Text to Accompany:

OPEN-FILE REPORT 79-496

1985

FEDERAL COAL RESOURCE OCCURRENCE AND FEDERAL COAL DEVELOPMENT POTENTIAL MAPS OF THE SPIRO 7.5-MINUTE QUADRANGLE LE FLORE COUNTY, OKLAHOMA

(Report includes 11 plates)

Prepared for

UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

By

GEOLOGICAL SERVICES OF TULSA, INC.

TULSA, OKLAHOMA

B. T. BRADY

U.S. GEOLOGICAL SURVEY, DENVER, COLORADO

AND

J. L. QUERRY, BUREAU OF LAND MANAGEMENT, TULSA, OKLAHOMA

CONTENTS

TABLES

ILLUSTRATIONS

(Plates are in pocket)

INTRODUCTION

Purpose

This text is to be used in conjunction with the Federal Coal Resource Occurrence (FCRO) and Federal Coal Development Potential (FCDP) Maps of the Spiro 7.5-minute quadrangle, Le Flore Country, Oklahoma.

This report was complied to support the land-planning work of the Bureau of Land Management (BLM). The work was undertaken by Geological Services of Tulsa, Tulsa, Oklahoma, at the request of the United States Geological Survey under contract number 14-08--0001-17989. The resource information gathered for this report is in response to the Federal Coal Leasing Amendments Act of 1976 (Public Law 94-377). Published and unpublished publicly available information was used as the data base for this study. No new drilling or field mapping was done to supplement this study, nor was any confidential or proprietary data used.

Location

The Spiro 7.5-minute quadrangle is located to the north of the Howe-Wilburton coal mining district, in the eastern part of the southeastern Oklahoma coal field. All of the quadrangle lies in Le Flore County. The town of Spiro, is in the extreme northwest corner of the largest settlement in the area. The city of McAlester is 700 miles (112 km) west of the quadrangle, and the city of Tulsa is approximately 100 miles (160 km) northwest of the quadrangle.

Accessibility

The town of Spiro is accessible by U.S. Route 271 and State Route 9, which run east-west through town. Ft. Smith, Arkansas is about 15 miles from the northern edge on the quadrangle on this road. State Route 112 crosses through the southeast portion of the quadrangle, also continuing on to Ft. Smith. In addition to these main roads, almost every section in the quadrangle is accessible by light-duty and unimproved dirt roads.

The area is served by a number of railroads. The Kansas City Southern Railroad runs through Spiro in the northwest, the Missouri Pacific runs through the central part of the quadrangle, and the St. Louis-San Francisco Railroad runs through the town of Cameron in the southeast.

Physiography

The Spiro quadrangle is in the Arkoma Basin, north of the Ouachita Mountains, in the Arkansas Valley physiographic province (Hendricks, 1939). The Choctaw Fault, which essentially marks the southern edge of the basin, is approximately 18 miles (29 km) south of the quadrangle.

Much of the region is hilly, due largely to the action of streams on bedrock strata with differing capabilities for resisting erosion (Knechtel, 1949). The dominant features of the local landscape are long sinuous hogbacks that generally coincide with the outcrop of sandstone members. Between the hogbacks are wide erosional valleys underlain mostly by shale (Knechtel, 1949). Folding is quite widespread, resulting in sandstone-capped synclinal mountains. Total relief in the Spiro quadrangle is about 360 feet (110 m), with a low of 420 feet (128 m) in the river valleys to a high of about 780 feet (240 m) on Backbone Mountain.

The Spiro quadrangle is drained by the Poteau River, which flows from southwest to northeast through the quadrangle. The James Fork also flows through the south half of the study area from east to west, and joins the Poteau River to the west in neighboring Panama quadrangle. Several smaller creeks and intermittent streams also flow through the area and a number of man-made lakes and small ponds exist within the quadrangle. The Arkansas River Navigation Channel is located just north of the study area.

Climate and Vegetation

The climate in southeastern Oklahoma is for the most part fairly moderate. Winters are short, and extremely cold weather is rare. Summers, however, are generally long and hot. The mean annual temperature is about 62°F (17°C), and ranges from a daily average of about 41°F (5°C) in January to about 82°F (28°C) in July though it is not unusual to have occasional periods of very hot days (Hendricks, 1939). Annual precipitation in the area averages approximately 41 in. (105 cm), with rains generally abundant in the spring, early summer, fall and winter (Hendricks, 1939).

The area supports a wide variety of vegetation, with oaks, blackjacks, hickories, elms and hackberries being most common. On the higher mountains and ridges pines can also be found. In parts of the valleys that have not been cleared for farming, thick stands of water and willow oaks, hickories, cottonwoods, willows and wild plums may be present (Hendricks, 1939).

Land Status

Federal coal land in the Spiro quadrangle totals approximately 14,170 acres (5734 hectares), or 37% of the quadrangle. Of that, 5,400 acres (2185 hectares), or 38% is leased (as of October 19, 1979), 320 acres (129 hectares) is unleased (2%), and the remaining 8,450 acres (3420 hectares), or 60% belongs to known recoverable Coal Resource Occurrence Areas (KRCRA). There are parts of two KRCRA's in the Spiro quadrangle: the Spiro-Bokoshe KRCRA and the Rock Island KRCRA (Plate 2).

GENERAL GEOLOGY

Previous Work

Much work has been done on the southeastern Oklahoma coal field. The first geologic study of the Choctaw coal field was published by Chance (1890) and included a map showing the outcrops of the most important coal beds in the area. In 1897, Drake published the results of his study on the coal fields of the Indian Territory, which consisted of a map and text of the principal coal beds, general stratigraphy and structural features.

From 1899 to 1910, Taff and his associates published several reports on the Oklahoma coal lands. These included a number of investigations carried out for the United States Geological Survey on the extent and general character of local stratigraphy, including coal beds. Much of his work was a part of Senate Document 390 (1910), which represented a compilation of material collected for the purpose of determining the value and extent of coal deposits in and under the segregated coal lands of the

Choctaw and Chickasaw Nations in Oklahoma.

The Oklahoma Geological Survey published a bulletin by Snider in 1914 on the geology of east-central Oklahoma, emphasizing the geologic structure and oil and gas possibilities of the area. Further studies on the southern Oklahoma coal lands were carried out by Shannon and others (1926), Moose and Searle (1929), and Hendricks (1939). These, along with later works by Knechtel and Oakes in the 1940's added greatly to the body of knowledge on Oklahoma coals, particularly in terms of their quality, chemical composition and extent.

A number of estimates as to original and remaining coal reserves have been published, among them are the figures published in papers by Trumbull (1957) and Friedman (1974). Non-proprietary information from coal test holes drilled in various years in the Spiro quadrangle was obtained from USGS files.

In recent years a number of masters theses have been done in the southeastern Oklahoma coal field. Agbe-Davis (1978) carried out a study on the geology of the Hartshorne coal in the Spiro and Hackett quadrangles, and much of his work has been incorporated into this report.

Stratigraphy

The Arkoma Basin, once part of the larger Ouachita geosyncline, formed as a result of subsidence beginning in Mississippian time and continuing through Early and Middle Pennsylvanian. Strata in the basin are thought to have been deposited in a deltaic environment with sediment coming primarily from eroding highlands to the northeast, north, and northwest (Branan, 1968).

Evidence that the basin was becoming full is provided by coal seams in the upper Atoka and lower Desmoinesian section. Sedimentation continued until late Pennsylvanian time, when the Arbuckle Orogeny of southern Oklahoma took place (Branan, 1068). In early Permian time, Ouachita mountain building to the south of the basin compressed Arkoma Basin strata into a series of long, narrow, east-west anticlinal and synclinal folds (see section on Structure below).

All of the rock units cropping out in the Spiro quadrangle are of Pennsylvanian age, and include the Atoka Formation, as well as the Hartshorne, McAlester, and Savanna formations of the Lower Desmoinesian Krebs Group. The Hartshorne and McAlester formations are coal bearing in this quadrangle.

The Atoka Formation was named by Taff and Adams in 1900. It is the oldest exposed formation in the quadrangle, and crops out across the central section of it in conjunction with the Backbone Fault (Knechtel, 1949). The formation consists mostly of gray silty shale interbedded with ridge-forming brown or light gray sandstone units (Knechtel, 1949). The sandstone is highly variable in character, both from bed to bed and within a single bed. In most exposures it is fine-grained, silty and irregularly bedded; however, locally it may be coarse-grained, clean, and massive to thick-bedded. The Atoka Formation thickens somewhat across the quadrangle, from about 6000 feet (1830 m) in the northwest to 75000 feet (2288 m) in the southeast (Hendricks, 1930).

The Hartshorne Formation forms the basal unit of the Desmoinesian Series. It is most probably conformable with the underlying Atoka Formation (McDaniel, 1961, Oakes and Knechtel, 1948), although the sharp and irregular contact between the Hartshorene and Atoka formations has lead some observers to conclude that a minor unconformity separates them, at least locally (Hendricks, 1939, and Branson, 1962). The contact between the Hartshorne Formation and the overlying McAlester Formation is conformable (Hendricks, 1939).

