OWNER/CLIENT **Burns & McDonnell Engineering Company**	PROJECT NAME **Western Farmers Electric Cooperative**
ARCHITECT/ENGINEER	LOCATION **Anadarko Simple Cycle Units 9, 10, and 11** **Anadarko, Oklahoma**

SAMPLE NO.	SAMPLE TYPE	RECOVERY	***STANDARD PENETRATION BLOWS/FT.	UNCONFINED STRENGTH PSF	DRY DENSITY PCF	MOISTURE CONTENT, %	UNIFIED SOIL SYMBOL	GRAPHIC LOG	DEPTH, FT.
	WB								
10	SS	16	22			22.4	SP		40
	WB								
11	SS	12	31			12.4	SP		
	WB								
12	SS	18	22/6" 38/6" 50/5"			20.5	CL		50
	WB								
13	SS	18	31/6" 33/6" 50/4.5"			21.1			
	WB								
~~14~~	~~SS~~	~~2~~	~~50/2"~~			~~18.3~~			60
	WB								
~~15~~	~~SS~~	~~4~~	~~50/4"~~			~~20.0~~			
	WB								
~~16~~	~~SS~~	~~2~~	~~50/1.5"~~			~~18.3~~			

***CME Automatic Hammer

DEPTH	DESCRIPTION
37.1	SAND with silt, fine grained, dense, tan and brown
41.0	SAND with gravel, fine grained and mediun grained, dense, brown and tan
48.6	
49.4	LEAN CLAY with trace sand, hard, reddish brown
	**WEATHERED CLAYSTONE, soft, reddish brown with gray seams
56.6	**CLAYSTONE with gypsum seams, hard, reddish brown

The stratification lines represent the approximate boundary lines between soil and rock types. In-situ the transition may be gradual.

WATER LEVEL OBSERVATIONS	BORING STARTED **4-8-08**	
▽ **24.1 W.D**	BORING COMPLETED **4-8-08**	
▼ **A,B**	DRILL RIG **CME 75**	DRILLER **AT**
Backfilled @ Completion	APPROVED **JS**	JOB NO. **92254**

KLEINFELDER
Bright People. Right Solutions.

LOG OF BORING NO. B-10

OWNER/CLIENT **Burns & McDonnell Engineering Company**	PROJECT NAME **Western Farmers Electric Cooperative**
ARCHITECT/ENGINEER	LOCATION **Anadarko Simple Cycle Units 9, 10, and 11 Anadarko, Oklahoma**

SAMPLE NO.	SAMPLE TYPE	RECOVERY	***STANDARD PENETRATION BLOWS/FT.	UNCONFINED STRENGTH PSF	DRY DENSITY PCF	MOISTURE CONTENT, %	UNIFIED SOIL SYMBOL	GRAPHIC LOG	DEPTH, FT.	DESCRIPTION
	WB							▤		71.8
								▤		**SHALE with gypsum seams, moderately hard, reddish brown
17	SS	3	50/3"			21.0		▤		
	WB							▤		75.7
								▤		**SHALE, hard, reddish brown
18	SS	2	50/2"			19.2		▤		
								▤	80	
	WB							▤		82.1
								▤		SHALE with gypsum seams, hard, reddish brown
19	SS	2	50/2"			17.7		▤		
								▤		- moderately hard @ 84.8 feet
	WB							▤		
20	SS	4	50/4"			20.5		▤		
								▤	90	
	WB							▤		
21	SS	3	50/3"			15.7		▤		
	WB							▤		
22	SS	3	50/3"			18.9		▤		
								▤	100	
	WB							▤		
										103.0
										BOTTOM OF BORING

***CME Automatic Hammer

The stratification lines represent the approximate boundary lines between soil and rock types. In-situ the transition may be gradual.

WATER LEVEL OBSERVATIONS	BORING STARTED	**4-8-08**	
∇ **24.1 W.D**	BORING COMPLETED	**4-8-08**	
▼ **A,B**	DRILL RIG **CME 75**	DRILLER **AT**	
Backfilled @ Completion	APPROVED **JS**	JOB NO. **92254**	

KLEINFELDER
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LOG OF BORING NO. B-10

OWNER/CLIENT
Burns & McDonnell Engineering Company

ARCHITECT/ENGINEER

PROJECT NAME
Western Farmers Electric Cooperative

LOCATION **Anadarko Simple Cycle Units 9, 10, and 11**
Anadarko, Oklahoma

SAMPLE NO.	SAMPLE TYPE	RECOVERY	***STANDARD PENETRATION BLOWS/FT.	UNCONFINED STRENGTH PSF	DRY DENSITY PCF	MOISTURE CONTENT, %	UNIFIED SOIL SYMBOL	GRAPHIC LOG	DEPTH, FT.	DESCRIPTION
										Rock classification is based on drilling characteristics and visual observation of disturbed samples. Core samples would be required for exact classification. **ATTERBERG LIMITS Sample 2, Depth 2.5-4 feet LL 38, PL 21, PI 17 **SIEVE ANALYSIS** Sample 6, Depth 18.5-20 feet Percent Fines = 18.4% **SIEVE ANALYSIS** Sample 8, Depth 28.5-30 feet Percent Fines = 13.0% **SIEVE ANALYSIS** Sample 11, Depth 43.5-45 feet Percent Fines = 5.5%

***CME Automatic Hammer

The stratification lines represent the approximate boundary lines between soil and rock types. In-situ the transition may be gradual.

WATER LEVEL OBSERVATIONS		
∇ **24.1 W.D**	BORING STARTED **4-8-08**	
▼ **A,B**	BORING COMPLETED **4-8-08**	
	DRILL RIG **CME 75**	DRILLER **AT**
Backfilled @ Completion	APPROVED **JS**	JOB NO. **92254**

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LOG OF BORING NO. B-11

Page 1 of 2

OWNER/CLIENT **Burns & McDonnell Engineering Company**

ARCHITECT/ENGINEER

PROJECT NAME **Western Farmers Electric Cooperative**

LOCATION **Anadarko Simple Cycle Units 9, 10, and 11**
Anadarko, Oklahoma

SAMPLE NO.	SAMPLE TYPE	RECOVERY	***STANDARD PENETRATION BLOWS/FT.	UNCONFINED STRENGTH PSF	DRY DENSITY PCF	MOISTURE CONTENT, %	UNIFIED SOIL SYMBOL	GRAPHIC LOG	DEPTH, FT.
	PA								
1	ST	24		1948	97.0	20.4	CL		
2	SS	9	12			20.0	CL		
	PA								
3	ST	24		1562	93.1	20.2	ML		
	PA								
4	SS	16	13			12.9	SC		10
	PA								
5	SS	15	10			5.4	SP		
	PA								
6	SS	13	13			32.9	SP		20
	PA								
7	SS	18	10			17.7	ML		
	PA								
8	SS	10	7			20.2	ML		30
	WB								
9	SS	9	14			18.3	ML		

***CME Automatic Hammer

DESCRIPTION

Approximate Surface Elevation: 98.8

0.3	TOPSOIL	98.5
	LEAN CLAY, medium stiff to stiff, reddish brown	
4.8		94.0
	SILT, loose, reddish brown	
9.2		89.6
	CLAYEY SAND, medium dense, tan	
12.8		86.0
	SAND, fine grained to medium grained, medium dense, tan ▼	
22.7	∇	76.1
	SANDY SILT, loose to medium dense, red	

The stratification lines represent the approximate boundary lines between soil and rock types. In-situ the transition may be gradual.

WATER LEVEL OBSERVATIONS

∇ 22.4 W.D.

▼ 18.3 A.C.R.

Backfilled @ Completion

BORING STARTED	3-21-08		
BORING COMPLETED	3-21-08		
DRILL RIG	CME 55	DRILLER	PV
APPROVED	JS	JOB NO.	92254

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AUTO HAMMER 92254-RESTORED 4.3.08.GPJ GEOSYSTM.GDT 5/12/08

LOG OF BORING NO. B-11

Page 2 of 2

OWNER/CLIENT **Burns & McDonnell Engineering Company**	PROJECT NAME **Western Farmers Electric Cooperative**
ARCHITECT/ENGINEER	LOCATION **Anadarko Simple Cycle Units 9, 10, and 11** **Anadarko, Oklahoma**

SAMPLE NO.	SAMPLE TYPE	RECOVERY	***STANDARD PENETRATION BLOWS/FT.	UNCONFINED STRENGTH PSF	DRY DENSITY PCF	MOISTURE CONTENT, %	UNIFIED SOIL SYMBOL	GRAPHIC LOG	DEPTH, FT.	DESCRIPTION
	WB									36.8 — 62.0 SANDY GRAVEL with trace silt, very dense, brown
10	SS	14	13			18.9	GP		40	
	WB									43.8 — 55.0
11	SS	18	56			24.9	CL			LEAN CLAY with trace sand, hard, red with gray
	WB									46.8 — 52.0 **WEATHERED SHALE, moderately hard, red
12	SS	4	50/4"			16.5				48.8 — 50.0

BOTTOM OF BORING

**Rock classification is based on drilling characteristics and visual observation of disturbed samples. Core samples would be required for exact classification.

SIEVE ANALYSIS
Sample 3, Depth 5-7 feet

Percent Fines = 91.6%

SIEVE ANALYSIS
Sample 10, Depth 38.5-40 feet

Percent Fines = 4.5%

***CME Automatic Hammer

The stratification lines represent the approximate boundary lines between soil and rock types. In-situ the transition may be gradual.

WATER LEVEL OBSERVATIONS	BORING STARTED **3-21-08**		KLEINFELDER Bright People. Right Solutions.
▽ **22.4 W.D.**	BORING COMPLETED **3-21-08**		
▼ **18.3 A.C.R.**	DRILL RIG **CME 55**	DRILLER **PV**	
Backfilled @ Completion	APPROVED **JS**	JOB NO. **92254**	

LOG OF BORING NO. B-12

Page 1 of 2

OWNER/CLIENT **Burns & McDonnell Engineering Company**	PROJECT NAME **Western Farmers Electric Cooperative**
ARCHITECT/ENGINEER	LOCATION **Anadarko Simple Cycle Units 9, 10, and 11** **Anadarko, Oklahoma**

SAMPLE NO.	SAMPLE TYPE	RECOVERY	***STANDARD PENETRATION BLOWS/FT.	UNCONFINED STRENGTH PSF	DRY DENSITY PCF	MOISTURE CONTENT, %	UNIFIED SOIL SYMBOL	GRAPHIC LOG	DEPTH, FT.
	PA								
1	SS	9	6			21.4	CL		
	PA								
2	ST	16		5416	107	18.9	CL		
	PA								
3	SS	7	5			9.4	SM		
	PA								
4	SS	11	12			15.3	SM		
	PA								10
5	SS	14	9			2.8	SP		
	PA								
6	SS	12	7			15.3	SP		
	PA								20
7	SS	14	15			17.3	ML		
	PA								
8	SS	18	0			20.6	ML		30
	WB								
9	SS	12	3			24.0	ML		

***CME Automatic Hammer

DESCRIPTION

Depth	Description	Elevation
	Approximate Surface Elevation:	**98.9**
0.2	TOPSOIL	98.7
2.2	LEAN CLAY, stiff, brown	96.7
	LEAN CLAY, stiff, reddish brown	
4.8		94.1
	SILTY SAND, loose, medium dense, tan, yellow, and brown	
9.6		89.3
	SANDY LEAN CLAY, stiff, tan, yellow, and brown	
12.1		86.8
	SAND, fine to medium grained, loose, tan	
	▼	
23.7	▽	75.2
	SANDY SILT, very loose to medium dense, reddish brown	

The stratification lines represent the approximate boundary lines between soil and rock types. In-situ the transition may be gradual.

WATER LEVEL OBSERVATIONS	BORING STARTED **3-21-08**		KLEINFELDER Bright People. Right Solutions.
▽ **23.2 W.D.**	BORING COMPLETED **3-21-08**		
▼ **17.7 B.C.R.**	DRILL RIG **CME 55**	DRILLER **PV**	
Backfilled @ Completion	APPROVED **JS**	JOB NO. **92254**	

LOG OF BORING NO. B-12

OWNER/CLIENT
Burns & McDonnell Engineering Company

ARCHITECT/ENGINEER

PROJECT NAME
Western Farmers Electric Cooperative

LOCATION **Anadarko Simple Cycle Units 9, 10, and 11**
Anadarko, Oklahoma

SAMPLE NO.	SAMPLE TYPE	RECOVERY	***STANDARD PENETRATION BLOWS/FT.	UNCONFINED STRENGTH PSF	DRY DENSITY PCF	MOISTURE CONTENT, %	UNIFIED SOIL SYMBOL	GRAPHIC LOG	DEPTH, FT.	DESCRIPTION
	WB									37.8 — 61.1
										SAND, medium grained, medium dense, brown
10	SS	10	11			17.7	SP		40	
	WB									42.3 — 56.6
										LEAN CLAY with trace sand, hard, red with gray
11	SS	15	63			20.5	CL			
	WB									
~~12~~	~~SS~~	~~3~~	~~50/4"~~			~~23.0~~	~~CL~~			
	WB									50.0 — 48.9

BOTTOM OF BORING

**Rock classification is based on drilling characteristics and visual observation of disturbed samples. Core samples would be required for exact classification.

ATTERBERG LIMITS
Sample 2, Depth 2.5-4 feet

LL	PL	PI
36	20	16

ATTERBERG LIMITS
Sample 11, Depth 43.5-45 feet

LL	PL	PI
31	22	9

Percent Fines = 91.4%

***CME Automatic Hammer

The stratification lines represent the approximate boundary lines between soil and rock types. In-situ the transition may be gradual.

WATER LEVEL OBSERVATIONS	BORING STARTED **3-21-08**	
∇ **23.2 W.D.**	BORING COMPLETED **3-21-08**	
▼ **17.7 B.C.R.**	DRILL RIG **CME 55**	DRILLER **PV**
Backfilled @ Completion	APPROVED **JS**	JOB NO. **92254**

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Bright People. Right Solutions.

LOG OF BORING NO. B-13

OWNER/CLIENT **Burns & McDonnell Engineering Company**

ARCHITECT/ENGINEER

PROJECT NAME **Western Farmers Electric Cooperative**

LOCATION **Anadarko Simple Cycle Units 9, 10, and 11**
Anadarko, Oklahoma

SAMPLE NO.	SAMPLE TYPE	RECOVERY	***STANDARD PENETRATION BLOWS/FT.	UNCONFINED STRENGTH PSF	DRY DENSITY PCF	MOISTURE CONTENT, %	UNIFIED SOIL SYMBOL
	PA						
1	ST	24			98.5	16.2	SM
2	SS	8	4			12.4	SM
	PA						
3	SS	14	10			7.6	SM
	PA						
4	SS	15	10			6.8	SM
	PA						
5	SS	14	11			4.9	SP
	PA						
6	SS	18	5			15.6	SP
	PA						
7	SS	18	11			19.4	ML
	PA						
8	SS	18	4			19.8	SM
	PA						
9	SS	18	4			17.4	ML

***CME Automatic Hammer

DESCRIPTION

DEPTH, FT.		
	Approximate Surface Elevation:	**99.0**
0.2	TOPSOIL	98.8
	SILTY SAND, loose, tan and brown	
4.8	SILTY SAND, medium dense, tan	94.2
11.8	SAND, fine to medium grained, medium dense, tan	87.2
19.4	▼ SAND, medium grained, loose, tan ∇	79.6
22.8	SANDY SILT, medium dense, brown	76.2
27.8	SANDY SILT, loose, reddish brown	71.2
35.0		64.0

Depth scale: 10, 20, 30

The stratification lines represent the approximate boundary lines between soil and rock types. In-situ the transition may be gradual.

WATER LEVEL OBSERVATIONS			
∇ 21.4 W.D.	BORING STARTED 3-22-08		
▼ 19.2 A.B.	BORING COMPLETED 3-22-08		
	DRILL RIG CME 55	DRILLER PV	
Backfilled @ Completion	APPROVED JS	JOB NO. 92254	

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AUTO HAMMER 92254-RESTORED 4.3.08.GPJ GEOSYSTM.GDT 5/12/08

LOG OF BORING NO. B-13

Page 2 of 2

OWNER/CLIENT **Burns & McDonnell Engineering Company**	PROJECT NAME **Western Farmers Electric Cooperative**
ARCHITECT/ENGINEER	LOCATION **Anadarko Simple Cycle Units 9, 10, and 11** **Anadarko, Oklahoma**

SAMPLE NO.	SAMPLE TYPE	RECOVERY	***STANDARD PENETRATION BLOWS/FT.	UNCONFINED STRENGTH PSF	DRY DENSITY PCF	MOISTURE CONTENT, %	UNIFIED SOIL SYMBOL	GRAPHIC LOG	DEPTH, FT.	DESCRIPTION
										BOTTOM OF BORING **SIEVE ANALYSIS** Sample 3, Depth 5.5-7 feet Percent Fines = 30.7% **SIEVE ANALYSIS** Sample 7, Depth 23.5-25 feet Percent Fines = 50.9%

***CME Automatic Hammer

The stratification lines represent the approximate boundary lines between soil and rock types. In-situ the transition may be gradual.

WATER LEVEL OBSERVATIONS	BORING STARTED	**3-22-08**	
∇ **21.4 W.D.**	BORING COMPLETED	**3-22-08**	
▼ **19.2 A.B.**	DRILL RIG **CME 55**	DRILLER **PV**	
Backfilled @ Completion	APPROVED **JS**	JOB NO. **92254**	

KLEINFELDER
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LOG OF BORING NO. B-14

Page 1 of 2

OWNER/CLIENT **Burns & McDonnell Engineering Company**	PROJECT NAME **Western Farmers Electric Cooperative**
ARCHITECT/ENGINEER	LOCATION **Anadarko Simple Cycle Units 9, 10, and 11** **Anadarko, Oklahoma**

SAMPLE NO.	SAMPLE TYPE	RECOVERY	***STANDARD PENETRATION BLOWS/FT.	UNCONFINED STRENGTH PSF	DRY DENSITY PCF	MOISTURE CONTENT, %	UNIFIED SOIL SYMBOL	GRAPHIC LOG	DEPTH, FT.	DESCRIPTION **Approximate Surface Elevation:**	98.9
	PA									0.2 TOPSOIL	98.7
1	SS	4	7			17.8	CL			LEAN CLAY, medium stiff to stiff, brown	
	PA										
2	ST	23		1815	106	14.1	CL				
	PA									5.1 SANDY SILT, loose, reddish brown	93.8
3	SS	11	6			10.1	ML				
	PA									7.6 CLAYEY SAND, loose, red and tan	91.3
4	ST	24		2789	112	15.1	SC		10		
	PA									11.8 SAND, fine to medium grained, loose, tan	87.1
5	SS	12	8			6.5	SP				
	PA									▼	
6	SS	8	11			5.9	SP			19.6	79.3
	PA								20	SAND, medium grained, medium dense, tan ▽	
7	SS	14	11			14.5	SP				
	PA									27.6 SILTY SAND, very loose, reddish brown	71.3
8	SS	6	1			25.5	SM		30		
	PA										
9	SS	13	3			15.3	SM			35.0	63.9

***CME Automatic Hammer

The stratification lines represent the approximate boundary lines between soil and rock types. In-situ the transition may be gradual.