The boundaries of the Hartshorne Formation have been modified several times since the unit was first mapped by H. M. Chance in 1890. Then called the "Tobucksy" sandstone, the formation was renamed the Hartshorne sandstone by Taff in 1899. Early workers defined the formation such that the Upper Hartshorne coal was considered to be part of the overlying McAlester Formation. However, Oakes and Knechtel (1948) recognized a convergence of the Upper and Lower Hartshorne coals in northern Le Flore and eastern Haskell counties, and redefined the formation to include both coals. The Hartshorne coal, undivided to the north, splits into Upper and Lower Hartshorne coals along a northeast-southwest trending line. This split line is only approximately located through the central part of the Spiro quadrangle due to erosion of the Hartshorne Formation in the area. The presently-used definition of the Hartshorne Formation is one proposed by McDaniel (1961), which supports the boundaries suggested by Oakes and Knechtel (1948), but formally divides the formation into upper and lower members where applicable (based on the above mentioned coal "split line").

The Hartshorne Formation is highly variable in character and thickness. In general it contains interbedded sandstones and shales which tend to become discontinuous as the upper and lower coals merge. The sands are for the most part fine-grained, brown to gray, silty and micaceous, and the shales are gray and sandy. Plant fossils are abundant in the shales. The formation is roughly 250 feet (76 m) thick in the Spiro quadrangle.

The McAlester Formation ranges from 1000 to 1500 feet (305 to 458 m) thick in the Spiro quadrangle, thinning to the north. It crops out quite extensively across the area, and lies conformably on the Hartshorne Formation. The McAlester Formation consists primarily of various unnamed shale units, but includes one shale member and several sandstone members as well. In acsending order, the McAlester Formation includes the McCurtain Shale Member, and the Warner, Lequire, Cameron, Tamaha, and Keota Sandstone members. Between each of these sandstones, and above the Keota Sandstone member, is an unnamed shale unit. The thickness given below of each individual member or unit has been estimated from well logs in the area.

The lowermost unit of the McAlester Formation is the McCurtain Shale member. This is a blue to dark gray, clayey shale with numerous siderite concretions and plant material (Knechtel, 1949). The McCurtain Shale Member contains a few thin sandstone units, including a locally persistent thin sandstone with an associated unnamed local coal found approximately 250 feet (76 m) above the base of the shale.

The most persistent sandstone of the McAlester Formation is the Warner Sandstone Member, a fine-grained, argillaceous unit which forms the first prominent escarpment stratigraphically above the Hartshorne Formation. This member forms the upper boundary of the McCurtain Shale. It is highly variable in thickness, ranging from 15 to 150 feet (5 to 46 m), and has a locally persistent coal associated with it. Above the Warner Sandstone is an unnamed shale unit which is dark gray, silty and fissile, and in the northern LeFlore County ranges an average in thickness from 120 to 300 feet (37 to

92 m) (Knechtel, 1949). Siderite concretions are common, and a few thin sandstones can be found within it.

The Lequire Sandstone Member of the McAlester Formation overlies this unnamed shale. This unit includes lenticular sandstone beds interbedded with siltstones and shales, and can include a thin local coal. It crops out in the southern part of the Spiro quadrangle, forming in most places low, inconspicuous ridges (Knechtel, 1949). To the north it is either absent or so close to either the Warner or Cameron sandstones that it has not been recognized as a separate unit (Knechtel, 1949). Units between the Lequire and Keota Sandstone members are highly variable in thicknesss and lateral extent. They include two unnamed shale units and the Cameron and Tamaha Sandstone members.

The Cameron Sandstone member is a buff to gray, fine-grained, ripple-marked sandstone with interbeds and lenses of shale and sandy shale. It ranges from 10 to 20 feet (3 to 6 m) in northern LeFlore County (Knechtel, 1949). In the Spiro quadrangle it is exposed on a long, narrow ridge southeast of Spiro (Knechtel, 1949). Overlying the Cameron is an unnamed gray shale unit with siderite concretions near the base and sandstone laminae throughout (Knechtle, 1949). This shale includes the Stigler coal, which crops out around Cameron Mountain in the southeast corner of the quadrangle.

The Tamaha Sandstone Member averages about 15 feet (5 m) thick in the area. In general it is buff to gray, fine-grained, micaceous, cross-bedded and hard. It crops out on Cameron Mountain, above the Stigler coal (Knechtel, 1949).

The Keota Sandstone Member, separated from the Tamaha by a fairly thick

(200 feet, 61 m) unnamed dark gray shale unit, is the uppermost sand member of the McAlester Formation. It is generally a silty, buff, fine-grained sandstone, ranging from 30 to 70 feet (9 to 21 m) thick, and tends to be erratic and discontinuous. It is not exposed in the Spiro quadrangle. A dark, fissile to blocky shale with siderite concretions marks the top of the McAlester Formation.

The Savanna Formation is the youngest formation to crop out in the Spiro quadrangle, and is found only in the extreme northwest corner of the quadrangle (Knechtel, 1949). It consists, in general, of buff to olive green, fine-grained, micaceous sandstones interbedded with gray to brown shales (Knechtel, 1949).

Quaternary deposits of alluvium cover some stream valleys and flood plains in the area.

Structure

The Spiro quadrangle lies within a zone of folded Pennsylvanian rocks characterized by broad, shallow synclines and narrow anticlines (Russell, 1960). The axes of these structures are commonly en echelon, and in general run parallel to the frontal margin of the adjacent Ouachita salient, marked by the Choctaw Fault. The principal surface structures in the Spiro quadrangle are shown on Plate 1. They include the Spiro anticline, the Coal Creek syncline, the Backbone fault, the Pocola anticline, and the James Fork syncline.

The Spiro anticline is a minor flexure trending in an east-west direction south of the town of Spiro. It is a low, westward plunging structure exposing rocks of the McAlester Formation (Knechtel, 1949). South of this is the Coal Creek Syncline another minor flexure characterized by Knechtel (1949) as a shallow structural depression.

The Backbone thrust fault extends across the central part of the Spiro anticline in a general east-west direction. Maximum displacement along the structure is more than 5000 feet (1525 m), exposing rocks of the Atoka Formation. The Hartshorne coals are exposed on both the north and south sides of the fault. Dips associated with the fault range from 15^{o} to 90^{o} and some overturned beds are present, particularly in connection with a small branch of the Backbone fault in Secs. 4 and 5 of T. 8 N., R. 26 E. (Knechtel, 1949).

Also associated with Backbone fault is the Pocola anticline, on the north side of the fault. This is a sharply crested fold with steep limbs, and is expressed in outcrops of the Atoka Formation (Knechtel, 1949). The axis of the Pocola anticline passes beneath the Backbone fault.

In the southwest corner of the Spiro quadrangle is the James Fork Syncline. This is a shallow structural trough plunging gently in a west-southwesterly direction. It ends near Cameron, just west of a prominent mesa (Cameron Mountian) which lies along its axis and is capped by an outlier of the Tamaha Sandstone (Knechtel, 1949).

COAL GEOLOGY

Several major coal beds have been identified in the Spiro quadrangle. They include in ascending order the Hartshorne coal bed and its lower and upper splits, the Stigler Lower McAlester coal bed, and the upper McAlester (Stigler Rider) coal bed. Only the Hartshorne coals have been mapped in this quadrangle, because the Stigler and Upper McAlester coals are not found on Federal coal land (Plate 2). In the Spiro quadrangle there is one measurement of a local coal which exceeds the Reserve Base thickness of 1 foot (0.3 m) and is treated as an isolated data point. A local coal 3 feet (0.9 m) thick has been identified in data point 1 (Plate 1).

Hartshorne Coal Bed and Upper and Lower Splits

The Hartshorne coals occur at or near the top of the Hartshorne Sandstone Formation. The split line for the Hartshorne Coal Bed has been approximately located through the center of the quadrangle, although it has not actually been observed due to erosion and Quaternary alluvium cover. The split line is defined in this report as the 1-foot interburden line (Plate 6). North of this line only one coal seam is present; such of it the seam is split into

Upper and Lower Hartshorne coals. The structure on these coals is presented on Plate 5, and the thickness of the interburden between the Upper and Lower Splits is shown on Plate 6. The interburden ranges from 1 foot at the split line to more than 20 feet (6 m).

All three Hartshorne coals are found at the surface in this quadrangle. They crop out in bands trending basically east-west across the quadrangle and dip away from the Backbone fault. The displacement of the Hartshorne crop line in the northeast corner on the boundary with the Hackett quadrangle suggests that the Hartshorne seam is faulted at that location. In addition, Knechtel had incorrectly correlated the coal in data points 91-94 as the Upper Hartshorne, thus incorrectly locating the crop line in Secs. 15 and 16 of T. 8 N., R. 26 E. This has been corrected on Plate 1, based on information from a Cameron Coal Co. property map (see Appendix I).