WATER LEVEL OBSERVATIONS			
▽ 21.3 W.D.	BORING STARTED 3-17-08		
▼ 16.8 Caved	BORING COMPLETED 3-17-08		
Backfilled @ Completion	DRILL RIG CME 55	DRILLER PV	
	APPROVED JS	JOB NO. 92254	

KLEINFELDER
Bright People. Right Solutions.

AUTO HAMMER 92254-RESTORED 4.3.08.GPJ GEOSYSTM.GDT 5/12/08

LOG OF BORING NO. B-14

OWNER/CLIENT
Burns & McDonnell Engineering Company

PROJECT NAME
Western Farmers Electric Cooperative

ARCHITECT/ENGINEER

LOCATION
Anadarko Simple Cycle Units 9, 10, and 11
Anadarko, Oklahoma

SAMPLE NO.	SAMPLE TYPE	RECOVERY	***STANDARD PENETRATION BLOWS/FT.	UNCONFINED STRENGTH PSF	DRY DENSITY PCF	MOISTURE CONTENT, %	UNIFIED SOIL SYMBOL	GRAPHIC LOG	DEPTH, FT.	DESCRIPTION
										BOTTOM OF BORING

BOTTOM OF BORING

ATTERBERG LIMITS
Sample 4, Depth 8-10 feet

LL	PL	PI
27	21	6

Percent Fines = 39.2%

SIEVE ANALYSIS
Sample 8, Depth 28.5-30 feet

Percent Fines = 27.5%

***CME Automatic Hammer

The stratification lines represent the approximate boundary lines between soil and rock types. In-situ the transition may be gradual.

WATER LEVEL OBSERVATIONS	BORING STARTED	3-17-08	
∇ 21.3 W.D.	BORING COMPLETED	3-17-08	
▼ 16.8 Caved	DRILL RIG **CME 55**	DRILLER **PV**	KLEINFELDER Bright People. Right Solutions.
Backfilled @ Completion	APPROVED **JS**	JOB NO. **92254**	

LOG OF BORING NO. B-15

Page 1 of 2

OWNER/CLIENT **Burns & McDonnell Engineering Company**	PROJECT NAME **Western Farmers Electric Cooperative**
ARCHITECT/ENGINEER	LOCATION **Anadarko Simple Cycle Units 9, 10, and 11** **Anadarko, Oklahoma**

SAMPLE NO.	SAMPLE TYPE	RECOVERY	***STANDARD PENETRATION BLOWS/FT.	UNCONFINED STRENGTH PSF	DRY DENSITY PCF	MOISTURE CONTENT, %	UNIFIED SOIL SYMBOL
	PA						
1	SS	12	7			14.9	CL ML
	PA						
2	ST	14			105	13.9	ML
	PA						
3	SS	14	7			11.1	ML
	PA						
4	SS	15	11			13.4	SP
	PA						
5	SS	14	11			5.1	SP
	PA						
6	SS	18	3			19.1	ML
	PA						
7	SS	18	15			19.9	ML
	WB						
8	SS	17	12			19.2	SP
	WB						
9	SS	14	15			21.6	SP

***CME Automatic Hammer

DESCRIPTION

Approximate Surface Elevation: **98.6**

DEPTH, FT.	DESCRIPTION	
0.3	TOPSOIL	98.3
2.3	SILTY CLAY, stiff, brown	96.3
	SANDY SILT, loose, brown and tan	
7.8		90.8
	SAND with silt, medium dense, reddish tan	
11.8		86.8
	SAND, fine to medium grained, tan	
17.1	▼	81.5
	SANDY SILT, loose, brown	
22.3		76.3
	SANDY SILT, medium dense, red and tan	
27.8		70.8
	POORLY GRADED SAND with silt, fine grained, medium dense, tan with red ∇	

The stratification lines represent the approximate boundary lines between soil and rock types. In-situ the transition may be gradual.

WATER LEVEL OBSERVATIONS	BORING STARTED **3-22-08**	
∇ **28.4 W.D.**	BORING COMPLETED **3-22-05**	
▼ **16.6 A.C.R.**	DRILL RIG **CME 55** DRILLER **PV**	KLEINFELDER Bright People. Right Solutions.
Backfilled @ Completion	APPROVED **JS** JOB NO. **92254**	

AUTO HAMMER 92254-RESTORED 4.3.08.GPJ GEOSYSTM.GDT 5/12/08

LOG OF BORING NO. B-15

OWNER/CLIENT **Burns & McDonnell Engineering Company**

PROJECT NAME **Western Farmers Electric Cooperative**

ARCHITECT/ENGINEER

LOCATION **Anadarko Simple Cycle Units 9, 10, and 11**
Anadarko, Oklahoma

SAMPLE NO.	SAMPLE TYPE	RECOVERY	***STANDARD PENETRATION BLOWS/FT.	UNCONFINED STRENGTH PSF	DRY DENSITY PCF	MOISTURE CONTENT, %	UNIFIED SOIL SYMBOL	GRAPHIC LOG	DEPTH, FT.	DESCRIPTION
	WB									
10	SS	13	23			21.3	SP		40	
										41.2 57.4 SANDY GRAVEL, very dense, tan
	WB									
										44.2 54.4 LEAN CLAY with trace sand, hard, red with gray
11	SS	16	46			15.8	GP			
	WB									
12	SS	16	45			19.4	CL			
									50	50.0 48.6 BOTTOM OF BORING

**Rock classification is based on drilling characteristics and visual observation of disturbed samples. Core samples would be required for exact classification.

SIEVE ANALYSIS
Sample 2, Depth 2.5-4.5 feet

Percent Fines = 61.0%

SIEVE ANALYSIS
Sample 9, Depth 33.5-35 feet

Percent Fines = 11.0%

ATTERBERG LIMITS
Sample 12, Depth 48.5-50 feet

LL	PL	PI
28	22	6

Percent Fines = 95.9%

***CME Automatic Hammer

The stratification lines represent the approximate boundary lines between soil and rock types. In-situ the transition may be gradual.

WATER LEVEL OBSERVATIONS
▽ 28.4 W.D.
▼ 16.6 A.C.R.
Backfilled @ Completion

BORING STARTED 3-22-08
BORING COMPLETED 3-22-05
DRILL RIG CME 55
DRILLER PV
APPROVED JS
JOB NO. 92254

KLEINFELDER
Bright People. Right Solutions.

LOG OF BORING NO. B-16

OWNER/CLIENT
Burns & McDonnell Engineering Company

ARCHITECT/ENGINEER

PROJECT NAME
Western Farmers Electric Cooperative

LOCATION **Anadarko Simple Cycle Units 9, 10, and 11**
Anadarko, Oklahoma

SAMPLE NO.	SAMPLE TYPE	RECOVERY	***STANDARD PENETRATION BLOWS/FT.	UNCONFINED STRENGTH PSF	DRY DENSITY PCF	MOISTURE CONTENT, %	UNIFIED SOIL SYMBOL
	PA						
1	ST	23		716	97.5	18.7	SM
2	SS	8	4			11.9	SM
	PA						
3	SS	16	6			8.6	ML
	PA						
4	SS	14	12			13.0	SP
	PA						
5	SS	15	9			3.6	SP
	PA						
6	SS	18	7			34.6	CL
	PA						
7	SS	18	20			16.9	ML
	PA						
8	SS	17	12			20.0	SM
	WB						
9	SS	13	11			19.4	SM

***CME Automatic Hammer

DEPTH, FT.: 10, 20, 30

DESCRIPTION

Approximate Surface Elevation: 98.4

DEPTH	DESCRIPTION	ELEVATION
0.2	TOPSOIL	98.2
	SILTY SAND, loose, brown	
4.8	SANDY SILT, loose, orange and tan	93.6
7.7	SAND with silt, medium dense, tan	90.7
11.8	SAND, fine to medium grained, loose, tan and yellow ▼	86.6
17.1	LEAN CLAY with sand, stiff, red	81.3
21.8	SILT with sand, medium dense, brown and gray ∇	76.6
26.7	SANDY SILT, medium dense to dense, red	71.7

The stratification lines represent the approximate boundary lines between soil and rock types. In-situ the transition may be gradual.

WATER LEVEL OBSERVATIONS

∇ **22.3 W.D.**
▼ **12.8 A.C.R.**
Backfilled @ Completion

BORING STARTED	3-22-08		
BORING COMPLETED	3-22-08		
DRILL RIG	CME 55	DRILLER	PV
APPROVED	JS	JOB NO.	92254

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LOG OF BORING NO. B-16

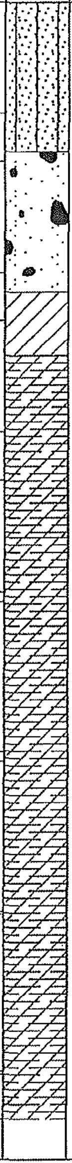
Page 2 of 4

OWNER/CLIENT **Burns & McDonnell Engineering Company**	PROJECT NAME **Western Farmers Electric Cooperative**
ARCHITECT/ENGINEER	LOCATION **Anadarko Simple Cycle Units 9, 10, and 11** **Anadarko, Oklahoma**

SAMPLE NO.	SAMPLE TYPE	RECOVERY	***STANDARD PENETRATION BLOWS/FT.	UNCONFINED STRENGTH PSF	DRY DENSITY PCF	MOISTURE CONTENT, %	UNIFIED SOIL SYMBOL
	WB						
10	SS	10	40			15.9	SM
	WB						
11	SS	18	33			20.2	GP
	WB						
12	SS	18	78			21.8	
	WB						
~~13~~	~~SS~~	~~4~~	~~50/4"~~			~~15.3~~	
	WB						
~~14~~	~~SS~~	~~3~~	~~50/3.5"~~			~~19.2~~	
	WB						
~~15~~	~~SS~~	~~1~~	~~50/2"~~			~~16.3~~	
	WB						
~~16~~	~~SS~~	~~2~~	~~50/2"~~			~~16.6~~	

***CME Automatic Hammer

GRAPHIC LOG



DEPTH, FT.: 40, 50, 60

DESCRIPTION

39.7	SANDY GRAVEL, very dense, tan with red	58.7
44.1	LEAN CLAY with sand, very dense, red with black and gray	54.3
46.1	**WEATHERED SHALE with sand, soft, red with gray	52.3
51.8	**WEATHERED SHALE with sand and gypsum seams, moderately hard to hard, red with white	46.6

The stratification lines represent the approximate boundary lines between soil and rock types. In-situ the transition may be gradual.

WATER LEVEL OBSERVATIONS	BORING STARTED	3-22-08		
∇ 22.3 W.D.	BORING COMPLETED	3-22-08		
▼ 12.8 A.C.R.	DRILL RIG	CME 55	DRILLER	PV
Backfilled @ Completion	APPROVED	JS	JOB NO.	92254

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LOG OF BORING NO. B-16

Page 3 of 4

OWNER/CLIENT
Burns & McDonnell Engineering Company

PROJECT NAME
Western Farmers Electric Cooperative

ARCHITECT/ENGINEER

LOCATION
Anadarko Simple Cycle Units 9, 10, and 11
Anadarko, Oklahoma

SAMPLE NO.	SAMPLE TYPE	RECOVERY	***STANDARD PENETRATION BLOWS/FT.	UNCONFINED STRENGTH PSF	DRY DENSITY PCF	MOISTURE CONTENT, %	UNIFIED SOIL SYMBOL	GRAPHIC LOG	DEPTH, FT.	DESCRIPTION
	WB									
17	SS	3	50/3"			17.8				
	WB									
18	SS	2	50/3"			13.4				
									80	
	WB									
19	SS	1	50/0.50"			13.1				
										84.4 14.0
										**SHALE, soft, red
	WB									
20	SS	5	50/5"			12.2				
									90	
	WB									
21	SS	4	50/4"			16.1				
	WB									
22	SS	4	50/5"			13.7				98.9 -0.5

BOTTOM OF BORING

**Rock classification is based on drilling characteristics and visual observation of disturbed samples. Core samples would be required for exact classification.

***CME Automatic Hammer

The stratification lines represent the approximate boundary lines between soil and rock types. In-situ the transition may be gradual.

WATER LEVEL OBSERVATIONS

∇	**22.3 W.D.**
▼	**12.8 A.C.R.**
	Backfilled @ Completion

BORING STARTED	**3-22-08**		
BORING COMPLETED	**3-22-08**		
DRILL RIG	**CME 55**	DRILLER	**PV**
APPROVED	**JS**	JOB NO.	**92254**

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LOG OF BORING NO. B-16

Page 4 of 4

OWNER/CLIENT
Burns & McDonnell Engineering Company

PROJECT NAME
Western Farmers Electric Cooperative

ARCHITECT/ENGINEER

LOCATION
Anadarko Simple Cycle Units 9, 10, and 11
Anadarko, Oklahoma

SAMPLE NO.	SAMPLE TYPE	RECOVERY	***STANDARD PENETRATION BLOWS/FT.	UNCONFINED STRENGTH PSF	DRY DENSITY PCF	MOISTURE CONTENT, %	UNIFIED SOIL SYMBOL	GRAPHIC LOG	DEPTH, FT.	DESCRIPTION

ATTERBERG LIMITS
Sample 6, Depth 18.5-20 feet

LL	PL	PI
33	21	12

Percent Fines = 75.2%

ATTERBERG LIMITS
Sample 11, Depth 43.5-45 feet

LL	PL	PI
18	16	2

***CME Automatic Hammer

The stratification lines represent the approximate boundary lines between soil and rock types. In-situ the transition may be gradual.

WATER LEVEL OBSERVATIONS
∇ **22.3 W.D.**
▼ **12.8 A.C.R.**
Backfilled @ Completion

BORING STARTED **3-22-08**
BORING COMPLETED **3-22-08**
DRILL RIG **CME 55**
DRILLER **PV**
APPROVED **JS**
JOB NO. **92254**

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LOG OF BORING NO. B-17

Page 1 of 2

OWNER/CLIENT
Burns & McDonnell Engineering Company

PROJECT NAME
Western Farmers Electric Cooperative

ARCHITECT/ENGINEER

LOCATION **Anadarko Simple Cycle Units 9, 10, and 11**
Anadarko, Oklahoma

SAMPLE NO.	SAMPLE TYPE	RECOVERY	***STANDARD PENETRATION BLOWS/FT.	UNCONFINED STRENGTH PSF	DRY DENSITY PCF	MOISTURE CONTENT, %	UNIFIED SOIL SYMBOL	GRAPHIC LOG	DEPTH, FT.	DESCRIPTION Approximate Surface Elevation: 99.9
	PA									0.3 TOPSOIL 99.6
1	ST	24		973	92.2	20.6	CL	▨		LEAN CLAY, soft to very stiff, brown with red
2	SS	9	10			23.3	CL	▨		
	PA							▨		
3	ST	20		6015	107	21.3	CL	▨		
	PA							▨		7.9 92.0 LEAN CLAY, very stiff, reddish brown
4	SS	18	21			24.0	CL	▨	10	
	PA							▨		12.8 87.1 LEAN CLAY with sand, stiff, brown with red
5	SS	15	13			16.6	CL	▨		
	PA							▨		17.2 82.7 CLAYEY SAND, very loose, brown
6	SS	15	2			17.9	SC	▩	20	
	PA							▩		21.9 ▼ 78.0 CLAYEY SAND, loose, reddish brown
7	SS	17	5			19.0	SC	▩		
	PA							▩		27.7 72.2 CLAYEY SAND, very loose, tan and red
8	SS	18	2			15.1	SC	▩	30	
	PA							▩		
9	SS	17	2			18.3	SC	▩		35.0 64.9

***CME Automatic Hammer

The stratification lines represent the approximate boundary lines between soil and rock types. In-situ the transition may be gradual.

WATER LEVEL OBSERVATIONS
▽ 21.9 W.D.
▼ 21.7 A.B.
Backfilled @ Completion

BORING STARTED 3-17-08
BORING COMPLETED 3-17-08
DRILL RIG CME 55 DRILLER PV
APPROVED JS JOB NO. 92254

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AUTO HAMMER 92254-RESTORED 4.3.08.GPJ GEOSYSTM.GDT 5/12/08

LOG OF BORING NO. B-17

Page 2 of 2

OWNER/CLIENT **Burns & McDonnell Engineering Company**	PROJECT NAME **Western Farmers Electric Cooperative**
ARCHITECT/ENGINEER	LOCATION **Anadarko Simple Cycle Units 9, 10, and 11** **Anadarko, Oklahoma**

SAMPLE NO.	SAMPLE TYPE	RECOVERY	***STANDARD PENETRATION BLOWS/FT.	UNCONFINED STRENGTH PSF	DRY DENSITY PCF	MOISTURE CONTENT, %	UNIFIED SOIL SYMBOL	GRAPHIC LOG	DEPTH, FT.	DESCRIPTION
										BOTTOM OF BORING

ATTERBERG LIMITS

Sample 2, Depth 2.5-4 feet

LL	PL	PI
38	18	20

ATTERBERG LIMITS

Sample 7, Depth 23.5-25 feet

LL	PL	PI
23	15	8

Percent Fines = 44.3%

***CME Automatic Hammer

The stratification lines represent the approximate boundary lines between soil and rock types. In-situ the transition may be gradual.

WATER LEVEL OBSERVATIONS	BORING STARTED **3-17-08**		KLEINFELDER Bright People. Right Solutions.
▽ **21.9 W.D.**	BORING COMPLETED **3-17-08**		
▼ **21.7 A.B.**	DRILL RIG **CME 55**	DRILLER **PV**	
Backfilled @ Completion	APPROVED **JS**	JOB NO. **92254**	

AUTO HAMMER 92254-RESTORED 4.3.08.GPJ GEOSYSTM.GDT 5/12/08

LOG OF BORING NO. B-18

Page 1 of 2

OWNER/CLIENT **Burns & McDonnell Engineering Company**	PROJECT NAME **Western Farmers Electric Cooperative**
ARCHITECT/ENGINEER	LOCATION **Anadarko Simple Cycle Units 9, 10, and 11** **Anadarko, Oklahoma**

SAMPLE NO.	SAMPLE TYPE	RECOVERY	***STANDARD PENETRATION BLOWS/FT.	UNCONFINED STRENGTH PSF	DRY DENSITY PCF	MOISTURE CONTENT, %	UNIFIED SOIL SYMBOL	GRAPHIC LOG	DEPTH, FT.
	PA								
1	SS	8	4			19.5	CL ML		
	PA								
2	ST	24		3897	104	20.9	CL CH		
	PA								
3	SS		14			17.2	CL CH		
	PA								
4	ST	24		4993	111	16.2	CL CH		10
	PA								
5	SS	13	7			11.6	SP		
	PA								
6	SS	9	9			15.3	ML		20
	PA								
7	SS	10	11			17.3	ML		
	PA								
8	SS	18	8			15.3	ML		30

***CME Automatic Hammer

DESCRIPTION

Approximate Surface Elevation: 99.1

0.3	TOPSOIL	98.8
1.2	SILT, loose, brown	97.9
3.0	SILTY CLAY, soft, reddish brown	96.1
	LEAN TO FAT CLAY, stiff, reddish brown	
11.4	SAND, fine to medium grained, loose, tan and yellow	87.7
17.8	SANDY SILT, loose to medium dense, reddish tan ▼ ▽	81.3
30.0	BOTTOM OF BORING	69.1

The stratification lines represent the approximate boundary lines between soil and rock types. In-situ the transition may be gradual.

WATER LEVEL OBSERVATIONS	BORING STARTED	3-17-08		
▽ 22.6 W.D.	BORING COMPLETED	3-17-08		
▼ 21.2 A.B.	DRILL RIG	CME 55	DRILLER	PV
Backfilled @ Completion	APPROVED	JS	JOB NO.	92254

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AUTO HAMMER 92254-RESTORED 4.3.08.GPJ GEOSYSTM.GDT 5/12/08

LOG OF BORING NO. B-18

Page 2 of 2

OWNER/CLIENT
Burns & McDonnell Engineering Company

PROJECT NAME
Western Farmers Electric Cooperative

ARCHITECT/ENGINEER

LOCATION **Anadarko Simple Cycle Units 9, 10, and 11**
Anadarko, Oklahoma

SAMPLE NO.	SAMPLE TYPE	RECOVERY	***STANDARD PENETRATION BLOWS/FT.	UNCONFINED STRENGTH PSF	DRY DENSITY PCF	MOISTURE CONTENT, %	UNIFIED SOIL SYMBOL	GRAPHIC LOG	DEPTH, FT.	DESCRIPTION
										ATTERBERG LIMITS Sample 2, Depth 2.5-4.5 feet LL 45 PL 21 PI 24 **SIEVE ANALYSIS** Sample 6, Depth 18.5-20 feet Percent Fines = 70.0%

***CME Automatic Hammer

The stratification lines represent the approximate boundary lines between soil and rock types. In-situ the transition may be gradual.

WATER LEVEL OBSERVATIONS			
∇ 22.6 W.D.	BORING STARTED	3-17-08	
▼ 21.2 A.B.	BORING COMPLETED	3-17-08	
	DRILL RIG CME 55	DRILLER PV	
Backfilled @ Completion	APPROVED JS	JOB NO. 92254	

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BORING LOG SYMBOLS

SURFACE MATERIALS

- ▒ Topsoil
- ▩ Fill Material
- ■ Asphaltic Concrete
- ▒ Concrete
- ▨ Granular Base
- ▩ Rubble Fill
- ▨ Wood Fill
- ≋ Water

WEATHERED BEDROCK

- ■ Joint or Void
- ▦ Weathered Shale
- ▧ Weathered Sandstone
- ▦ Weathered Limestone
- ▩ Weathered Dolomite

FINE-GRAINED SOILS

- ▨ Fat Clay
- ▧ Lean Fat Clay
- ▨ Lean Clay
- ▥ Clayey Silt
- ▥ Silt
- ▥ Elastic Silt
- ▨ Sandy Fat Clay
- ▧ Sandy Lean to Fat Clay
- ▨ Sandy Lean Clay
- ▥ Low Plasticity Organic
- ▦ High Plasticity Organic
- □ Peat

BEDROCK UNITS

- ▤ Shale
- ▤ Fissile Shale
- ▤ Sandstone
- ▤ Chalk
- ▦ Limestone
- ▦ Dolomite
- ▦ Siltstone
- ▤ Claystone
- ■ Coal
- ▩ Gypsum
- ▤ Interbedded Limestone & Shale
- ▤ Interbedded Sandstone and Shale
- ▒ Cherty Bedrock

COARSE-GRAINED SOILS

- ▒ Cobbles and Boulders
- ▒ Well Graded Gravel
- ▒ Poorly Graded Gravel
- ▥ Silty Gravel
- ▨ Clayey Gravel
- ▒ Gravelly Sand
- ▒ Well Graded Sand
- ▒ Poorly Graded Sand
- □ Silty Sand
- ▥ Interbedded Sand and Silt
- ▒ Sandy Silt
- ▨ Clayey Sand

WELL SYMBOLS

- ▤ Solid Pipe with Bentonite
- ▥ Screen with Sand

General Notes

DRILLING NOTES

WATER LEVEL MEASUREMENTS

Water levels indicated on the boring logs are levels measured in the borings at the times indicated. In permeable materials, the indicated levels may reflect the location of groundwater. In low permeability soils, the accurate determination of groundwater levels is not possible with only short-term observations.

WATER LEVEL OBSERVATION DESIGNATION

W.D.	While Drilling
A.B.	After Boring
B.C.R.	Before Casing Removal
A.C.R.	After Casing Removal
24 hr.	Water level taken approximately 24 hrs. after boring completion

DRILLING AND SAMPLING SYMBOLS

AS	Auger Sample
CS	Continuous Sampler
DB	Diamond Bit -NX unless otherwise noted
HA	Hand Auger
HS	Hollow Stem Auger
PA	Power Auger
RB	Rock Bit
SS*	Split-Barrel
ST	Shelby Tube - 2" (51mm) unless otherwise noted
WB	Wash Bore

*The Standard Penetration Test is conducted in conjunction with the split-barrel sampling procedure. The "N" value corresponds to the number of blows required to drive the last 1 foot (0.3m) of an 18 in. (0.46m) long, 2 in. (51mm) O.D. split-barrel sampler with a 140 lb. (63.5 kg) hammer falling a distance of 30 in. (0.76m). The Standard Penetration Test is carried out according to ASTM D-1586. (See "N" Value below.)

SOIL PROPERTIES & DESCRIPTIONS

TEXTURE

PARTICLE	SIZE	
Clay	< 0.002 mm	(< 0.002 mm)
Silt	< #200 Sieve	(0.075 mm)
Sand	#4 to #200 Sieve	(4.75 to 0.075 mm)
Gravel	3 in. to #4 Sieve	(75 mm to 4.75 mm)
Cobbles	12 in. to 3 in.	(300 mm to 75 mm)
Boulders	> 12 in.	(300 mm)

COMPOSITION

SAND & GRAVEL

Description	% by Dry Weight
trace	< 15
with	15 - 29
modifer	> 30

FINES

Description	% by Dry Weight
trace	< 5
with	5 - 12
modifier	> 12

Soil descriptions are based on the Unified Soil Classification System (USCS) as outlined in ASTM Designations D-2487 and D-2488. The USCS group symbol shown on the boring logs correspond to the group names listed below. The description includes soil constituents, consistency, relative density, color and other appropriate descriptive terms. Geologic description of bedrock, when encountered, also is shown in the description column.

GROUP SYMBOL	GROUP NAME	GROUP SYMBOL	GROUP NAME
GW	Well Graded Gravel	CL	Lean Clay
GP	Poorly Graded Gravel	ML	Silt
GM	Silty Gravel	OL	Organic Clay or Silt
GC	Clayey Gravel	CH	Fat Clay
SW	Well Graded Sand	MH	Elastic Silt
SP	Poorly Graded Sand	OH	Organic Clay or Silt
SM	Silty Sand	PT	Peat
SC	Clayey Sand	CL-CH	Lean to Fat Clay

COHESIVE SOILS

CONSISTENCY	UNCONFINED COMPRESSIVE STRENGTH (Qu) (psf)	(kPa)
Very Soft	< 500	(< 24)
Soft	500 - 1000	(24 - 48)
Medium	1001 - 2000	(48 - 96)
Stiff	2001 - 4000	(96 - 192)
Very Stiff	4001 - 8000	(192 - 383)
Hard	> 8001	(> 383)

PLASTICITY

Description	Liquid Limit (%)
Lean	< 45%
Lean to Fat	45 to 49%
Fat	≥ 50%

COHESIONLESS SOILS

RELATIVE DENSITY	"N" VALUE*
Very Loose	0 - 3
Loose	4 - 9
Medium Dense	10 - 29
Dense	30 - 49
Very Dense	≥ 50

BEDROCK PROPERTIES & DESCRIPTIONS

ROCK QUALITY DESIGNATION (RQD**)

DESCRIPTION OF ROCK QUALITY	RQD (%)
Very Poor	0 - 25
Poor	25 - 50
Fair	50 - 75
Good	75 - 90
Excellent	90 - 100

**RQD is defined as the total length of sound core pieces, 4 inches (102mm) or greater in length, expressed as a percentage of the total length cored. RQD provides an indication of the integrity of the rock mass and relative extent of seams and bedding planes.

DEGREE OF WEATHERING

Slightly Weathered	Slight decomposition of parent material in joints and seams.
Weathered	Well-developed and decomposed joints and seams.
Highly Weathered	Rock highly decomposed, may be extremely broken.

SOLUTION AND VOID CONDITIONS

Solid	Contains no voids.
Vuggy	Containing small pits or cavities < 1/2" (13mm).
Porous	Containing numerous voids which may be interconnected.
Cavernous	Containing cavities, sometimes quite large.

When classification of rock materials has been estimated from disturbed samples, core samples and petrographic analysis may reveal other rock types.

HARDNESS & DEGREE OF CEMENTATION

LIMESTONE	
Hard	Difficult to scratch with knife.
Moderately Hard	Can scratch with knife but not with fingernail.
Soft	Can be scratched with fingernail.
SHALE	
Hard	Can scratch with knife but not with fingernail.
Moderately Hard	Can be scratched with fingernail.
Soft	Can be molded easily with fingers.
SANDSTONE	
Well Cemented	Capable of scratching a knife blade.
Cemented	Can be scratched with knife.
Poorly Cemented	Can be broken apart easily with fingers.

BEDDING CHARACTERISTICS

TERM	THICKNESS (inches)	THICKNESS (mm)
Very Thick Bedded	> 36	> 915
Thick Bedded	12 - 36	305 - 915
Medium Bedded	4 - 12	102 - 305
Thin Bedded	1 - 4	25 - 102
Very Thin Bedded	0.4 - 1	10 - 25
Laminated	0.1 - 0.4	2.5 - 10
Thinly Laminated	< 0.1	< 2.5

Bedding Planes	Planes dividing the individual layers, beds or strata of rocks.
Joint	Fracture in rock, generally more or less vertical or transverse to the bedding.
Seam	Applies to bedding plane with an unspecified degree of weathering.

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APPENDIX B

LABORATORY TESTING PROGRAM

APPENDIX B
LABORATORY TESTING PROGRAM

GENERAL

Laboratory tests were performed on select, representative samples to evaluate pertinent engineering properties of these materials. We directed our laboratory testing program primarily toward classifying the subsurface materials and measuring index values, as well as strength characteristics of the on-site materials. Laboratory tests were performed in general accordance with applicable standards. The results of the laboratory tests are presented on the boring logs. The laboratory testing program consisted of the following:

- **Moisture content tests**, ASTM D 2216, Standard Test Method for Laboratory Determination of Water
- **Atterberg limits**, ASTM D 4318, Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
- **Visual classification**, ASTM D 2488, Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)
- **Unconfined compression tests on soil**, ASTM D 2166, Standard Test Method for Unconfined Compressive Strength of Cohesive Soil
- **Chemical testing,** pH, electrical resistivity, sulfate content, sulfide content, and chloride content
- **Consolidation testing**, ASTM D 4546, Standard Test Methods for One–Dimensional Swell or Settlement Potential of Cohesive Soils

ATTERBERG LIMITS

Atterberg limits tests were conducted on samples representative of the materials encountered in the borings. The tests provide information on the plasticity of the soil, which is a basis for soil classification and for estimating the potential of the subgrade soils to change volume with variations in moisture content.

CLASSIFICATION

All samples were examined in our laboratory or field by a geotechnical engineer using visual and manual procedures. The samples were classified in accordance with the General Notes included in APPENDIX B. Estimated group symbols, in general accordance with the Unified Soil Classification System, are shown on the boring logs.

Bedrock units encountered in the borings were described in accordance with the enclosed General Notes for Bedrock in APPENDIX A based on visual classification of disturbed auger cuttings, recovered core samples, as well as drilling characteristics. Core samples and Petrographic analysis of the bedrock samples may indicate other rock types.

UNCONFINED COMPRESSION ON SOIL

Unconfined compression, moisture content, and dry density determination tests were performed on representative portions of the Shelby tube samples. A calibrated hand penetrometer was used to determine the approximate unconfined compressive strength when samples were deformed or of insufficient size for performing an unconfined compression test.

CHEMICAL TESTING

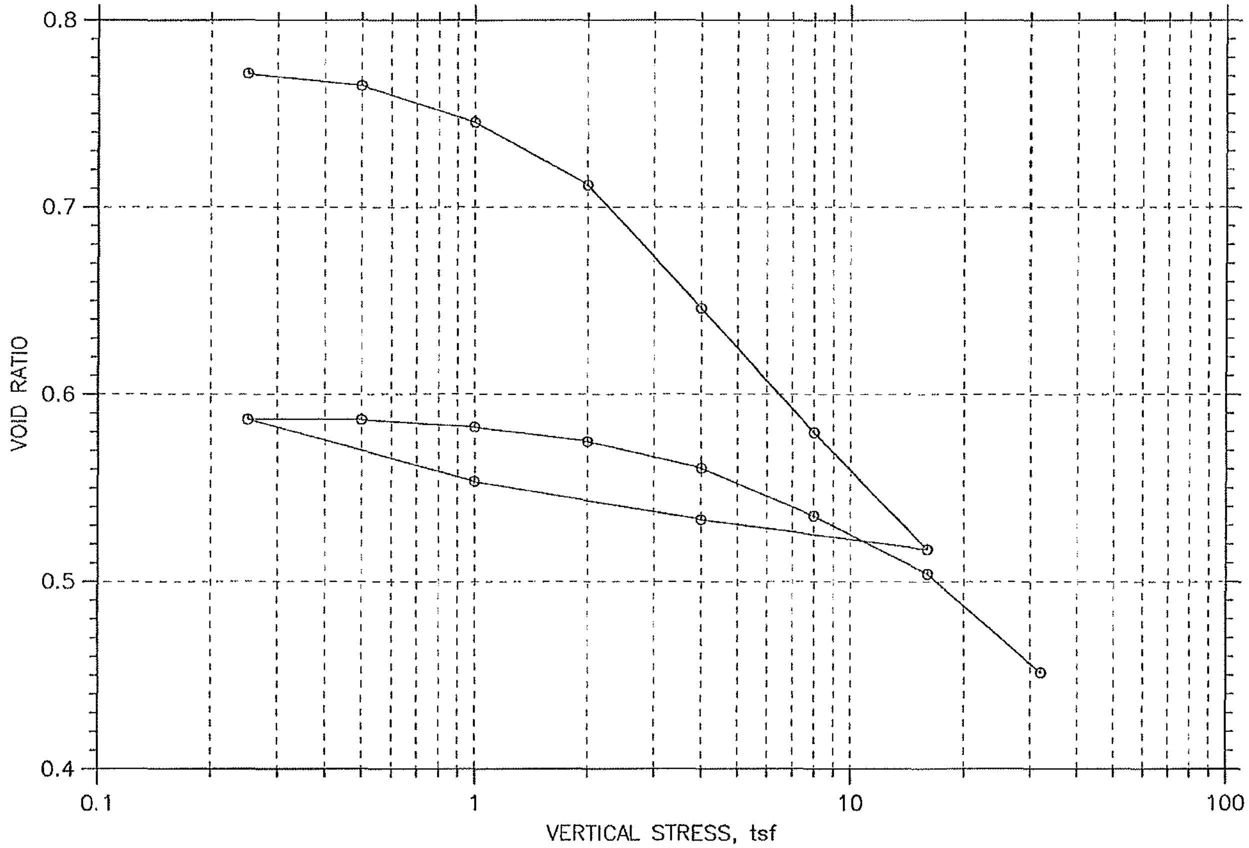
Three representative samples of the soil types encountered across the proposed site were submitted to an outside agency, Accurate Laboratories, in order to conduct corrosivity testing. In addition, testing for pH, electrical resistivity, sulfate content, sulfide content, and chloride content were also completed. The results of these tests are presented in this APPENDIX.

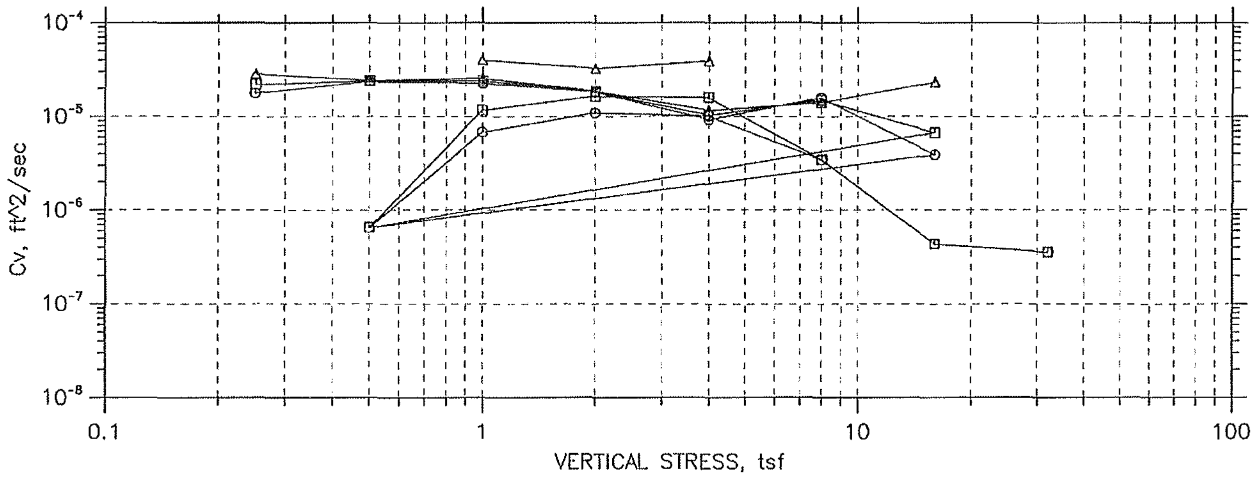
CONSOLIDATION TESTS

One-dimensional consolidation tests were performed on representative samples of the site soils. The consolidation test measures the compressibility characteristics of a soil under incremental increases in load, and is used to develop parameters for computing the amount and rate of settlement. Test results were not available at the time of this report, but will be provided in an addendum.