The isopach map of the Hartshorne coals is shown on Plate 4. The Hartshorne coal ranges from about 3 to 6 feet (0.9 to 1.8 m) thick, and has undergone some strip mining. The Lower Hartshorne coal varies from just under 2 feet (0.6 m) to almost 7 feet (2.1 m), and has been mined extensively. The Upper Hartshorne coal is thinner than either of the two above-mentioned coals, ranging from 1.5 to 4 feet (0.5 to 1.2 m) thick.

Structure map (Plate 5) for the Hartshorne coals indicates that there has been some minor faulting in the vicinity of Secs. 20 and 21, T8N, R26E. There also seems to be some faulting of the Hartshorne Formation connected with the James Fork syncline in the southeast corner of the quadrangle.

The interburden between the Upper and Lower Hartshorne coals (Plate 6) ranges from 1 foot (0.3 m) at the split line to more than 80 feet (24 m) in the southeast.

Stigler (Lower McAlester) and Upper McAlester Coal Beds

As previously mentioned, the Stigler and Upper McAlester coal beds crop out in the southeast and southwest corners of the Spiro quadrangle. However, due to the fact that they do not exist within the boundaries of Federal coal land in the quadrangle, these seams have not been mapped in this report.

Chemical Analyses of Coal

Chemical analyses were available for all three Hartshorne coals in this quadrangle. A summary of the analyses available is presented on Table 1. Average analyses are given, as in the range for all samples used to calculate each average value.

The coals are listed according to fixed carbon as determined on a dry, mineral-matter-free (mmf) basis. The "as received" FC values shown on Table 1 were converted to dry mmf FC figures according to the following formula: (American Society for Testing and Materials, 1975).

$$\text{Dry mmf FC} = \frac{\text{As rec'd FC} - 0.15\ S}{[100 - (M + 1.08\ A + 0.55\ S)]} \times 100$$

where M = moisture, A = ash, S = sulfur

Based on the average fixed carbon shown on Table 1, both the Hartshorne coal and the Lower Harthshorne coal are classified as low volatile bituminous coals, both having an average 83% dry mmf fixed carbon. Only one chemcial analysis was available for the Upper Hartshorne. Based on its high percentage of fixed carbon, it, too, is classified as low volatile bituminous.

Table 1. Average chemical analyses of coal in the Spiro quadrangle, Le Flore County, Oklahoma.

	HARTSHORNE COAL				LOWER HARTSHORNE COAL			UPPER HARTSHORNE COAL*
ANALYSIS %	FORM OF ANALYSIS	# OF SAMPLES	AVERAGE	RANGE	# OF SAMPLES	AVERAGE	RANGE	ANALYSIS %
PROXIMATE								
Moisture	A	11	2.9	2.5 - 4.7	12	2.5	1.8 - 3.5	-
Volatile Matter	A	11	15.9	14.5 - 17.0	12	16.5	15.5 - 17.4	-
	C	-	-	-	-	-	-	18.8
Fixed Carbon	A	11	67.4	64.9 - 70.9	12	73.1	70.4 - 74.3	-
	C	-	-	-	-	-	-	74.5
Ash	A	11	13.7	10.9 - 17.0	12	8.0	6.5 - 10.3	-
	C	-	-	-	-	-	-	6.8
ULTIMATE								
Sulfur	A	11	1.9	1.1 - 2.8	12	0.9	0.5 - 1.5	-
	C	-	-	-	-	-	-	1.1
Hydrogen	A	-	-	-	-	-	-	-
	C	-	-	-	-	-	-	-
Carbon	A	-	-	-	-	-	-	-
	C	-	-	-	-	-	-	-
Nitrogen	A	-	-	-	-	-	-	-
	C	-	-	-	-	-	-	-
Oxygen	A	-	-	-	-	-	-	-
	C	-	-	-	-	-	-	-
HEATING VALUE								
Calories	A	-	-	-	-	7,730	7,467 - 7,833	-
	C	-	-	-	-	-	-	-
Btu/lb	A	11	12,748	12,265-13,220	-	13,913	13,440-14,100	14,751
	C	-	-	-	-	-	-	-

Form of analyses: A = as received. C = moisture.
To convert Btu/lb to Kj/kg, multiply by 2.324
Source of data: Knechtel (1949) Agbe-Davies (1978)

*Only one chemical analysis was available for the Upper Hartshorne coal bed.

Isolated Data Points

In instances where single or isolated measurements of coal beds thicker than 1.0 foot (0.3 m) are encountered, the standard criteria for construction of isopach, structure contour, mining ratio, and overburden isopach maps are not available. The lack of data concerning these beds limits the extent to which they can be reasonably projected in any direction, and usually precludes their correlation with other, better known beds. For this reason, isolated data points have been mapped on separate figures for non-isopached coal beds. These figures are not included in this report, but are kept on file at the USGS office in Denver. However, coal reserves from these isolated data points are included in tables 2 and 3, and in the Reserve Base tonnages shown on Plate 2.

The only isolated data points in the Spiro quadrangle is a measurement of an unnamed local coal in data point 156 (Plate 1).

COAL RESOURCES

Data from drill holes, mine measured sections, outcrops, well logs and mine maps were used to construct outcrop, isopach, and structure contour maps of the various coal beds in the Spiro quadrangle (see below). The source of each indexed data point shown on Plate 1 is listed in Appendix I at the end of this report.

A system for classifying coal resources has been published by the U.S. Bureau of Mines and the U.S. Geological Survey, and published in U.S. Geological Survey Bulletin 1450-B (1976). Under this system, resources are classified as either Identified or Undiscovered. Identified Resources are specific bodies of coal whose location, rank, quality and quantity are known from geologic evidence supported by specific measurements, while Undiscovered Resources are bodies of coal which are thought to exist, based on broad geologic knowledge and theory.

Identified Resources may be subdivided into three categories of reliability of occurrence, according to their distance from a known point of coal-bed measurement. In order of decreasing reliability, these categories are: measured, indicated and inferred. Measured coal is that which is located within 0.25 mile (0.4 km) from a measurement point, indicated coal extends 0.5 mile (0.8 km) beyond measured coal to a distance of 0.75 mile (1.2 km) from the measurement point, and inferred coal extends 2.25 (3.6 km) miles beyond indicated coal, or a maximum distance of 3 miles (4.8 km) from the measurement point.

Undiscovered Resources may be either hypothetical or speculative. Hypothetical resources are those undiscovered coal resources that may reasonably be expected to exist in known coal fields under known geologic conditions. They are located beyond the outer boundary of inferred resources (see above) in areas where the coal-bed continuity is assumed, based on geologic evidence. Hypothetical resouces are those more than 3 miles (4.8 km) from the nearest measurement point.

Speculative resources are Undiscovered Resources that may occur in favorable areas where no discoveries have yet been made. Speculative resources have not been estimated in this report.

Coal resources for the Hartshorne coal and its upper and lower splits were calculated using data obtained from their coal isopach maps (Plate 4).

The coal bed acreage (measured by planimeter and calculated using the trapezoidal method (modified from Hollo and Fifadara, 1980) multiplied by the average thickness of the coal bed, and by a conversion factor of 1800 short tons of coal per acre-foot (13,238 metric tons per hectare-meter) for bituminous coal yields the coal resources in short tons. Coal resource tonnages were calculated for Identified Resources in the measure, indicated, and inferred categories for unleased Federal coal lands. All coal beds thicker than 1 foot (0.305 m) that lie less than 3000 feet (914 m) below the ground surface are included in these calculations. These criteria differ from those stated in U.S. Geological Survey Bulletin 1450-B, which calls for a minimum thickness of 28 inches (70 cm) and a maximum depth of 1000 feet (305 m) for bituminous coal. Narrow strips between mines where undisturbed coal is less than 75 meters from the nearest mine are considered to have no reserves and are included within mined-out areas. Mine boundaries are only approximately located (as stated in the legend on Plate 1), and therefore these narrow areas may in reality not even exist, For this reason they are considered to have no reserves, and have not been planimetered.

Reserve Base and Reserve tonnages for the above mentioned coal beds are shown on Plates 8 & 9, and have been rounded to the nearest 10,000 short tons (9,072 metric tons). In this report, Reserve Base coal is the gross amount of Identified Resources that occurs in beds 1 foot (0.3 m) or more thick and under less than 3,000 feet (914 m) of overburden. Reserves are the recoverable part of the Reserve Base coal. In the southeastern Oklahoma coal field, a recovery factor of 80 percent is applied toward surface-minable coal, and a recovery factor of 50 percent is applied toward subsurface-minable coal. No recovery factor is applicable for in-situ coal gasification methods.

The total tonnage per section for both Reserve Base and hypothetical coal, including both surface and subsurface minable coal is shown in the northwest corner of the Federal coal lands in each section on Plate 2. All values shown on Plate 2 are rounded to the nearest 10,000 short tons, and total approximately 74.94 million short tons (67.99 million metric tons) for the entire quadrangle, including tonnages in the isolated data points. Reserve Base tonnages from the various development potential categories for surface and subsurface mining and in-situ coal gasification methods are shown in tables 2 and 3.

The authors have not made any determination of economic recoverability for any of the coal beds described in this report.

COAL DEVELOPMENT POTENTIAL

Coal development potential areas are drawn to coincide with the boundaries of the smallest legal land subdivisions shown on Plate 2. In sections or parts of sections where no land subdivisions have been surveyed by the BLM, approximate 40-acre (16-hectare) parcels have been used to show to limits of the high, moderate, or low development potentials. A constraint imposed by the BLM specifies that the highest development potential affecting any part of a 40-acre (16-hectare) lot, tract, or parcel be applied to that entire lot, tract, or parcel. For example, if 5 acres (2 hectares) within a parcel meet the criteria for a high development potential; 25 acres (10 hectares), a moderate development potential; and 10 acres (4 hectares), a low development potential; then the entire 40 acres (16 hectares) are assigned a high development potential contains coal in beds with a nominal minimum areal extent of 1 acre (0.4 hectare).

Development Potential for Surface Mining Methods

Areas where the coal beds of Reserve Base thickness are overlain by 150 feet (46 m) or less of overburden are considered to have potential for surface mining and are assigned a high, moderate, or low development potential based on their mining ratios (cubic yards of overburden per ton of recoverable coal). The formula used to calculate mining ratios for surface mining of coal is as follows:

$$MR = \frac{t_o\ (cf)}{t_c\ (rf)}$$

where MR = mining ration

t_o = thickness of overburden in feet
t_c = thickness of coal in feet
rf = recovery factor (80 percent for this quadrangle)
cf = conversion factor to yield MR value in terms of cubic yards of overburden per short tons of recoverable coal:

0.896 for bituminous coal

Note: To convert mining ratio to cubic meters of overburden per metric ton of recoverable coal, multiply MR by 0.8428.

Areas of high, moderate, and low development potential for surface mining methods are defined as areas underlain by coal beds having respective mining ratio values of 0 to 10, 10 to 15, and greater than 15. These mining ratio values for each development potential category are based on economic and technological criteria and were provided by the U.S. Geological Survey.

Areas where the coal data are absent or extremely limited between the 150-foot (46 m) overburden line and the coal outcrop are assigned unknown development potential for surface mining methods. This applies to areas where coal bds 1.0 foot (0.305 m) or more thick are not known but may occur, and to those areas influenced by isolated data points. Limited knowledge pertaining to the areal distribution, thickness, depth and attitude of the coals in these areas prevents accurate evaluation of development potential in the high, moderate, or low categories. The areas influenced by isolated data points in this quadrangle contain no coal available for surface mining.

The coal development potential for surface mining methods is shown on Plate 10. A summary of all tonnage values is presented in table 2. Of Federal coal land not subject to currently outstanding coal lease, permit, license or preference right lease application having a known development potential for surface mining, 13 percent is rated high, none is rated moderate, and 10 percent is rated low. The remaining Federal land (77%) is classified as having no development potential for surface mining methods.

Development Potential for Subsurface Mining and In-Situ Coal Gasification Methods

Areas considered to have a development potential for conventional subsurface mining methods are those areas where the coal beds of Reserve Base thickness are between 150 and 3,000 feet (46 to 914 m) below the ground surface and have dips of 15° or less. Unfaulted coal beds lying between 150 and 3,000 feet (46 and 914 m) below the ground surface, dipping greater than 15°, are considered to have a development potential for in-situ coal gasification methods.

Areas of high, moderate, and low development potential for conventional subsurface mining methods are defined as areas underlain by coal beds at depths ranging from 150 to 1,000 feet (46 to 305 m), 1,000 to 2,000 feet (305 to 610 m), and 2,000 and 3,000 feet (610 to 914 m), respectively.

Table 2. Coal Reserve Base data for surface mining methods for Federal coal land (in short tons) in the Spiro quadrangle, Le Flore County, Oklahoma.

Coal Bed or Coal Zone	High Development Potential	Moderate Development Potential	Low Development Potential	Unknown Development Potential	Total
Upper Hartshorne	260,000	130,000	1,180,000	-	1,570,000
Hartshorne	20,000,000	6,340,000	-	-	26,340,000
Lower	450,000	240,000	1,600,000	-	2,290,000
Isolated Data Points	-	-	-	-	-
TOTAL	20,710,000	6,710,000	2,780,000	-	30,200,000

Table 3. Coal Reserve Base data for subsurface mining and in-situ gasification methods for Federal coal land (in short tons) in the Spiro quadrangle, Le Flore County, Oklahoma.

Coal Bed or Coal Zone	High Subsurface Development Potential	Moderate Subsurface Development Potential	Low Subsurface Development Potential	Low In-Situ Development Potential	Unknown Development Potential	Total
Upper Hartshorne	17,180,000	1,570,000	-	240,000	-	18,990,000
Hartshorne	380,000	180,000	770,000	-	-	1,300,000
Lower Hartshorne	20,270,000	3,770,000	-	280,000	-	24,320,000
Isolated Data Points	-	-	-	-	100,000	100,000
TOTAL	37,830,000	5,520,000	770,000	520,000	100,000	44,740,000

Areas where the coal data are absent or extremely limited between the 150-foot (46 to 914 m) below the ground surface are assigned unknown development potentials. This applies to areas where coal beds of Reserve Base thickness are not known, but may occur, and to those areas influenced by isolated data points. The areas influenced by isolated data points in this quadrangle contain approximately 0.10 million short tons (0.09 million metric tons) of coal available for conventional subsurface mining.

The coal development potential for conventional subsurface mining methods is shown on plate 11. A summary of all tonnage values is presented on table 3. Of Federal coal lands areas having a known development potential for conventional subsurface mining methods, 79 percent is rated high, 9 percent is rated moderate, and none is rated low. The remaining Federal land (12 percent) in the quadrangle is classified as having no development potential for conventional subsurface mining methods.

Based on criteria provided by the U.S. Geological Survey, coal beds of Reserve Base thickness dipping between 15^{o} and 35^{o}, regardless of tonnage, have a low development potential for the situ coal gasification methods. Beds dipping from 35^{o} to 90^{o}, with a minimum of 50 million tons of coal in a single unfaulted bed or multiple, closely spaced, approximately parallel beds have a moderate development potential for in-situ coal gasification methods. Coal lying between the 150-foot (46 m) overburden isopach and the outcrop is not included in total coal tonnages available because it is needed for cover and containment in the in-situ process. Approximately 210 acres in the Spiro quadrangle are classified as having a low development potential for in-situ coal gasification, however, all of this land also has a rating for conventional subsurface mining. No land in the quadrangle has a moderate development potential for in-situ gasification.

REFERENCES

American Society for Testing and Materials, 1980, Gaseous fuels; coal and coke; atmospheric analyses: 1980 Annual Book of ASTM Standards, Part 26, p. 225-226

Agbe-Davies, V.F., 1978, The geology of the Hartshorne coals in the Spiro and Hackett Quadrangles, Le Flore County, Oklahoma: M.S. thesis, Univ. of Oklahoma, 132 p.

Branan, C.B. Jr., 1968, Natural gas in Arkoma Basin of Oklahoma and Arkansas, in Natural Gases of North America, American Association of Petroleum Geologists Memoir 9, p. 1616-1635.

Branson, C.C., 1962, Pennsylvanian system of the Mid-Continent, in C.C. Branson (editor) Pennsylvanian system in the United States: American Association of Petroleum Geologists, Symposium, p. 431-460.

Chance, H.M., 1890, Geology of the Choctaw coal field: American Institute of Mining Engineers, Transactions, Vol. 18, p. 653-660.

Drake, N.F., 1897, A geological reconnaissance of the coal fields of the Indian Territory: American Philosophical Society Proceedings, Vol. 36, p. 326-419.

Donica, D.R., 1978, The geology of the Hartshorne coals (Desmoinesian) in parts of the Heavener 15' Quadrangle, Le Flore County, Oklahoma: M.S. thesis, Univ. of Oklahoma, 128 p.

Friedman, S.A., 1974, An investigation of the coal reserves in the Ozarks Section of Oklahoma and their potential uses: Ozarks Regional Commission Final Report, 117 p.

__________ 1978, A field guidebook to Desmoinesian coal deposits in part of the Arkoma Basin, eastern Oklahoma: American Association of Petroleum Geologist Petroleum Geologist, National Annual Meeting, Oklahoma City, Preconvention Field Trip 2, April 8-9, 1978, 62 p.

Hendricks, T.A., 1937, Geology and fuel resources of the southern part of the Oklahoma coal field, part 1 - The McAlester District, Pittsburg, Atoka, and Latimer Counties: U.S. Geological Survey Bulletin S74-A, p. 1-90.

__________ 1939, Geology and fuel resources of the southern part of the Oklahoma coal field, part 4 - The Howe-Wilburton District, Latimer and Le Flore counties: U.S. Geological Survey Bulletin 874-D, p. 254-300.

Hollo, R. and Fifadara, H., 1980, TI-59 reservoir engineering manual: Keplinger and Associates, Inc., Houston, 220 p.