CONSOLIDATION TEST DATA

SUMMARY REPORT

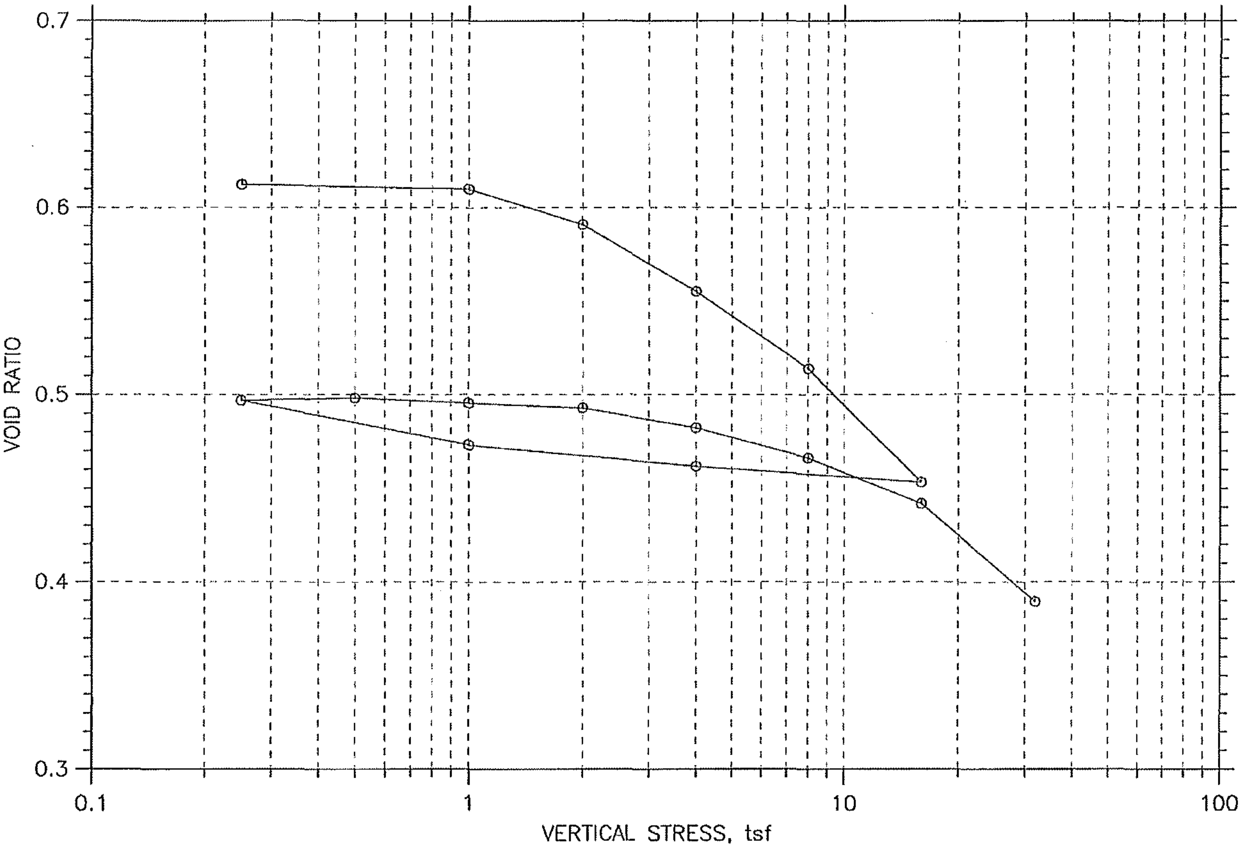


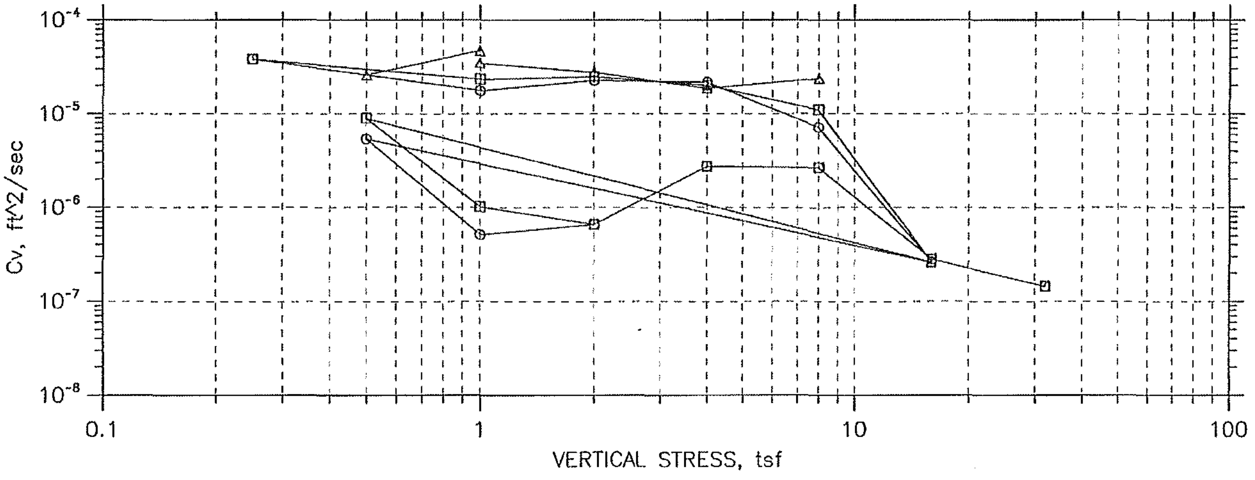


KLEINFELDER Bright People. Right Solutions.	Project: WFEC Simple Cycle Units	Location: Anadarko, Oklahoma	Project No.: 92254
	Boring No.: B-11	Tested By: SS	Checked By: BM
	Sample No.: ST-3	Test Date: 4/10/2008	Depth: 5.0 - 7.0
	Test No.: 1	Sample Type: Shelby Tube	Elevation:
	Description:		
	Remarks:		

CONSOLIDATION TEST DATA

SUMMARY REPORT



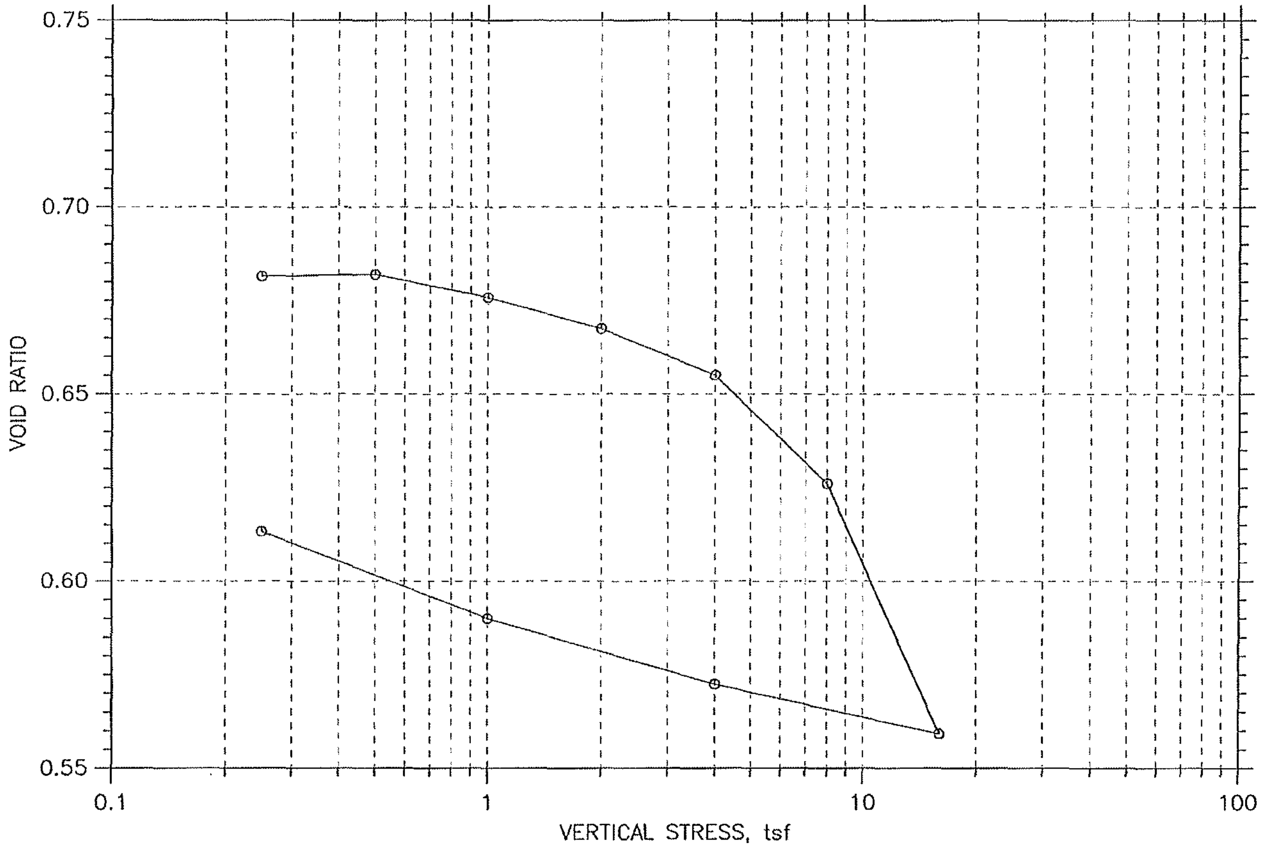


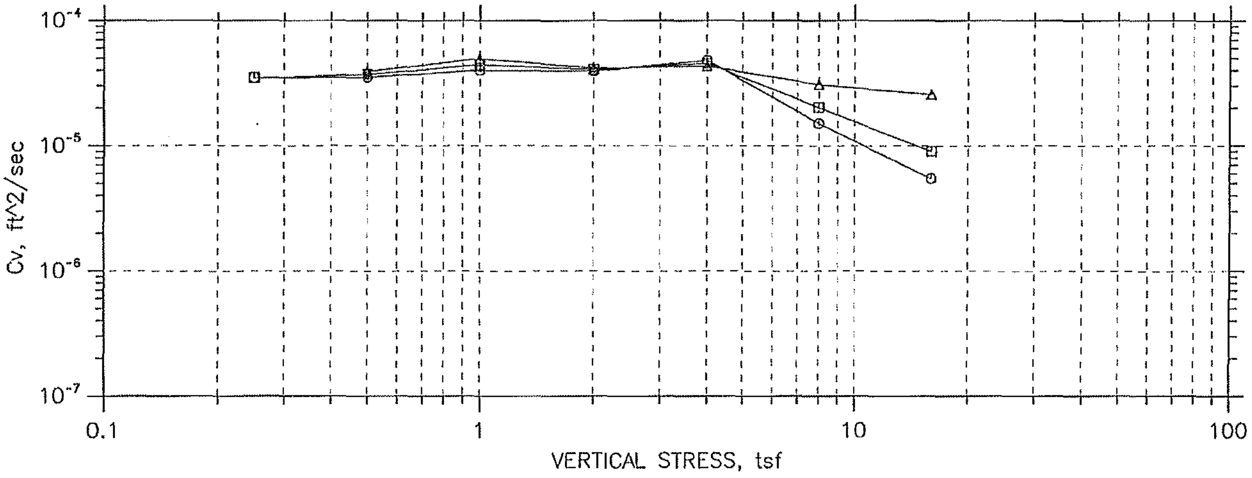
KLEINFELDER Bright People. Right Solutions.	Project: WFEC Simple Cycle Units	Location: Anadarko, Oklahoma	Project No.: 92254
	Boring No.: B-4	Tested By: SS	Checked By: BM
	Sample No.: ST-2	Test Date: 4/15/2008	Depth: 2.5 - 4.5
	Test No.: 1	Sample Type: Shelby Tube	Elevation:
	Description:		
	Remarks:		

Fri, 18-APR-2008 11:27:25

CONSOLIDATION TEST DATA

SUMMARY REPORT





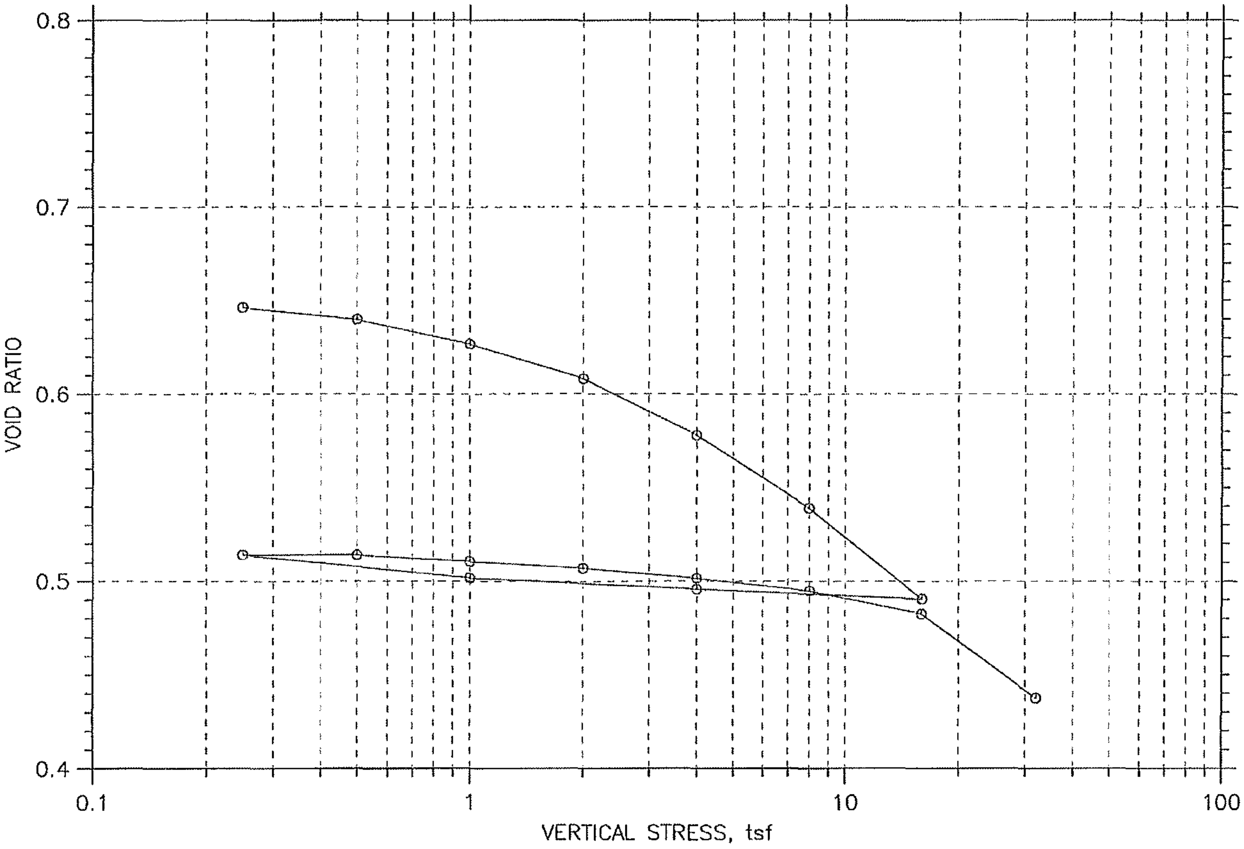
KLEINFELDER
Bright People. Right Solutions.

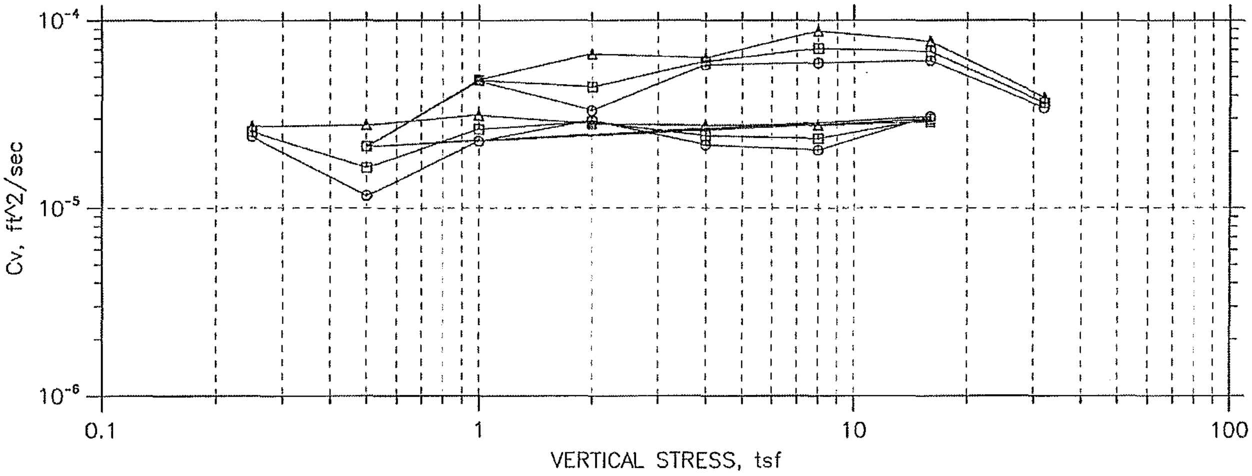
Project: WFEC Simple Cycle Units	Location: Anadarko, Oklahoma	Project No.: 92254
Boring No.: B-5	Tested By: SS	Checked By: BM
Sample No.: ST-4	Test Date: 4/8/2008	Depth: 8 - 10 ft
Test No.: 1	Sample Type: Shelby Tube	Elevation:
Description:		
Remarks:		

Fri, 18-APR-2008 11:16:07

CONSOLIDATION TEST DATA

SUMMARY REPORT





Project: WFEC Simple Cycle Units	Location: Anadarko, Oklahoma	Project No.: 92254
Boring No.: B-6	Tested By: SS	Checked By: BM
Sample No.: ST-3	Test Date: 4/11/2008	Depth: 5.0 - 7.0
Test No.: 1	Sample Type: Shelby Tube	Elevation:
Description:		
Remarks:		

KLEINFELDER Bright People. Right Solutions.

Fri, 18-APR-2008 11:36:36

Accurate
Environmental Labs

April 24, 2008
Client: Kleinfelder
10835 E. Independence , Ste 102
Tulsa, OK 74116
Requested By: Jessica Spriet

National Environmental Laboratory Accreditation Program
LELAP CERT # 03039

Sample Project Name: 92254

Date Samples Received: April 17, 2008 Time: 13:35 sample temp upon arrival at lab = 22°C

Matrix: Solid

Lab Log Numbers: **8D17035-01** **8D17035-02** **8D17035-03** **8D17035-04** **8D17035-05**

Work Order: 8D17035

Report # 8D17035-0424081334

EPA Lab ID#'s Stillwater OK00092 Tulsa OK00983 OKC OK00129 ICR OK 001

Oklahoma Certification: Stillwater WasteWater, DEQ 8316/ Drinking Water, DEQ D9602
Tulsa WasteWater, DEQ 9905 / Drinking Water, DEQ D9901
Oklahoma City WasteWater DEQ 7202

Kansas Certification: Stillwater NELAP CERT # E-10219

Louisiana Certification: LELAP # 03039

Method Reference: 40 CFR 136,261 Method for Chemical Analysis of Water and Waste EPA-600/4-79-020, march, 1983. Test Methods for Evaluating Solid Wastes, SW-846, Final Update III, 1998 Standard Methods (20th Edition) for the Examination of Water and Wastewater.

Analysis Reference: If qualifiers present in "Prep Info" or "Analysis Info", then analysis performed as follows as follows: @= Tulsa Lab and * = OKC Lab. If no qualifiers present, then analysis performed at Stillwater Lab.

Accurate Environmental Laboratories certify that the test results performed at the Stillwater lab meet all requirements of NELAC. Any exceptions to this can be found in the report footer or Quality Control Section of the report.

Sample: *B-7, B-8 (235-350)* **Location Code:** **PWSID#:**

Collection Type: Composite Start Date: 3/19/08 0:00 End Date: 3/19/08 0:00 **Lab Log#** 8D17035-01

Method/Parameter	Test	Result			PQL#	Prep Info	Analysis Info
Chloride EPA 300.0	Chloride	62.9	mg/kg dry	-02	50.0	04/18/08 12:00 BM	04/18/08 18:42 BM
pH SM4500H+B	pH	7.88	pH Units	#03	0.01	04/22/08 10:15 @SD	04/22/08 10:15 @SD
Oxidation Reduction Potential	Redox	256	mV	-02	1.0	04/21/08 15:27 CM	04/21/08 15:27 CM
Resistivity SM2510 B	Resistivity	3480	umhos/cm	#03	0.500	04/21/08 12:00 @SD	04/22/08 10:35 @SD
Sulfate EPA 300.0	Sulfate	629	mg/kg dry	-02	50.0	04/18/08 12:00 BM	04/18/08 18:42 BM
Sulfide SM4500S2 F	Sulfide	BPQL	mg/kg dry	-02	20.0	04/21/08 10:30 CM	04/21/08 11:30 CM
Percent Solids SM2540 B	Percent Solids	84.0	%	-02	0.10	04/18/08 14:00 CM	04/21/08 16:00 CM

Sample: *B-9, B-10 (13.5-20.0)* **Location Code:** **PWSID#:**

Collection Type: Composite Start Date: 3/19/08 0:00 End Date: 3/19/08 0:00 **Lab Log#** 8D17035-02

Method/Parameter	Test	Result			PQL#	Prep Info	Analysis Info
Chloride EPA 300.0	Chloride	123	mg/kg dry	-02	50.0	04/18/08 12:00 BM	04/18/08 19:27 BM
pH SM4500H+B	pH	8.02	pH Units	#03	0.01	04/22/08 10:17 @SD	04/22/08 10:17 @SD
Oxidation Reduction Potential	Redox	249	mV	-02	1.0	04/21/08 15:27 CM	04/21/08 15:27 CM
Resistivity SM2510 B	Resistivity	3250	umhos/cm	#03	0.500	04/21/08 12:00 @SD	04/22/08 10:35 @SD
Sulfate EPA 300.0	Sulfate	1700	mg/kg dry	-02	50.0	04/18/08 12:00 BM	04/18/08 19:27 BM
Sulfide SM4500S2 F	Sulfide	BPQL	mg/kg dry	-02	20.0	04/21/08 10:30 CM	04/21/08 11:30 CM
Percent Solids SM2540 B	Percent Solids	89.0	%	-02	0.10	04/18/08 14:00 CM	04/21/08 16:00 CM

Sample: *B-13 (28.5-30.0)* **Location Code:** **PWSID#:**

Collection Type: Composite Start Date: 3/19/08 0:00 End Date: 3/19/08 0:00 **Lab Log#** 8D17035-03

Method/Parameter	Test	Result			PQL#	Prep Info	Analysis Info
Chloride EPA 300.0	Chloride	BPQL	mg/kg dry	-02	50.0	04/18/08 12:00 BM	04/18/08 19:49 BM
pH SM4500H+B	pH	7.84	pH Units	#03	0.01	04/22/08 10:22 @SD	04/22/08 10:22 @SD
Oxidation Reduction Potential	Redox	272	mV	-02	1.0	04/21/08 15:27 CM	04/21/08 15:27 CM
Resistivity SM2510 B	Resistivity	6540	umhos/cm	#03	0.500	04/21/08 12:00 @SD	04/22/08 10:35 @SD
Sulfate EPA 300.0	Sulfate	105	mg/kg dry	-02	50.0	04/18/08 12:00 BM	04/18/08 19:49 BM
Sulfide SM4500S2 F	Sulfide	BPQL	mg/kg dry	-02	20.0	04/21/08 10:30 CM	04/21/08 11:30 CM
Percent Solids SM2540 B	Percent Solids	86.0	%	-02	0.10	04/18/08 14:00 CM	04/21/08 16:00 CM

Sample: *B-16, B-15 (43.5 - 50.0)* **Location Code:** **PWSID#:**

Collection Type: Composite Start Date: 3/19/08 0:00 End Date: 3/19/08 0:00 **Lab Log#** 8D17035-04

Method/Parameter	Test	Result			PQL#	Prep Info	Analysis Info
Chloride EPA 300.0	Chloride	68.7	mg/kg dry	-02	50.0	04/18/08 12:00 BM	04/18/08 20:11 BM
pH SM4500H+B	pH	8.10	pH Units	#03	0.01	04/22/08 10:25 @SD	04/22/08 10:25 @SD
Oxidation Reduction Potential	Redox	258	mV	-02	1.0	04/21/08 15:27 CM	04/21/08 15:27 CM

Sample: *B-16, B-15 (43.5 - 50.0) (cont'd)* **Location Code:** **PWSID#:**

Collection Type: Composite Start Date: 3/19/08 0:00 End Date: 3/19/08 0:00 Lab Log# 8D17035-04

Method/Parameter	Test	Result			PQL#	Prep Info	Analysis Info
Resistivity SM2510 B	Resistivity	1960	umhos/cm	#03	0.500	04/21/08 12:00 @SD	04/22/08 10:35 @SD
Sulfate EPA 300.0	Sulfate	1410	mg/kg dry	-02	50.0	04/18/08 12:00 BM	04/18/08 20:11 BM
Sulfide SM4500S2 F	Sulfide	BPQL	mg/kg dry	-02	20.0	04/21/08 10:30 CM	04/21/08 11:30 CM
Percent Solids SM2540 B	Percent Solids	84.0	%	-02	0.10	04/18/08 14:00 CM	04/21/08 16:00 CM

Sample: *B-18 (2.5-10.0)* **Location Code:** **PWSID#:**

Collection Type: Composite Start Date: 3/19/08 0:00 End Date: 3/19/08 0:00 Lab Log# 8D17035-05

Method/Parameter	Test	Result			PQL#	Prep Info	Analysis Info
Chloride EPA 300.0	Chloride	BPQL	mg/kg dry	-02	50.0	04/18/08 12:00 BM	04/18/08 20:33 BM
pH SM4500H+B	pH	8.33	pH Units	#03	0.01	04/22/08 10:27 @SD	04/22/08 10:27 @SD
Oxidation Reduction Potential	Redox	297	mV	-02	1.0	04/21/08 15:27 CM	04/21/08 15:27 CM
Resistivity SM2510 B	Resistivity	3920	umhos/cm	#03	0.500	04/21/08 12:00 @SD	04/22/08 10:35 @SD
Sulfate EPA 300.0	Sulfate	140	mg/kg dry	-02	50.0	04/18/08 12:00 BM	04/18/08 20:33 BM
Sulfide SM4500S2 F	Sulfide	BPQL	mg/kg dry	-02	20.0	04/21/08 10:30 CM	04/21/08 11:30 CM
Percent Solids SM2540 B	Percent Solids	84.0	%	-02	0.10	04/18/08 14:00 CM	04/21/08 16:00 CM

Notes and Definitions

-02	Sample was received and analyzed out of Holding Time
#03	This sample was received outside of EPA recommended holding time.
PQL	Practical Quantitation Limit - the method detection Limit (MDL) adjusted for any dilutions or other changes made to the sample to deal with interferences/matrix effects
BPQL	Below Practical Quantitation Limit (if applicable).

Lab Manager

Quality Control Data

Blank Data

QC Lab #	Test Group	Test	Result		PQL	Flags
S8D2119-BLK1	Chloride EPA 300.0	Chloride	BPQL	mg/kg wet	5.00	
S8D2119-BLK1	Sulfate EPA 300.0	Sulfate	BPQL	mg/kg wet	5.00	
S8D2126-BLK1	Sulfide SM4500S2 F	Sulfide	BPQL	mg/kg wet	20.0	

Duplicate Sample Data

QC Lab #	Test Group	Test Name	Dup Result	Samp Result	% RPD	RPD Limit	Flags
S8D2119-DUP1	Chloride EPA 300.0	Chloride	63.3	62.9	0.8	20	-02
S8D2224-DUP1	pH SM4500H+B	pH	7.93	7.88	0.6	20	#03
S8D2207-DUP1	Oxidation Reduction Potential	Redox	284	297	4	20	
S8D2220-DUP1	Resistivity SM2510 B	Resistivity	3480	3480	0	20	#03
S8D2119-DUP1	Sulfate EPA 300.0	Sulfate	627	629	0.4	20	-02
S8D2126-DUP1	Sulfide SM4500S2 F	Sulfide	BPQL	BPQL	UDL	200	
S8D2134-DUP1	Percent Solids SM2540 B	Percent Solids	84.0	84.0	0	20	

Laboratory Control Sample Data

Lab QC#	Test Group	Test Name	LCS Result	Spike Level	Units	% Rec.	Control Limits	Flags
S8D2119-BS1	Chloride EPA 300.0	Chloride	2.83	3.000	mg/kg wet	94	90 - 110	
S8D2119-BS1	Sulfate EPA 300.0	Sulfate	14.9	15.00	mg/kg wet	99	90 - 110	
S8D2126-BS1	Sulfide SM4500S2 F	Sulfide	508	560.0	mg/kg wet	91	80 - 120	

APPENDIX C

CROSS HOLE SHEAR VELOCITY TESTING

CROSS-HOLE SEISMIC TESTING
SIMPLE CYCLE CAPACITY ADDITION
WESTERN FARMERS ELECTRIC COOPERATIVE
ANADARKO, OKLAHOMA

Prepared for:

KLEINFELDER, INC.
Tulsa, Oklahoma

Prepared by:

GEOTECHNOLOGY, INC.
Kansas City, Kansas

Geotechnology, Inc. Report No. 1023201.82KS

May 8, 2008

GEOTECHNOLOGY, INC.
ENGINEERING AND ENVIRONMENTAL SERVICES
SAINT LOUIS • COLLINSVILLE • KANSAS CITY

May 8, 2008 1023201.82KS

Mr. Brian Marick
Kleinfelder, Inc.
10835 East Independence, Suite 102
Tulsa, Oklahoma 74116

Re: Cross-hole Seismic Testing
Simple Cycle Capacity Addition
Western Farmers Electric Cooperative
Anadarko, Oklahoma

Dear Mr. Marick:

Presented herein are the results of the cross-hole seismic test for the referenced site. This work was conducted in general accordance with proposal P14217.00.82KS dated February 25, 2008. Presented in this report is a description of the geophysical method and data plots.

It is a pleasure to be of service to you on this project. If you have any questions or comments, please contact the undersigned at (314) 997-7440.

Very truly yours,

GEOTECHNOLOGY, INC.

Douglas W. Lambert for

Glen L. Adams
Project Manager

Sheryl Gallagher, P.E.
Senior Engineer

GLA/DWL/SDG:gla/jsj

Copies Submitted: (2 hard copies; 1 via e-mail)

9136 CODY • OVERLAND PARK, KANSAS 66214 • 913/438-1900 • FAX: 913/438-1923

1023201.82KS

CROSS-HOLE SEISMIC TESTING
SIMPLE CYCLE CAPACITY ADDITION
WESTERN FARMERS ELECTRIC COOPERATIVE
ANADARKO, OKLAHOMA

TABLE OF CONTENTS

ILLUSTRATIONS

APPENDIX

CROSS-HOLE SEISMIC TESTING
SIMPLE CYCLE CAPACITY ADDITION
WESTERN FARMERS ELECTRIC COOPERATIVE
ANADARKO, OKLAHOMA

1.0 INTRODUCTION

1.1 Site Description. The subject site is located near Anadarko, Oklahoma. A site location map is presented on Plate 1. The project includes adding additional structures and equipment to the existing plant. Test locations were located near the proposed combustion turbine and generator units. Cross-hole seismic testing was performed and is reported herein to assist with vibration analyses for foundation designs. The cross-hole seismic testing was performed at two locations as shown on the boring location site plan on Plate 2. One test was performed within three borings generally oriented north–south and located near the northern side of the planned addition, and the other test was performed within three borings generally oriented north-south and located approximately 200 feet south of the northern test location.

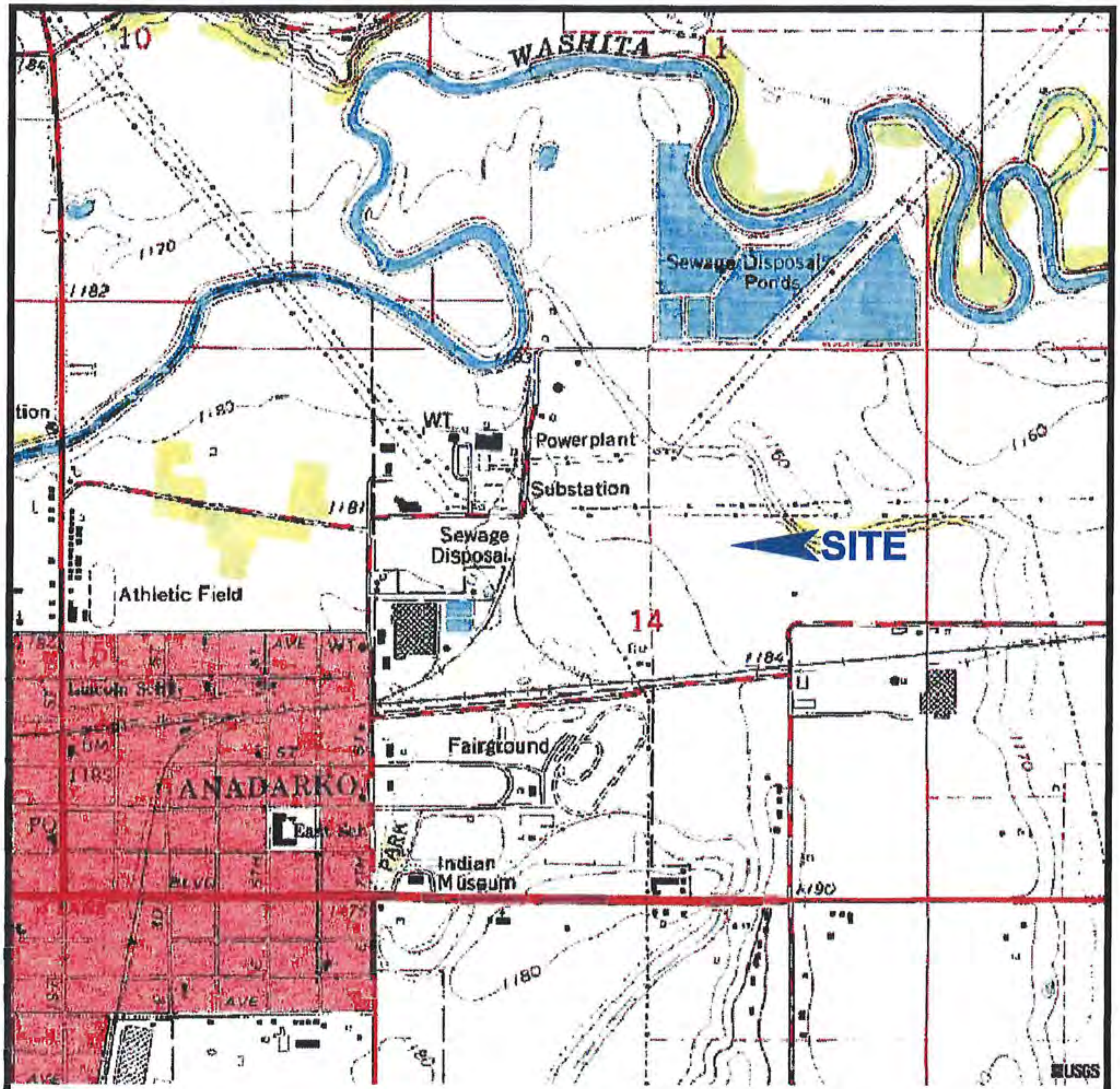
1.2 Scope of Work. The scope of work included mobilizing geophysical equipment and personnel to the site, conducting a cross-hole seismic test (including deviation logging), and processing/interpreting the data. The seismic data were processed, and shear and compressional wave velocities were calculated to determine dynamic soil properties. The seismic data were plotted and the results are presented in this report. Any engineering analysis or recommendations based on this data are outside our scope of work.

2.0 GEOPHYSICAL METHODOLOGY

The cross-hole seismic testing method involves generating compressional (P) and shear (S) wave seismic energy at periodic depth intervals within a borehole and measuring the seismic wave travel-times at geophones situated at the source depth between two adjacent boreholes (per ASTM Standard D4428). The seismic wave arrivals at the geophones are transmitted through cables to the seismograph for digital recording. The data are interpreted by analyzing the differences in elapsed travel-time from the source to geophones. P- and S-wave velocities can be calculated for each depth interval by analyzing the travel-time data. The distance between boreholes may vary with depth, therefore, borehole deviation logging is conducted to adjust the borehole separation distance with depth for the velocity calculations.