Johnson, K.S., 1971, Reclamation of mined coal lands in eastern Oklahoma: Oklahoma Geology Notes, Vol. 31, no. 6, Dec. 1971, p. 111-123.

Knechtel, M.M., 1949, Geology and coal and natural gas resources of northern LeFlore County, Oklahoma: Oklahoma Geological Survey Bulletin 68, 76 p.

McDaniel, G., 1961, Surface stratigraphy of the Hartshorne Formation, LeFlore Latimer and Pittsburg Counties, Oklahoma, in Arkoma Basin and north-central Ouachita Mountains of Oklahoma, Tulsa-Ft. Smith Geological

Moose, J.E., and Searle, V.C., 1929, A chemical study of Oklahoma coals: Oklahoma Geological Survey Bulletin 51, 112 p.

Oakes, M.C., and Knechtel, M.M., 1948, Geology and mineral resources of Haskell County, Oklahoma: Oklahoma Geological Survey Bulletin 67, 136 p.

Russell, Dearl T., 1960, Geology of northern Latimer county, Oklahoma: Oklahoma Geological Survey Circular 50, 57 p.

Snider, L.C., 1914, Geology of east-central Oklahoma: Geological Survey Bulletin 17, 25 p.

Taff, J.A., 1899, Geology of the McAlester - Lebign coal field, Indian Territory: U.S. Geological Survey 19th Annual Report, Part 3, p. 423-456.

__________ 1902, The southwestern coal field: U.S. Geological Survey 22nd Annual Report, Part 3, p. 367-413.

__________ 1905, Progress of coal work in Indian Territory: U.S. Geological Survey Bulletin 260, p. 382-401.

__________ and Adams, G.I., 1900, Geology of the eastern Choctaw coal field, Indian Territory: U.S. Geological Survey 21st Annual Report, Part 2, p. 257-311.

Trumbull, James V.A., 1957, Coal resources of Oklahoma: U.S. Geological Survey Bulletin 1042-J, p. 307-382.

United States Congress Documents, 1910, Coal lands in Oklahoma: 61st Congress, 2 d Session, Senate Document 390, 374 p.

Wilson, C.W., Jr., and Newell, 1937, Geology of the Muskogee - Porum District Muskogee and McIntosh Counties Oklahoma: Oklahoma Geological Survey Bulletin No. 57, 155 p.

Zubovic, P., and others, 1967, Distribution of minor elements in some coals in the western and southwestern regions of the Interior coal province: U.S. Geological Survey Bulletin 1117-D, 33 p.

APPENDIX I. SOURCE AND RELIABILITY OF DATA USED ON PLATE 1.

Listed below is a point by point accounting as to the source and reliability of all information shown on Plate 1. Also presented are any notes or comments pertaining to individual data points.

DATA POINT #	LOCATION	INCREASING RELIABILITY →	1	2	3	4	5	REFERENCE	NOTES/COMMENTS
	SW SW	Location			x			Agbe-Davies, 1978, p. 71	Correlated incorrectly as
	Section 13	Overburden				x		Bore Hole V2	Hartshorne by Agbe-Davies.
1	T 9 N | R 26 E	Coal Thickness			x				
	SW SW	Location			x			Knechtel, 1949, Plate II,	Core.
	Section 13	Overburden				x		Table III, Bore Hole #1A	
2	T 9 N | R 26 E	Coal Thickness				x			
	SW SW	Location			x			Agbe-Davies, 1978, p. 81	Upper and lower Hartshorne
	Section 15	Overburden					x	Bore Hole V3	benches.
3	T 9 N | R 26 E	Coal Thickness				x			
	SE SE	Location			x			Agbe-Davies, 1978, p. 82	Upper and lower Hartshorne
	Section 18	Overburden					x	Bore Hole V4	benches.
4	T 9 N | R 26 E	Coal Thickness				x			
	SW SE	Location			x			Agbe-Davies, 1978, p. 84	Upper and lower Hartshorne
	Section 24	Overburden					x	Bore Hole V5	benches.
5	T 9 N | R 25 E	Coal Thickness				x			
	NE SE	Location					x	Samson, Christian #1, 1977	Induction Gamma log.
	Section 24	Overburden			x				
6	T 9 N | R 25 E	Coal Thickness		x					
	SE SE	Location			x			Agbe-Davies, 1978, p. 86	Upper and lower Hartshorne
	Section 19	Overburden					x	Bore Hole V6	benches.
7	T 9 N | R 26 E	Coal Thickness				x			
	SE NW	Location					x	Galaxy, Mainard #1, 1969	Induction Gamma log.
	Section 20	Overburden			x				
8	T 9 N | R 26 E	Coal Thickness		x					
	NE SE	Location			x			Agbe-Davies, 1978, p. 88	Upper and lower Hartshorne
	Section 20	Overburden					x	Bore Hole V7	benches.
9	T 9 N | R 26 E	Coal Thickness				x			
	SE SE	Location			x			Agbe-Davies, 1978, p. 71	
	Section 21	Overburden			x			Bore Hole V8	
10	T 9 N | R 26 E	Coal Thickness			x				
	SW NE	Location					x	Whittington, Aishman #1,	Induction Gamma log.
	Section 22	Overburden			x			1969	
11	T 9 N | R 26 E	Coal Thickness		x					

DATE POINT #	LOCATION	INCREASING RELIABILITY →	1	2	3	4	5	REFERENCE	NOTES/COMMENTS
	SE NE	Location			x			Agbe-Davies, 1978, p. 71	Correlated incorrectly in
	Section 22	Overburden			x			Bore Hole V9	Agbe-Davies thesis.
12	T 9 N | R 26 E	Coal Thickness			x				
	NE SE	Location			x			Agbe-Davies, 1978, p. 71	
	Section 22	Overburden			x			Bore Hole V10	
13	T 9 N | R 26 E	Coal Thickness			x				
	NE NW	Location			x			Agbe-Davies, 1978, p. 71	Correlated incorrectly in
	Section 23	Overburden			x			Bore Hole V11	Agbe-Davies thesis.
14	T 9 N | R 26 E	Coal Thickness			x				
	NE SW	Location			x			Agbe-Davies, 1978, p. 71	
	Section 23	Overburden			x			Bore Hole V12	
15	T 9 N | R 26 E	Coal Thickness			x				
	NE SE	Location			x			Agbe-Davies, 1978, p. 71	
	Section 23	Overburden			x			Bore Holew V13	
16	T 9 N | R 26 E	Coal Thickness			x				
	NE SE	Location			x			Agbe-Davies, 1978, p. 71	
	Section 23	Overburden			x			Bore Hole V14	
17	T 9 N | R 26 E	Coal Thickness			x				
	NW SW	Location			x			Knechtel, 1949, Plate II,	Core.
	Section 24	Overburden				x		Table III, Bore Hole #2B	
18	T 9 N | R 26 E	Coal Thickness			x				
	NE SW	Location			x			Knechtel, 1949, Plate II,	Core.
	Section 24	Overburden				x		Table III, Bore Hole #2A	
19	T 9 N | R 26 E	Coal Thickness			x				
	SW SE	Location			x			Knechtel, 1949, Bull 68,	Upper and lower Hartshorne
	Section 24	Overburden			x			Plate II, Table III, Bore	benches.
20	T 9 N | R 26 E	Coal Thickness			x			Hole #2	
	NW NE	Location			x			Knechtel, 1949 Map, Bore	Upper and lower Hartshorne
	Section 25	Overburden			x			Hole #3	benches.
21	T 9 N | R 26 E	Coal Thickness			x				
	NE NW	Location			x			Knechtel, 1949, Slope mine,	Upper and lower Hartshorne
	Section 25	Overburden	-	-	-	-	-	Measured Section #4	benches.
22	T 9 N | R 26 E	Coal Thickness			x				
	NW NW	Location			x			Agbe-Davies, 1978, p. 71	
	Section 25	Overburden			x			Bore Hole V36	
23	T 9 N | R 26 E	Coal Thickness			x				
	NW NW	Location			x			Knechtel, 1949, Table III,	Core.
	Section 25	Overburden				x		Plate II, Bore Hole #4A	
24	T 9 N | R 26 E	Coal Thickness			x				

DATE POINT #	LOCATION	INCREASING RELIABILITY	1	2	3	4	5	REFERENCE	NOTES/COMMENTS
	NE NE	Location			x			Agbe-Davies, 1978, p. 71	
	Section 27	Overburden			x			Bore Hole V37	
25	T 9 N R 26 E	Coal Thickness			x				
	NE NW	Location			x			Agbe-Davies, 1978, p. 73	
	Section 27	Overburden			x			Bore Hole V38	
26	T 9 N R 26 E	Coal Thickness			x				
	NE SE	Location			x			Agbe-Davies, 1978, p. 73	
	Section 28	Overburden			x			Bore Hole V39	
27	T 9 N R 26 E	Coal Thickness			x				
	NW SE	Location			x			Agbe-Davies, 1978, p. 73	
	Section 28	Overburden			x			Bore Hole V40	
28	T 9 N R 26 E	Coal Thickness			x				
	NE NW	Location			x			Agbe-Davies, 1978, p. 73	
	Section 28	Overburden			x			Bore Hole V41	
29	T 9 N R 26 E	Coal Thickness			x				
	NW NW	Location			x			Agbe-Davies, 1978, p. 74	
	Section 28	Overburden			x			Bore Hole V42	
30	T 9 N R 26 E	Coal Thickness			x				
	SE NW	Location			x			Agbe-Davies, 1978, p. 74	
	Section 28	Overburden			x			Bore Hole V43	
31	T 9 N R 26 E	Coal Thickness			x				
	SW SW	Location			x			Agbe-Davies, 1978, p. 74	
	Section 28	Overburden			x			Bore Hole V44	
32	T 9 N R 26 E	Coal Thickness			x				
	SW SW	Location			x			Agbe-Davies, 1978, p. 74	
	Section 28	Overburden			x			Bore Hole V45	
33	T 9 N R 26 E	Coal Thickness			x				
	SW SW	Location			x			Agbe-Davies, 1978, p. 74	
	Section 28	Overburden			x			Bore Hole V46	
34	T 9 N R 26 E	Coal Thickness			x				
	SW SW	Location			x			Agbe-Davies, 1978, p. 74	
	Section 28	Overburden			x			Bore Hole V47	
35	T 9 N R 26 E	Coal Thickness			x				
	NE SE	Location			x			Agbe-Davies, 1978, p. 74	
	Section 29	Overburden			x			Bore Hole V52	
36	T 9 N R 26 E	Coal Thickness			x				
	NE SE	Location			x			Agbe-Davies, 1978, p. 74	
	Section 29	Overburden			x			Bore Hole V51	
37	T 9 N R 26 E	Coal Thickness			x				

DATA POINT #	LOCATION	INCREASING RELIABILITY	1	2	3	4	5	REFERENCE	NOTES/COMMENTS
	SE NE	Location			x			Agbe-Davies, 1978, p. 74	
	Section 29	Overburden			x			Bore Hole V50	
38	T 9 N | R 26 E	Coal Thickness			x				
	SE NE	Location			x			Agbe-Davies, 1978, p. 74	
	Section 29	Overburden			x			Bore Hole V49	
39	T 9 N | R 26 E	Coal Thickness			x				
	NE NE	Location			x			Agbe-Davies, 1978, p. 89	Upper and lower Hartshorne
	Section 29	Overburden			x			Bore Hole V48	benches.
40	T 9 N | R 26 E	Coal Thickness			x				
	SW NE	Location			x			Agbe-Davies, 1978, p. 74	
	Section 29	Overburden			x			Bore Hole V53	
41	T 9 N | R 26 E	Coal Thickness			x				
	Center	Location			x			Agbe-Davies, 1978, p. 74	
	Section 29	Overburden			x			Bore Hole V54	
42	T 9 N | R 26 E	Coal Thickness			x				
	NE SW	Location			x			Agbe-Davies, 1978, p. 74	
	Section 29	Overburden			x			Bore Hole V55	
43	T 9 N | R 26 E	Coal Thickness			x				
	NW SW	Location			x			Agbe-Davies, 1978, p. 74	Coal thickness not reported
	Section 29	Overburden			x			Bore Hole V56	
44	T 9 N | R 26 E	Coal Thickness	-	-	-	-	-		
	SW SW	Location			x			Agbe-Davies, 1978, p. 74	
	Section 29	Overburden			x			Bore Hole V57	
45	T 9 N | R 26 E	Coal Thickness			x				
	SW SW	Location			x			Agbe-Davies, 1978, p. 75	
	Section 29	Overburden			x			Bore Hole V58	
46	T 9 N | R 26 E	Coal Thickness			x				
	SW SW	Location			x			Agbe-Davies, 1978, p. 75	
	Section 30	Overburden			x			Bore Hole V60	
47	T 9 N | R 26 E	Coal Thickness			x				
	SE NE	Location			x			Agbe-Davies, 1978, p. 90	
	Section 30	Overburden					x	Bore Hole V59	
48	T 9 N R 26 E	Coal Thickness			x				
	SE NE	Location					x	USGS files, 1975, Bore Hole	
	Section 26	Overburden				x		#9	
49	T 9 N | R 26 E	Coal Thickness				x			
	NE SE	Location			x			Agbe-Davies, 1978, p. 93	Detailed log in text not
	Section 31	Overburden					x	Bore Hole V62	complete. See also plates.
50	T 9 N | R 26 E	Coal Thickness			x				

DATA POINT #	LOCATION	INCREASING RELIABILITY	1	2	3	4	5	REFERENCE	NOTES/COMMENTS
	NW NE	Location			x			Agbe-Davies, 1978, p. 75	
	Section 32	Overburden			x			Bore Hole V63	
51	T 9 N R 26 E	Coal Thickness			x				
	SE NE	Location					x	Senate Document 390, p. 68	Dip 10^{o}, 800' N 27 W from
	Section 32	Overburden					x	Bore Hole #32, 1910	CEL. Fault has thrust this
52	T 9 N R 26 E	Coal Thickness					x		coal near surface
	SE SE	Location					x	Senate Document 390, p. 69	Core. Local. Coal 300'above
	Section 1	Overburden					x	Bore Hole #34, 1910	Hartshorne.
53	T 8 N R 25 E	Coal Thickness					x	1600'N, 50'W from Sec.	
	SE NW	Location			x			Agbe-Davies, 1978, p. 75	
	Section 12	Overburden			x			Bore Hole V67	
54	T 8 N R 25 E	Coal Thickness			x				
	SE NW	Location			x			Agbe-Davies, 1978, p. 75	0.2' Lower Hartshorne (not
	Section 12	Overburden			x			Bore Hole V68	believable).
55	T 8 N R 25 E	Coal Thickness		x					
	SE NW	Location			x			Agbe-Davies, 1978, p. 75	
	Section 12	Overburden			x			Bore Hole V66	
56	T 8 N R 25 E	Coal Thickness			x				
	SE NW	Location			x			Agbe-Davies, 1978, p. 75	
	Section 12	Overburden			x			Bore Hole V65	
57	T 8 N R 25 E	Coal Thickness			x				
	SW SE	Location			x			Knechtel, 1949, Bore Hole	
	Section 12	Overburden			x			#1	
58	T 8 N R 26 E	Coal Thickness			x				
	S/2 SE	Location				x		USGS files, 1952, Bore Hole	
	Section 12	Overburden				x		#117	
59	T 8 N R 26 E	Coal Thickness			x				
	S/2 SE	Location				x		USGS files, 1952, Bore Hole	
	Section 12	Overburden				x		#118	
60	T 8 N R 26 E	Coal Thickness			x				
	SE SE	Location				x		USGS files, 1953, Bore Hole	Core.
	Section 12	Overburden					x	#6	
61	T 8 N R 26 E	Coal Thickness					x		
	SE SE	Location			x			Knechtel, 1949, Bore Hole	
	Section 12	Overburden			x			#2	
62	T 8 N R 26 E	Coal Thickness			x				
	SW SW	Location			x			Knechtel, 1949, Bore Hole	
	Section 7	Overburden			x			#1	
63	T 8 N R 27 E	Coal Thickness			x				

DATE POINT #	LOCATION	INCREASING RELIABILITY →	1	2	3	4	5	REFERENCE	NOTES/COMMENTS
	NW NW	Location					x	BLM Emria Project, 1979,	
	Section 18	Overburden					x	Bore Hole DH-AB-16	
64	T 8 N | R 27 E	Coal Thickness					x		
	SW NE	Location					x	Senate Document 390, p. 67	Dip of strata 80°.
	Section 13	Overburden					x	Bore Hole #28, 1910	
65	T 8 N | R 26 E	Coal Thickness					x		
	N/2 N/2	Location				x		USGS files, 1952, Bore Hole	Rashy coal.
	Section 13	Overburden				x		#114	
66	T 8 N | R 26 E	Coal Thickness	x						
	S/2 N/2	Location		x				USGS files, 1953, Bore Hole	Core hole spotted N/2 N/2
	Section 13	Overburden					x	#10	on Rock Island, KRCRA map,
67	T 8 N | R 26 E	Coal Thickness					x		1978.
	N/2 N/2	Location				x		USGS files, 1952, Bore Hole	Bony and rashy coal zone.
	Section 13	Overburden				x		#113	
68	T 8 N | R 26 E	Coal Thickness	x						
	N/2 N/2	Location				x		USGS files, 1952, Bore Hole	
	Section 13	Overburden				x		#115	
69	T 8 N | R 26 E	Coal Thickness			x				
	N/2 N/2	Location				x		USGS files, 1952, Bore Hole	
	Section 13	Overburden				x		#116	
70	T 8 N | R 26 E	Coal Thickness			x				
	NE NW	Location				x		USGS files, 1953, Bore Hole	Core analysis made.
	Section 13	Overburden					x	#11	
71	T 8 N | R 26 E	Coal Thickness					x		
	N/2 NW	Location			x			Knechtel, 1949, Bore Hole	
	Section 13	Overburden			x			#4	
72	T 8 N | R 26 E	Coal Thickness			x				
	SW NW	Location				x		USGS files, 1953, Bore Hole	
	Section 13	Overburden					x	#4	
73	T 8 N | R 26 E	Coal Thickness				x			
	SE NE	Location				x		USGS files, 1953, Bore Hole	Bony and rashy coal zone.
	Section 14	Overburden				x		#109	
74	T 8 N | R 26 E	Coal Thickness		x					
	NW NW	Location				x		USGS files, 1953, Bore Hole	Core drill (w/ chemical
	Section 13	Overburden					x	#3	analysis).
75	T 8 N | R 26 E	Coal Thickness					x		
	NE NE	Location				x		USGS files, 1953, Bore Hole	
	Section 14	Overburden				x		#108	
76	T 8 N | R 26 E	Coal Thickness			x				