3.0 RESULTS

Cross-hole seismic testing was conducted between boring sets B-2 and B-10. Each set contains one source boring and two adjacent receiver (geophone) borings as shown on Plates 3 and 10, respectively. The source boring was the sample boring and the two receiver borings were located at an approximate 10-foot spacing to the north for the B-2 test location and to the south for the B-10 test location. Cross-hole data were plotted as point data at the depth of each record. Seismic velocities calculated between the source boring and the two geophone borings are presented on Plates 4 and 5 for the B-2 test location and on Plates 11 and 12 for the B-10 test location. Values are tabulated on Plate 6 for B-2 and Plate 13 for B-10. Deviation logging was performed by Century Geophysical and recorded data was utilized to calculate the deviation with depth. Plots representing the deviation from vertical for each of the borings are presented on Plates 7 through 9 for the B-2 test location and Plates 14 through 16 for the B-10 test location. Due to the inherent noise in the earth and lateral variation in soil velocities between the test borings, some variations in velocities were calculated between the two receiver holes. An average velocity is plotted on the cross-hole data plots that will allow a smoother fit to the data. Data was collected to a depth of 100 feet from the surface. The borehole tools require a clearance of approximately 2 feet from the bottom of the casing. Densities used for the moduli calculations were based on wet unit weights values provided by the client.



NOTES

Plan adapted from a 7.5 minute U.S.G.S. map for Anadarko, Oklahoma Quadrangle, last revised in 1995.

0 1,500 3,000

SCALE IN FEET

N

Drawn By: SLC	Ck'd By: GLA	App'vd By:
Date: 05-07-08	Date: 5/8/08	Date: 5/8/08

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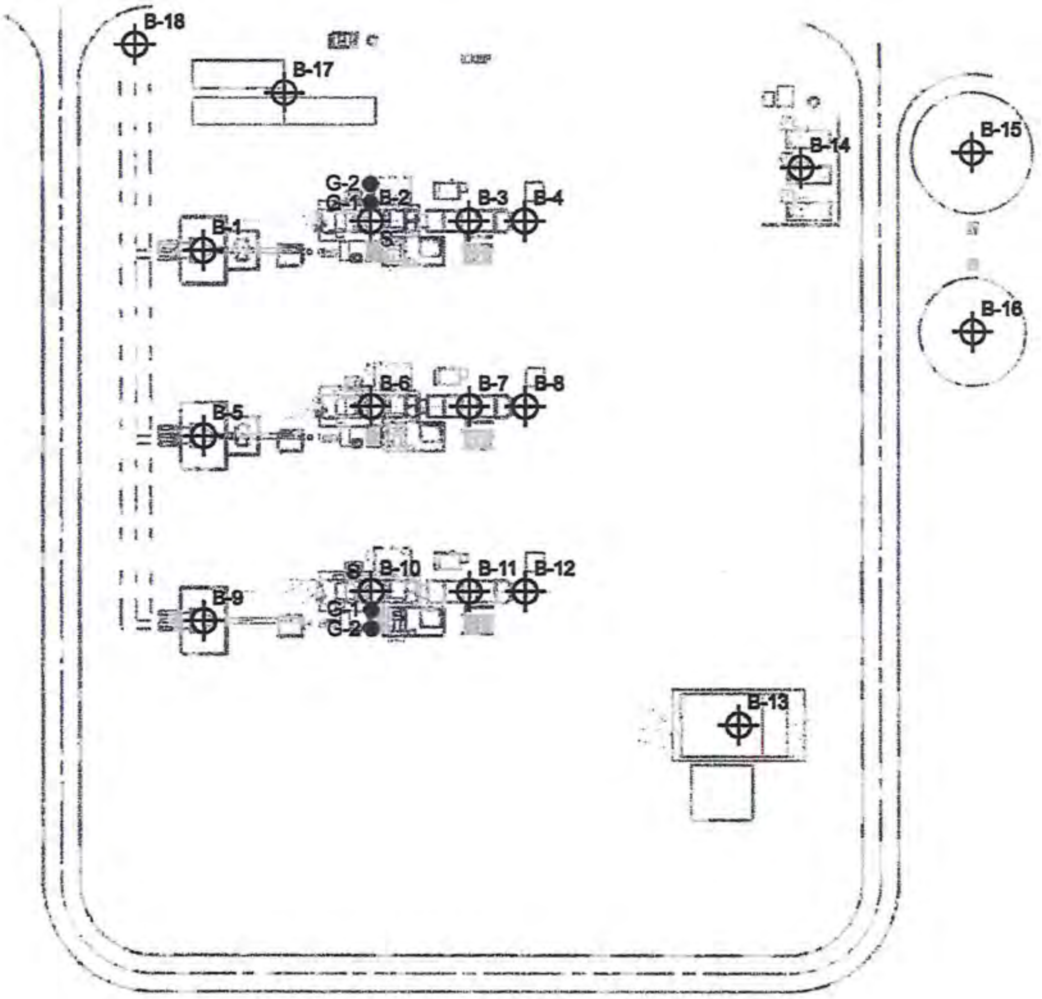
Western Farmers Electric Cooperative
Anadarko Plant
Simple Cycle Capacity Addition
Anadarko, Oklahoma

SITE LOCATION AND TOPOGRAPHY

Project Number 1023201.82KS	PLATE 1



NOTES

1. Plan adapted from a drawing titled "Partial Site Plan" issued by Shive Hattery.

2. Borings were located in the field with reference to site features and are shown approximate only.

LEGEND

- ● Additional Geophysical Boring
- S Source Boring
- G Geophone (Receiver Boring)

0 100 200

SCALE IN FEET

N

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Date: 05-07-08	Date: 5/8/08	Date: 5/8/08

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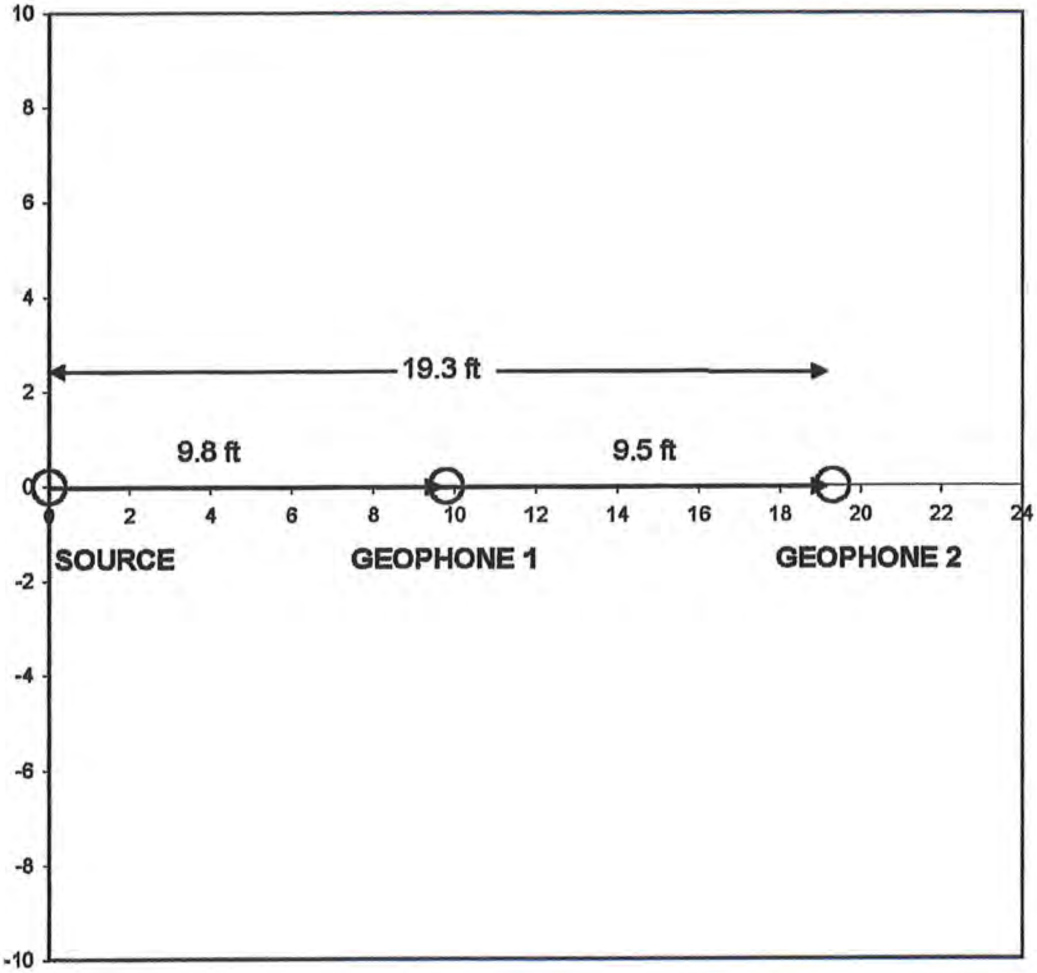
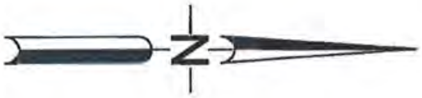
Anadarko Plant
Simple Cycle Capacity Addition
Anadarko, Oklahoma

PLAN OF SITE AND BORING LOCATIONS

Project Number
1023201.82KS

PLATE 2





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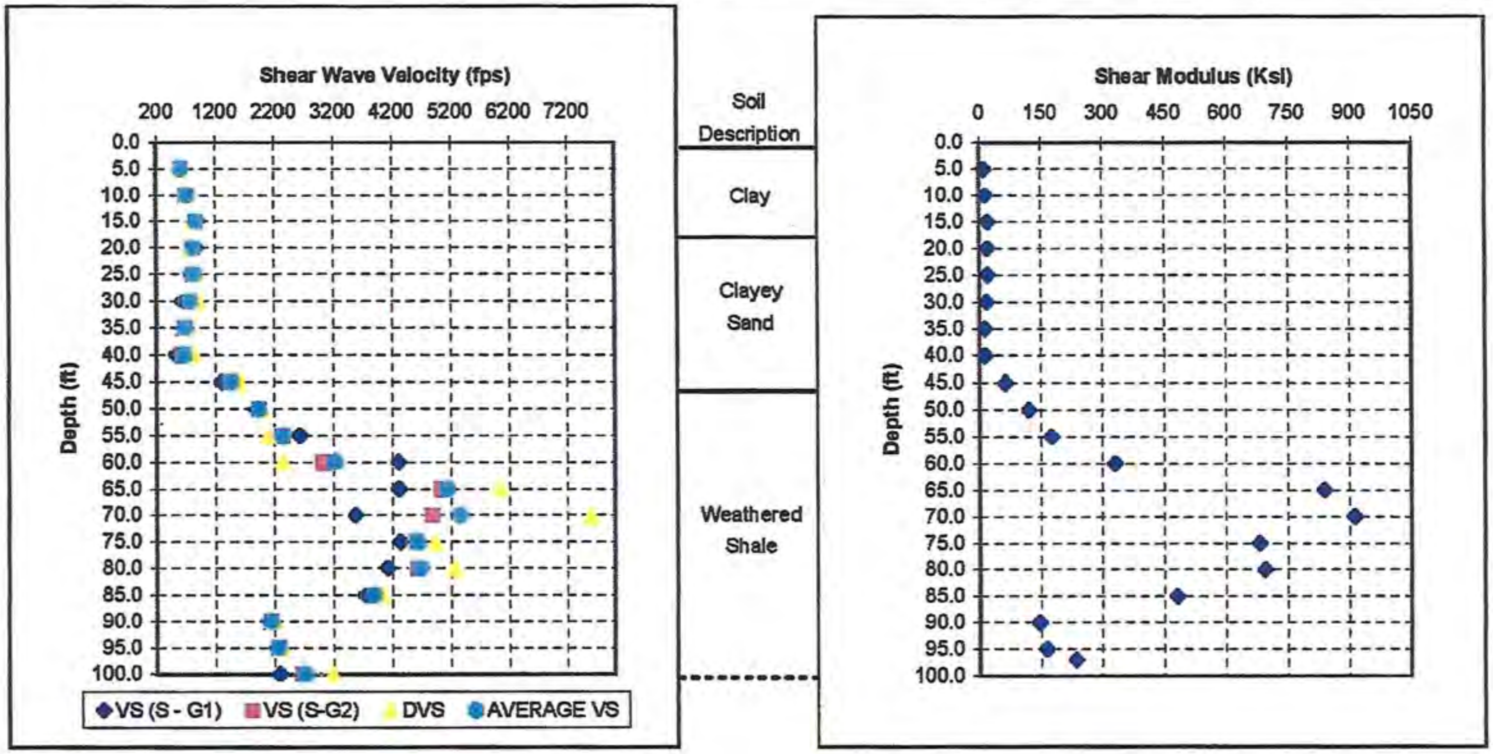
Anadarko Plant
Simple Cycle Capacity Addition
Anadarko, Oklahoma

B-2 RELATIVE BOREHOLE LOCATIONS

Project Number
1023201.82KS

PLATE 3



Drawn By: SLC	Ck'd By: GLA	App'vd By:
Date: 05-07-08	Date: 5/8/08	Date: 5/8/08

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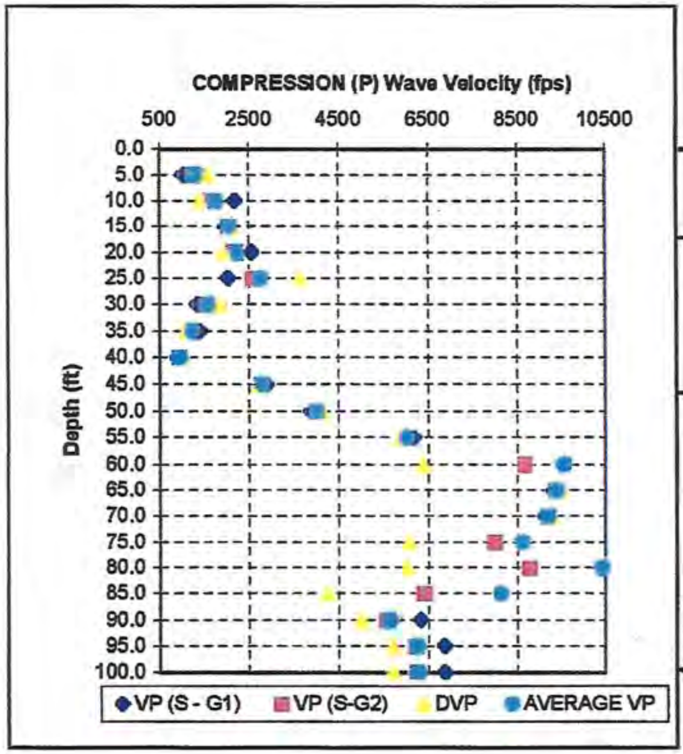
Western Farmers Electric Cooperative
Anadarko Plant
Simple Cycle Capacity Addition
Anadarko, Oklahoma

B-2 SHEAR (S) WAVE VELOCITY AND SHEAR MODULUS VS DEPTH

Project Number
1023201.82KS

PLATE 4

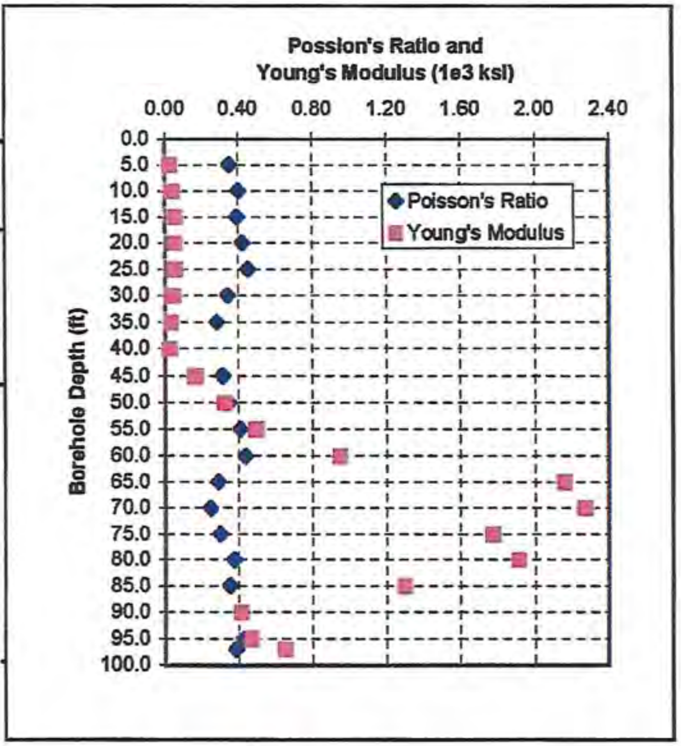


Soil Description

Clay

Clayey Sand

Weathered Shale



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Date: 05-07-08	Date: 5/8/08	Date: 5/8/08

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Anadarko Plant
Simple Cycle Capacity Addition
Anadarko, Oklahoma

B-2 COMPRESSIONAL (P) WAVE VELOCITY, POISSON'S RATIO, & YOUNG'S MODULUS VS DEPTH

Project Number
1023201.82KS

PLATE 5

SUMMARY TABLE - CROSSHOLE RESULTS

Boring 2

DEPTH (FT)	SHEAR VELOCITY (AVERAGE, FT/SEC)	P-WAVE VELOCITY (AVERAGE, FT/SEC)	UNIT WEIGHT (LB/CU FT)	SHEAR MODULUS (KSI)	POISSON RATIO	YOUNG'S MODULUS (KSI)
5	613	1287	126	10.27	0.35	27.79
10	712	1763	127	13.99	0.40	39.24
15	860	2038	126	20.23	0.39	56.32
20	822	2228	125	18.24	0.42	51.84
25	822	2753	130	19.06	0.45	55.31
30	772	1575	130	16.80	0.34	45.09
35	677	1228	130	12.93	0.28	33.15
40	661	944	130	12.31	0.02	25.11
45	1457	2793	135	62.19	0.31	163.33
50	1939	3993	147	119.99	0.35	322.93
55	2348	6024	147	175.84	0.41	496.02
60	3221	9560	147	330.95	0.44	950.48
65	5126	9384	147	838.28	0.29	2158.29
70	5346	9204	147	911.65	0.25	2270.79
75	4626	8606	147	682.63	0.30	1770.52
80	4668	10427	147	695.28	0.37	1911.51
85	3887	8122	147	482.03	0.35	1302.85
90	2145	5636	147	146.75	0.42	415.40
95	2267	6264	147	163.91	0.42	467.02
97	2715	6284	147	235.19	0.39	651.60