DATE POINT #	LOCATION		INCREASING RELIABILITY	1	2	3	4	5	REFERENCE	NOTES/COMMENTS
	NE NE		Location				x		USGS files, 1953, Bore Hole	
	Section 14		Overburden				x		#107	
77	T 8 N	R 26 E	Coal Thickness			x				
	NE NE		Location			x			Knechtel, 1949, Bore Hole	
	Section 14		Overburden			x			#5	
78	T 8 N	R 26 E	Coal Thickness			x				
	NW NE		Location			x			Knechtel, 1949, Bore Hole	
	Section 14		Overburden			x			#6	
79	T 8 N	R 26 E	Coal Thickness			x				
	S/2 N/2		Location				x		USGS files, 1953, Bore Hole	
	Section 14		Overburden				x		#96	
80	T 8 N	R 26 E	Coal Thickness			x				
	S/2 N/2		Location				x		USGS files, 1953, Bore Hole	
	Section 14		Overburden				x		#97	
81	T 8 N	R 26 E	Coal Thickness			x				
	SW NE		Location					x	BLM Emria Project, 1979,	
	Section 14		Overburden					x	Bore Hole DH-AB-17	
82	T 8 N	R 26 E	Coal Thickness					x		
	SE NW		Location				x		USGS files, 1953, Bore Hole	Bony and rashy coal. TD
	Section 14		Overburden		x				#103	reported incorrectly @ 47.9
83	T 8 N	R 26 E	Coal Thickness		x					
	SE NW		Location				x		USGS files, 1953, Bore Hole	Bony and rashy coal.
	Section 14		Overburden				x		#102	
84	T 8 N	R 26 E	Coal Thickness		x					
	SE NW		Location				x		USGS files, 1953, Bore Hole	
	Section 14		Overburden				x		#100	
85	T 8 N	R 26 E	Coal Thickness			x				
	SE NW		Location				x		USGS files, 1953, Bore Hole	Soft coal.
	Section 14		Overburden				x		#99	
86	T 8 N	R 26 E	Coal Thickness			x				
	S/2 NW		Location				x		USGS files, 1953, Bore Hole	
	Section 14		Overburden	-	-	-	-	-	#98	
87	T 8 N	R 26 E	Coal Thickness	-	-	-	-	-		
	S/2 NW		Location			x			Knechtel, 1949, Bore Hole	
	Section 14		Overburden			x			#7	
88	T 8 N	R 26 E	Coal Thickness			x				
	NW SW		Location			x			Knechtel, 1949, Bore Hole	
	Section 14		Overburden			x			#8	
89	T 8 N	R 26 E	Coal Thickness			x				

DATA POINT #	LOCATION	INCREASING RELIABILITY	1	2	3	4	5	REFERENCE	NOTES/COMMENTS
	NE SE	Location				x		USGS files, 1953, Bore Hole	Coal (analysis).
	Section 15	Overburden					x	#13	
90	T 8 N R 26 E	Coal Thickness					x		
	NE SE	Location					x	USGS files, Cameron Coal	Hole 9 in Knechtel, corre-
	Section 15	Overburden				x		Company, Mine Map 1944,	lation wrong.
91	T 8 N R 26 E	Coal Thickness				x		Bore Hole #106	
	NE SW	Location					x	USGS files, Cameron Coal	Hole 10 in Knechtel, corre-
	Section 15	Overburden				x		Company, Mine Map 1944,	lation wrong.
92	T 8 N R 26 E	Coal Thickness				x		Bore Hole #105	
	SW SW	Location					x	USGS files, Cameron Coal	Hole 11 in Knechtel, corre-
	Section 15	Overburden				x		Company, Mine Map 1944,	lation wrong.
93	T 8 N R 26 E	Coal Thickness				x		Bore Hole #104	
	SE SE	Location					x	USGS files, Cameron Coal	Hole 12 in Knechtel, corre-
	Section 16	Overburden				x		Company, Mine Map 1944,	lation wrong.
94	T 8 N R 26 E	Coal Thickness				x		Bore Hole #103	
	NW SW	Location					x	Oklahoma Department of	
	Section 24	Overburden				x		Mines Files, 1978-79, Bore	
95	T 8 N R 25 E	Coal Thickness				x		Hole P-1	
	NE SW	Location			x			Knechtel, 1949, Bore Hole	
	Section 24	Overburden			x			#31	
96	T 8 N R 25 E	Coal Thickness			x				
	SE SW	Location					x	Oklahoma Department of	
	Section 24	Overburden				x		Mines, 1978-79, Bore Hole	
97	T 8 N R 25 E	Coal Thickness				x		P-5	
	NW SE	Location			x			Knechtel, 1949, Bore Hole	
	Section 24	Overburden			x			#32	
98	T 8 N R 25 E	Coal Thickness			x				
	NW SE	Location			x			Knechtel, 1949, Bore Hole	Location appears wrong,
	Section 24	Overburden			x			#33	spotted due to drafting
99	T 8 N R 25 E	Coal Thickness			x				convenience.
	NE SE	Location			x			Knechtel, 1949, Bore Hole	Location spotted appears to
	Section 24	Overburden			x			#35	be wrong - moved for draft-
100	T 8 N R 25 E	Coal Thickness			x				ing convenience by Knechtel
	NE SE	Location			x			Knechtel, 1949, Bore Hole	
	Section 24	Overburden			x			#34	
101	T 8 N R 25 E	Coal Thickness			x				
	NW NE	Location					x	Oklahoma Department of	
	Section 25	Overburden				x		Mines files, 1978-79, Bore	
102	T 8 N R 25 E	Coal Thickness				x		Hole P-23	

DATA POINT #	LOCATION	INCREASING RELIABILITY	1	2	3	4	5	REFERENCE	NOTES/COMMENTS
	NW SW	Location			x			Knechtel, 1949, Bore Hole	Location spotted appears
	Section 19	Overburden			x			#13	to have been moved by
103	T 8 N | R 26 E	Coal Thickness			x				Knechtel.
	NW SW	Location			x			Knechtel, 1949, Bore Hole	
	Section 19	Overburden			x			#14	
104	T 8 N | R 26 E	Coal Thickness			x				
	SW SW	Location			x			Agbe-Davies, 1978, p. 76	
	Section 19	Overburden			x			Bore Hole V70	
105	T 8 N | R 26 E	Coal Thickness			x				
	SW SW	Location					x	Oklahoma Department of	Hit old mine while drilling
	Section 19	Overburden				x		Mines files, 1978-79, Bore	(at 354').
106	T 8 N | R 26 E	Coal Thickness				x		Hole P-18	
	SE SW	Location			x			Agbe-Davies, 1978, p. 76	
	Section 19	Overburden			x			Bore Hole V75	
107	T 8 N | R 26 E	Coal Thickness			x				
	SE SW	Location					x	Oklahoma Department of	
	Section 19	Overburden				x		Mines files, 1978-79, Bore	
108	T 8 N | R 26 E	Coal Thickness				x		Hole P-22	
	SE SW	Location			x			Agbe-Davies, 1978, p. 76	
	Section 19	Overburden			x			Bore Hole V74	
109	T 8 N | R 26 E	Coal Thickness			x				
	NE SW	Location			x			Knechtel, 1949, Bore Hole	
	Section 19	Overburden			x			#15	
110	T 8 N | R 26 E	Coal Thickness			x				
	NE SW	Location			x			Knechtel, 1949, Bore Hole	
	Section 19	Overburden			x			#16	
111	T 8 N | R 26 E	Coal Thickness			x				
	NW SE	Location			x			Agbe-Davies, 1978, p. 76	
	Section 19	Overburden			x			Bore Hole V72	
112	T 8 N | R 26 E	Coal Thickness			x				
	NW SE	Location			x			Knechtel, 1949, Bore Hole	
	Section 19	Overburden			x			#17	
113	T 8 N | R 26 E	Coal Thickness			x				
	NW SE	Location			x			Knechtel, 1949, Bore Hole	
	Section 19	Overburden			x			#18	
114	T 8 N | R 26 E	Coal Thickness			x				
	SE NE	Location			x			Knechtel, 1949, Bore Hole	See also Cameron Coal Com-
	Section 19	Overburden			x			#20	pany Mine Map, 1944.
115	T 8 N | R 26 E	Coal Thickness			x				