Drawn By: SLC	Ck'd By: GLA	App'vd By:
Date: 05-07-08	Date: 5/8/08	Date: 5/8/08

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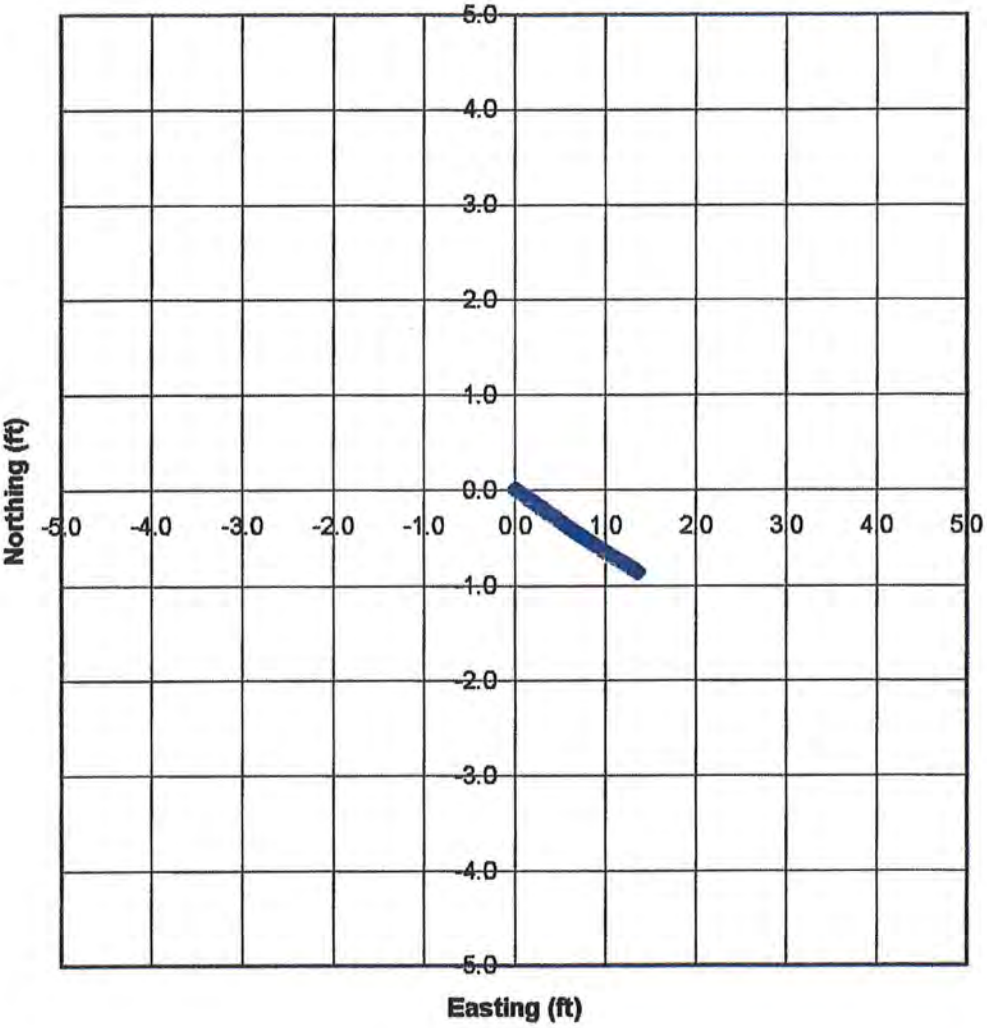
Western Farmers Electric Cooperative
Anadarko Plant
Simple Cycle Capacity Addition
Anadarko, Oklahoma

B-2 SUMMARY TABLE
CROSSHOLE RESULTS

Project Number
1023201.82KS

PLATE 6



Drawn By: SLC	Ck'd By: GLA	App'vd By:
Date: 05-07-08	Date: 5/8/08	Date: 5/8/08

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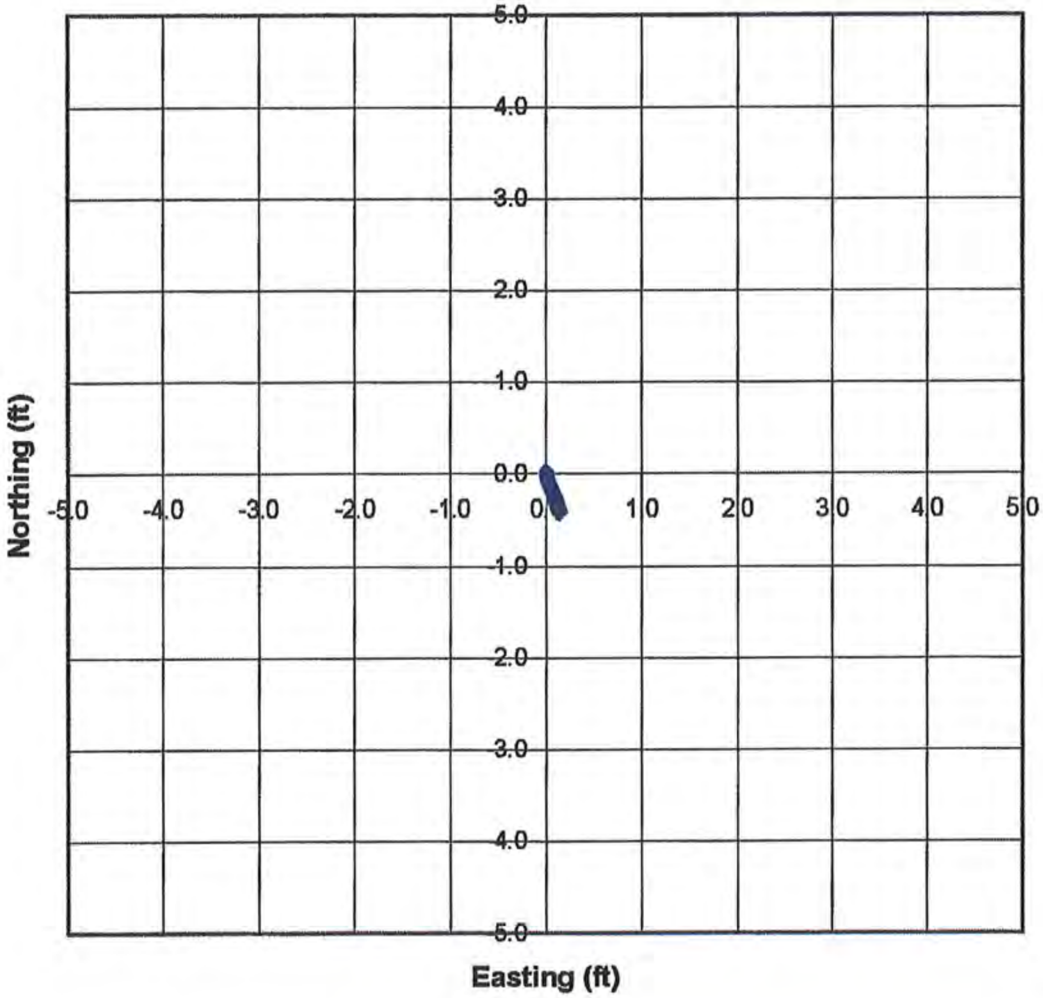
Anadarko, Oklahoma

B-2 SOURCE
BORING DEVIATION

Project Number 1023201.82KS	PLATE 7



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Date: 05-07-08	Date: 5/8/08	Date: 5/8/08

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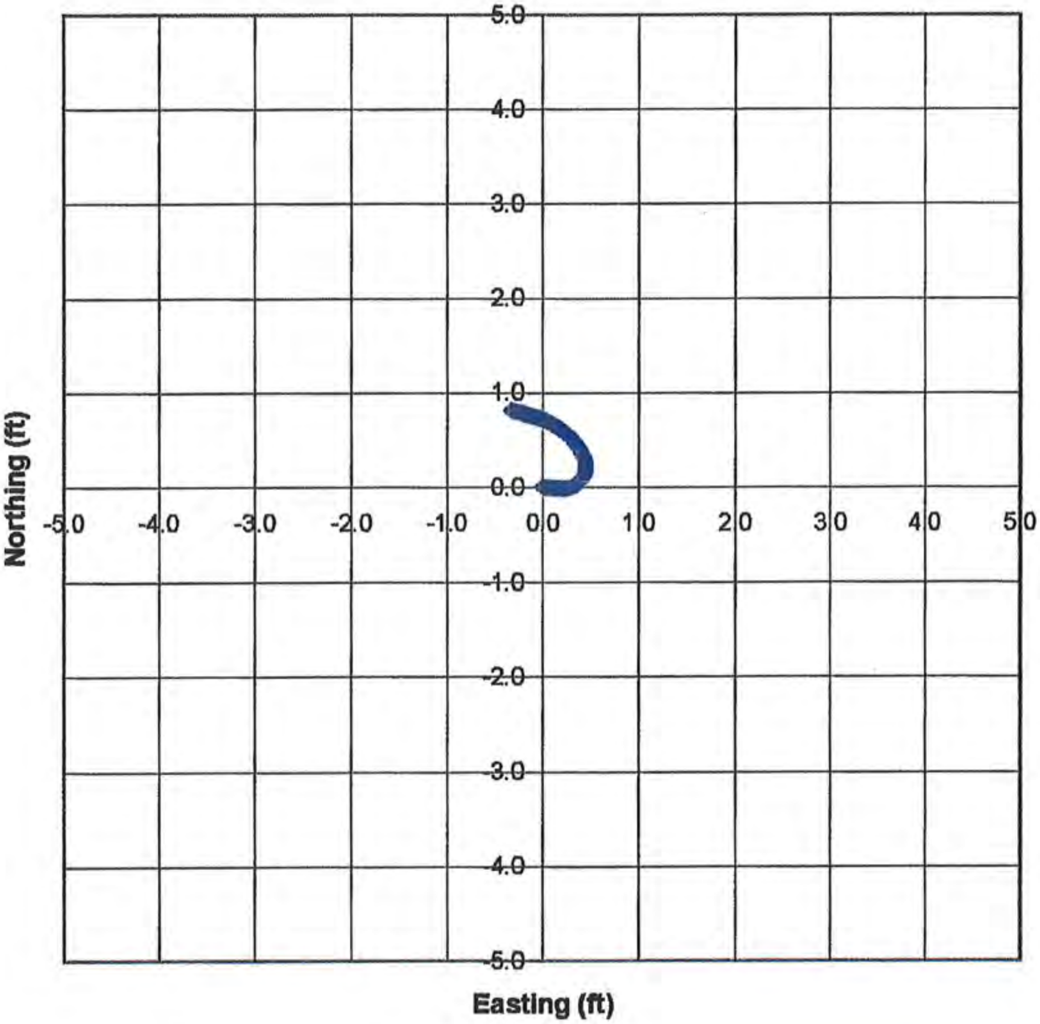
Simple Cycle Capacity Addition
Anadarko, Oklahoma

B-2 GEOPHONE
BORING 1 DEVATION

Project Number
1023201.82KS

PLATE 8



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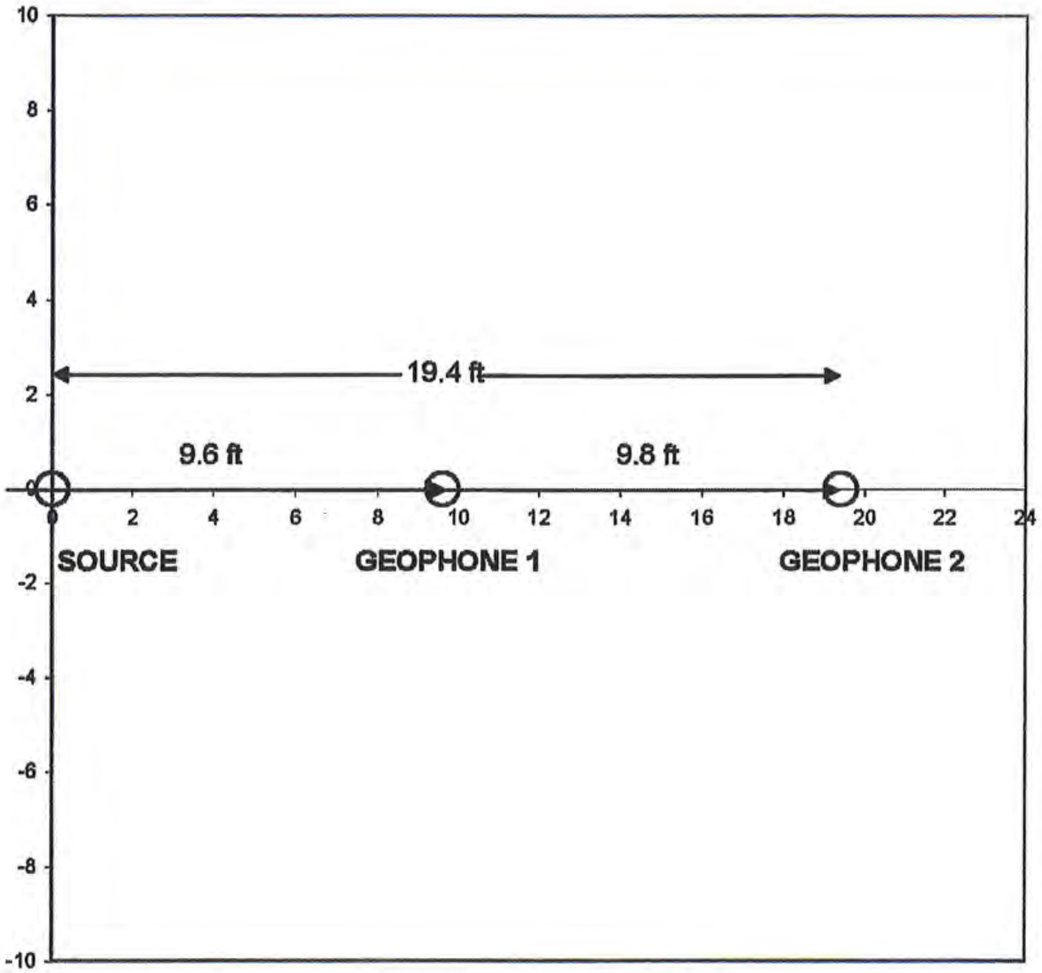
B-2 GEOPHONE
BORING 2 DEVATION

Project Number
1023201.82KS

PLATE 9



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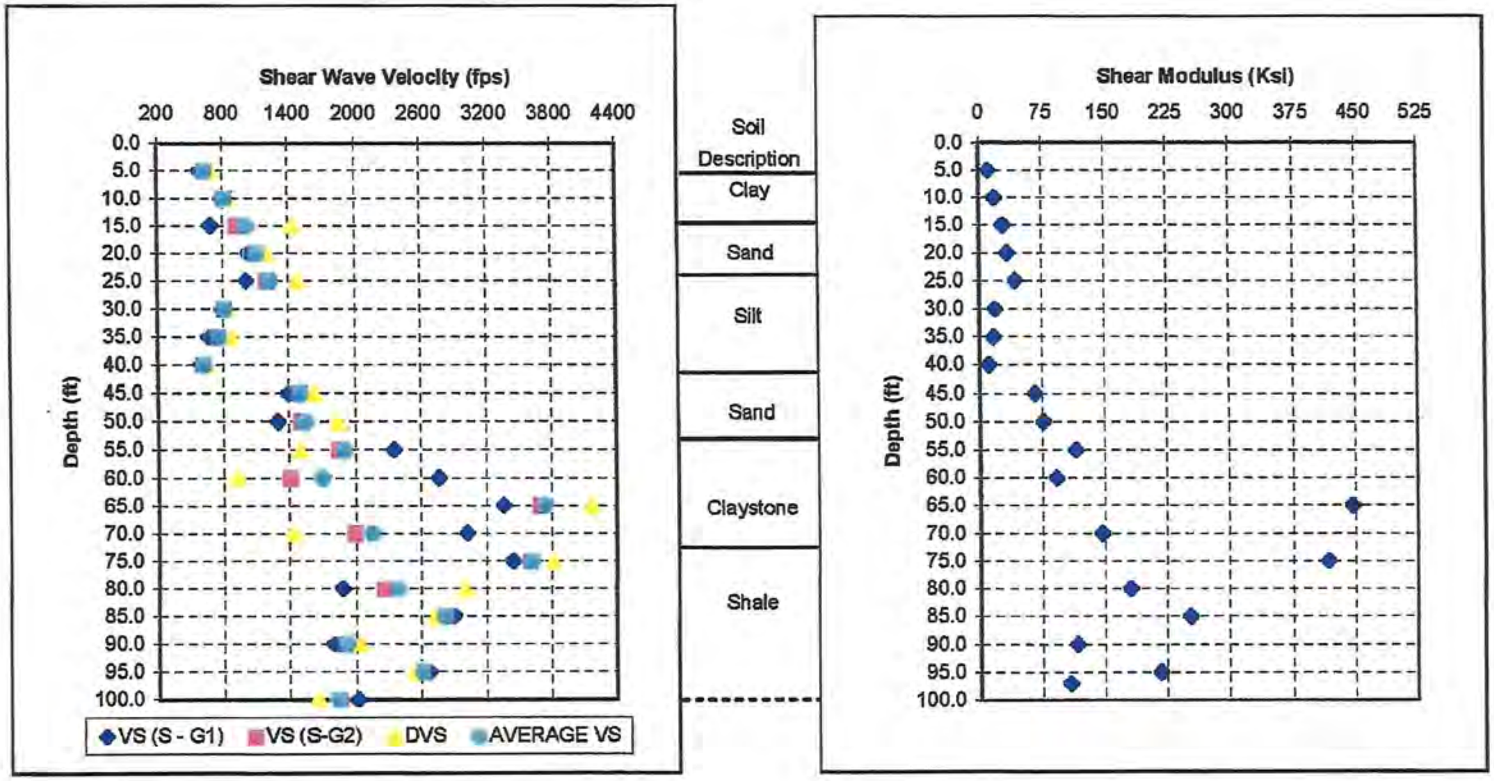
B-10 RELATIVE BOREHOLE LOCATIONS

Project Number
1023201.82KS

PLATE 10



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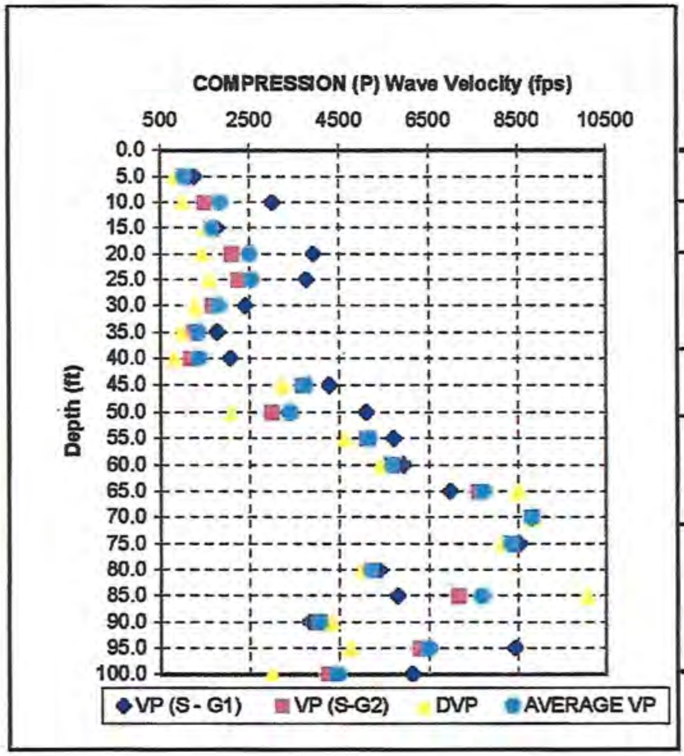
B-10 SHEAR (S) WAVE VELOCITY AND SHEAR MODULUS VS DEPTH

Project Number
1023201.82KS

PLATE 11



Soil Description

Clay

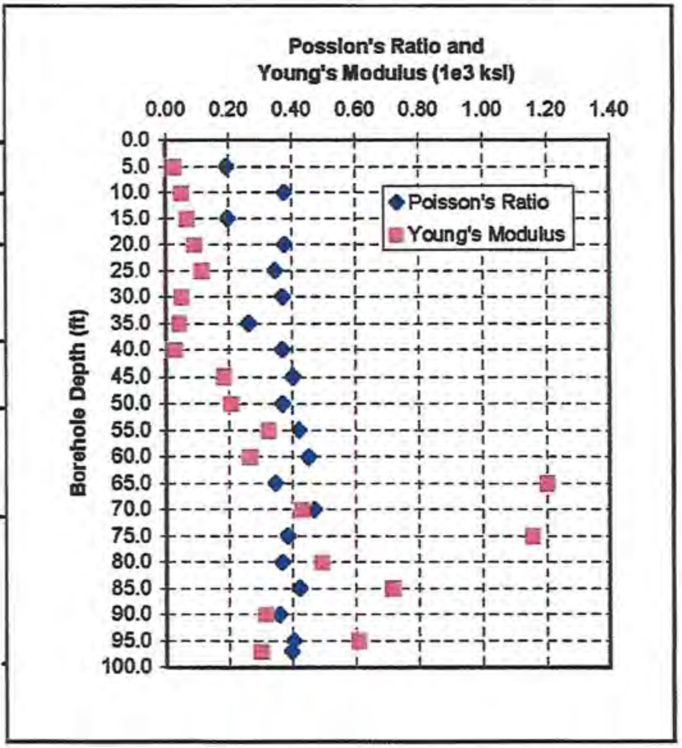
Sand

Silt

Sand

Claystone

Shale



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B-10 COMPRESSIONAL (P) WAVE VELOCITY, POISSON'S RATIO, & YOUNG'S MODULUS VS DEPTH

Project Number
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PLATE 12

SUMMARY TABLE - CROSSHOLE RESULTS

Boring 10

DEPTH (FT)	SHEAR VELOCITY (AVERAGE, FT/SEC)	P-WAVE VELOCITY (AVERAGE, FT/SEC)	UNIT WEIGHT (LB/CU FT)	SHEAR MODULUS (KSI)	POISSON RATIO	YOUNG'S MODULUS (KSI)
5	638	1037	126	11.14	0.19	26.61
10	815	1837	127	18.30	0.38	50.42
15	1015	1654	126	28.18	0.20	67.51
20	1108	2491	125	33.12	0.38	91.18
25	1230	2535	130	42.66	0.35	114.85
30	813	1788	130	18.63	0.37	51.04
35	761	1345	130	16.34	0.26	41.32
40	618	1359	130	10.79	0.37	29.54
45	1501	3725	135	65.96	0.40	185.11
50	1544	3388	147	76.08	0.37	208.28
55	1897	5147	147	114.78	0.42	326.31
60	1695	5667	147	91.70	0.45	266.07
65	3740	7713	147	446.18	0.35	1201.38
70	2143	8817	147	146.57	0.47	430.49
75	3616	8349	147	417.18	0.38	1155.22
80	2376	5194	147	180.13	0.37	492.70
85	2811	7686	147	252.10	0.42	717.37
90	1908	4063	147	116.18	0.36	315.67
95	2606	6500	147	216.61	0.40	608.34
97	1837	4455	147	107.66	0.40	300.92

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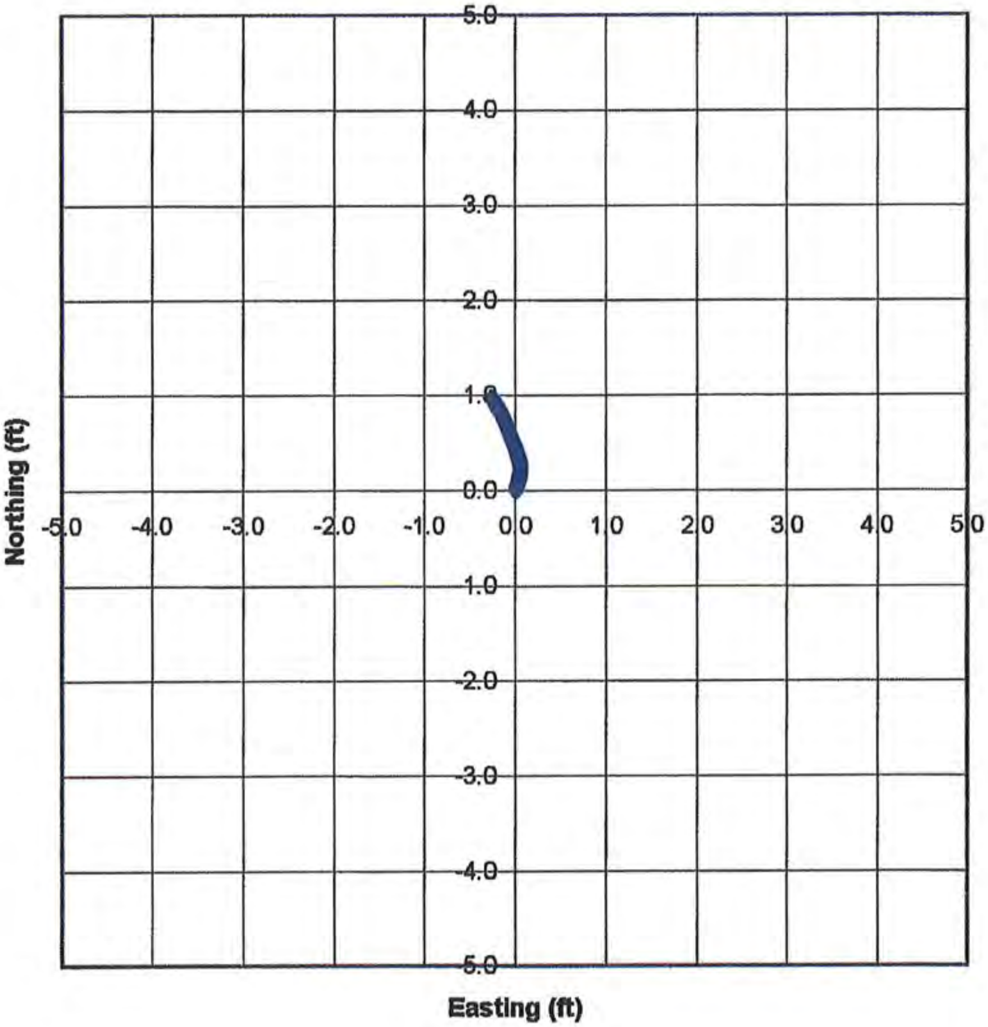
B-10 SUMMARY TABLE
CROSSHOLE RESULTS

Project Number
1023201.82KS

PLATE 13



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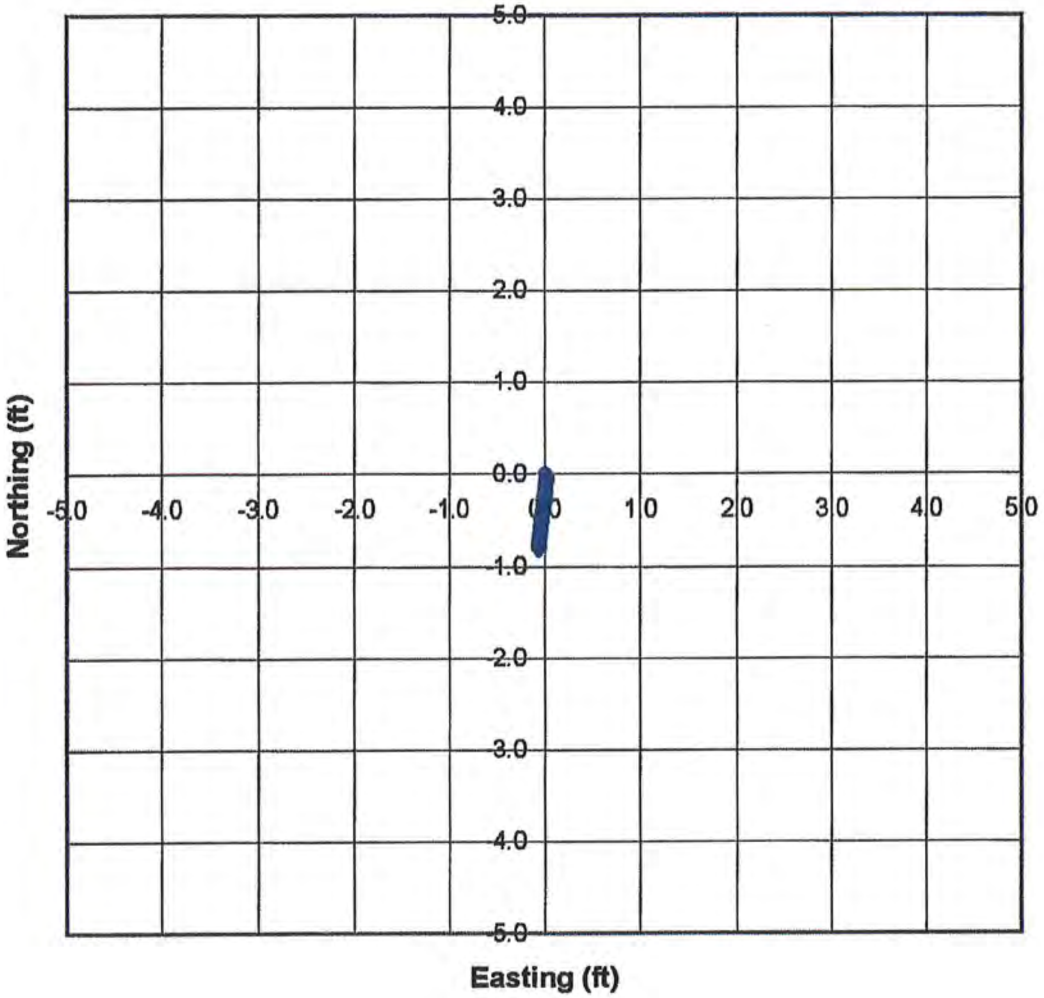
B-10 SOURCE
BORING DEVIATION

Project Number
1023201.82KS

PLATE 14



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B-10 GEOPHONE
BORING 1 DEVATION

Project Number
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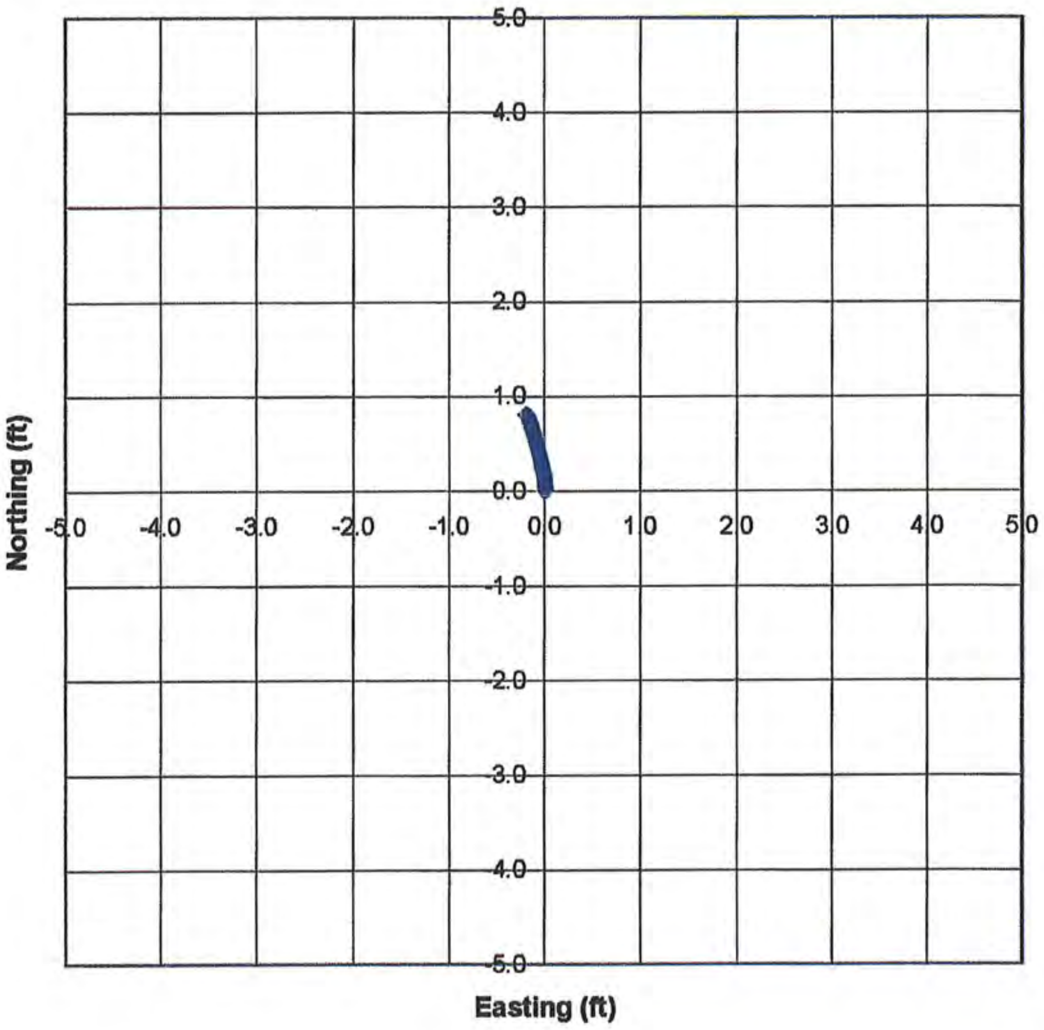
PLATE 15



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B-10 GEOPHONE
BORING 2 DEVATION

Project Number 1023201.82KS	PLATE 16

APPENDIX A

LIMITATIONS OF REPORT

GEOPHYSICAL SERVICES
LIMITATIONS OF REPORT

1. This report was prepared for the exclusive use of the owner, architect, and engineer for evaluating the project as it relates to the technical aspects discussed herein. It can be made available to prospective contractors for information on factual data only and not as a warranty of subsurface conditions included in this report. Unless other contractual agreements were made, the services described in this report were carried out in accordance with the Terms for Geotechnology's Services which were attached to the proposal.

2. Geotechnology endeavored to perform the cross-hole seismic geophysical survey in accordance with generally accepted practices of other consultants undertaking similar studies at the same time and in the same geographical area. The findings and conclusions stated herein must be considered not as scientific certainties, but rather as professional opinions concerning the significance of the limited data gathered during the course of the survey. No warranty, express or implied, is made.

3. The geophysical analyses and conclusions contained in this report are based on the site conditions, project layout, sampling interval, geophysical data, and interpretive procedures described herein. Geotechnology can make no interpretation of underground conditions beyond the test location. Geophysical exploration methods are indirect and potentially influenced by a variety of natural or man-made conditions. The resulting interpretations are based on the quality of the recorded data as limited by site conditions

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APPENDIX D

ASFE DOCUMENT

Important Information About Your

Geotechnical Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

The following information is provided to help you manage your risks.

Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering study conducted for a civil engineer may not fulfill the needs of a construction contractor or even another civil engineer. Because each geotechnical engineering study is unique, each geotechnical engineering report is unique, prepared *solely* for the client. No one except you should rely on your geotechnical engineering report without first conferring with the geotechnical engineer who prepared it. *And no one — not even you* — should apply the report for any purpose or project except the one originally contemplated.

Read the Full Report

Serious problems have occurred because those relying on a geotechnical engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

A Geotechnical Engineering Report Is Based on A Unique Set of Project-Specific Factors

Geotechnical engineers consider a number of unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical engineering report that was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light industrial plant to a refrigerated warehouse,
- elevation, configuration, location, orientation, or weight of the proposed structure,
- composition of the design team, or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes—even minor ones—and request an assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

Subsurface Conditions Can Change

A geotechnical engineering report is based on conditions that existed at the time the study was performed. *Do not rely on a geotechnical engineering report* whose adequacy may have been affected by: the passage of time; by man-made events, such as construction on or adjacent to the site; or by natural events, such as floods, earthquakes, or groundwater fluctuations. *Always* contact the geotechnical engineer before applying the report to determine if it is still reliable. A minor amount of additional testing or analysis could prevent major problems.

Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ—sometimes significantly—from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A Report's Recommendations Are *Not* Final

Do not overrely on the construction recommendations included in your report. *Those recommendations are not final,* because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations only by observing actual subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's recommendations if that engineer does not perform construction observation.*

A Geotechnical Engineering Report Is Subject to Misinterpretation

Other design team members' misinterpretation of geotechnical engineering reports has resulted in costly problems. Lower that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Contractors can also misinterpret a geotechnical engineering report. Reduce that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing construction observation.

Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

Give Contractors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make contractors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give contractors the complete geotechnical engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise contractors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure contractors have sufficient time* to perform additional study. Only then might you be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Read Responsibility Provisions Closely

Some clients, design professionals, and contractors do not recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations" many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform a *geoenvironmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical engineering report does not usually relate any geoenvironmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own geoenvironmental information, ask your geotechnical consultant for risk management guidance. *Do not rely on an environmental report prepared for someone else.*

Obtain Professional Assistance To Deal with Mold

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, a number of mold prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; ***none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.***

Rely on Your ASFE-Member Geotechncial Engineer for Additional Assistance

Membership in ASFE/The Best People on Earth exposes geotechnical engineers to a wide array of risk management techniques that can be of genuine benefit for everyone involved with a construction project. Confer with you ASFE-member geotechnical engineer for more information.

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