DATE POINT #	LOCATION	INCREASING RELIABILITY	1	2	3	4	5	REFERENCE	NOTES/COMMENTS
	NE SE	Location			x			Knechtel, 1949, Plate II,	
	Section 19	Overburden			x			Table III, Bore Hole #19	
116	T 8 N | R 26 E	Coal Thickness			x				
	SW SE	Location					x	Oklahoma Department of	
	Section 19	Overburden				x		Mines files, 1978-79, Bore	
117	T 8 N | R 26 E	Coal Thickness				x		Hole P-19	
	NW SW	Location			x			Agbe-Davies, 1976, p. 76	
	Section 20	Overburden			x			Bore Hole V76	
118	T 8 N | R 26 E	Coal Thickness			x				
	NW SW	Location				x		USGS files, 1946, Cameron	
	Section 20	Overburden	-	-	-	-	-	Coal Company Mine #2 Map	
119	T 8 N | R 26 E	Coal Thickness				x			
	NE SW	Location			x			Agbe-Davies, 1976, p. 76	
	Section 20	Overburden			x			Bore Hole V78	
120	T 8 N | R 26 E	Coal Thickness			x				
	NE SW	Location				x		USGS files, 1946, Cameron	
	Section 20	Overburden	-	-	-	-	-	Coal Company Mine #2 Map	
121	T 8 N | R 26 E	Coal Thickness				x			
	NE SW	Location				x		USGS files, 1946, Cameron	
	Section 20	Overburden	-	-	-	-	-	Coal Company Mine #2 Map	
122	T 8 N | R 26 E	Coal Thickness				x			
	SE SW	Location				x		USGS files, 1946, Cameron	
	Section 20	Overburden	-	-	-	-	-	Coal Company Mine #2 Map	
123	T 8 N | R 26 E	Coal Thickness				x			
	SW SE	Location				x		USGS files, 1946, Cameron	Dirty coal.
	Section 20	Overburden	-	-	-	-	-	Coal Company Mine #2 Map	
124	T 8 N | R 26 E	Coal Thickness				x			
	NW SE	Location			x			Agbe-Davies, 1978, p. 77	
	Section 20	Overburden			x			Bore Hole V80	
125	T 8 N | R 26 E	Coal Thickness			x				
	SW SE	Location				x		USGS files, 1946, Cameron	
	Section 20	Overburden	-	-	-	-	-	Coal Company Mine #2 Map	
126	T 8 N | R 26 E	Coal Thickness				x			
	SE NW	Location			x			Knechtel, 1949, Plate II,	Hole #B98, USGS files,
	Section 20	Overburden			x			Table III, Bore Hole #21	Cameron Coal Company,
127	T 8 N | R 26 E	Coal Thickness			x				Property Map, 1944.
	SW NE	Location			x			Knechtel, 1949, Plate II,	Hole #B99, USGS files,
	Section 20	Overburden			x			Table III, Bore Hole #23	Cameron Coal Company,
128	T 8 N | R 26 E	Coal Thickness			x				Property Map, 1944.

DATE POINT #	LOCATION	INCREASING RELIABILITY	1	2	3	4	5	REFERENCE	NOTES/COMMENTS
	SW NE	Location			x			Knechtel, 1949, Bore Hole	Hole #B100, USGS files,
	Section 20	Overburden			x			#22	Cameron Coal Company,
129	T 8 N | R 26 E	Coal Thickness			x				Property Map, 1944.
	NE SE	Location				x		USGS files, KRCRA map	
	Section 20	Overburden	-	-	-	-	-	(Rock Island) Bore Hole	
130	T 8 N | R 26 E	Coal Thickness	x					1978	
	SE SE	Location				x		USGS files, Cameron Coal	Dirty coal.
	Section 20	Overburden	-	-	-	-	-	Company Mine #2 Map	
131	T 8 N | R 26 E	Coal Thickness				x			
	SW SE	Location				x		USGS files, Cameron Coal	Dirty coal.
	Section 20	Overburden	-	-	-	-	-	Company Mine #2 Map	
132	T 8 N | R 26 E	Coal Thickness				x			
	SE SE	Location				x		USGS files, KRCRA map	Point not located on USGS
	Section 20	Overburden	-	-	-	-	-	(Rock Island) Mine Measured	Mine Maps.
133	T 8 N | R 26 E	Coal Thickness			x			Section 1978	
	SE SE	Location				x		USGS files, Mine Map (1944)	600' N 350'W of SE corner.
	Section 20	Overburden	-	-	-	-	-	Cameron Coal Company,	
134	T 8 N | R 26 E	Coal Thickness				x		Property Map	
	SE SE	Location			x			Agbe-Davies, 1978, p. 77	
	Section 20	Overburden			x			Bore Hole V81	
135	T 8 N | R 26 E	Coal Thickness			x				
	SW NE	Location				x		USGS files, 1946, Cameron	
	Section 21	Overburden	-	-	-	-	-	Coal Company, Mine #2 Map	
136	T 8 N | R 26 E	Coal Thickness				x			
	NW SW	Location				x		USGS files, 1946, Cameron	
	Section 21	Overburden	-	-	-	-	-	Coal Company, Mine #2 Map	
137	T 8 N | R 26 E	Coal Thickness				x			
	NW SW	Location			x			Agbe-Davies, 1978, p. 77	
	Section 21	Overburden			x			Bore Hole V82	
138	T 8 N | R 26 E	Coal Thickness			x				
	SW NW	Location				x		USGS files KRCRA map	Point not located on USGS
	Section 21	Overburden	-	-	-	-	-	(Rock Island) Mine measured	Mine Maps.
139	T 8 N | R 26 E	Coal Thickness			x			section.	
	SE NW	Location				x		Fieldner et al, 1922, p.224	Measured section located w/
	Section 21	Overburden	-	-	-	-	-		1908 Mine Map (USGS files)
140	T 8 N | R 26 E	Coal Thickness				x			of Williams Coal Company.
	N/2 N/2	Location					x	USGS files, 1944, Cameron	See also Knechtel, 1949,
	Section 21	Overburden				x		Coal Company, Mine Map	Bore Hole #24.
141	T 8 N | R 26 E	Coal Thickness				x		Bore Hole #102	

DATA POINT #	LOCATION	INCREASING RELIABILITY →	1	2	3	4	5	REFERENCE	NOTES/COMMENTS
	N/2 N/2	Location					x	USGS files, 1944, Cameron	See also Knechtel, 1949,
	Section 21	Overburden				x		Coal Mine Map, Bore Hole	Bore Hole #25.
142	T 8 N R 26 E	Coal Thickness				x		#101	
	NW NE	Location			x			Knechtel, 1949, Slope mine	Location from Williams
	Section 21	Overburden	-	-	-	-	-	Measured Section #26	Coal Company Mine Map, 1968
143	T 8 N R 26 E	Coal Thickness			x				
	NE NE	Location				x		Fieldner et al, 1922, p.224	Location from Williams
	Section 21	Overburden	-	-	-	-	-	Measured Section A	Coal Company Mine Map, 1968
144	T 8 N R 26 E	Coal Thickness				x			
	SE NE	Location				x		Fieldner et al, 1922, p.224	Location from Williams
	Section 21	Overburden	-	-	-	-	-	Measured Section B	Coal Company Mine Map, 1968
145	T 8 N R 26 E	Coal Thickness				x			
	SW NE	Location			x			Knechtel, 1949, Slope mine	Top somewhat indefinite on
	Section 25	Overburden	-	-	-	-	-	Measured Section #27	coal.
146	T 8 N R 26 E	Coal Thickness		x					
	SW NE	Location			x			Knechtel, 1949, Measured	
	Section 25	Overburden	-	-	-	-	-	Section #28	
147	T 8 N R 26 E	Coal Thickness				x			
	NE SW	Location					x	Leben Drilling, Needham 1-	KB 15' above GL. I-G log.
	Section 25	Overburden				x		25, 1970	
148	T 8 N R 26 E	Coal Thickness	-	-	-	-	-		
	C SE	Location			x			Headington Reed #1, 1971	KB 15' above GL. I-G log.
	Section 26	Overburden				x			Hartshorne FM is faulted
149	T 8 N R 26 E	Coal Thickness	-	-	-	-	-		out (approx. 350' fault).
	SW SE	Location			x			Knechtel, 1949, Coal Pros-	
	Section 26	Overburden	-	-	-	-	-	pect, Measured Section #29	
150	T 8 N R 26 E	Coal Thickness				x			
	SW SE	Location		x				Knechtel, 1949, p. 68,	Stigler coal on road cut.
	Section 26	Overburden	-	-	-	-	-	Line Measured Section #16	
151	T 8 N R 26 E	Coal Thickness			x				
	SW SW	Location			x			Agbe-Davies, 1978, p. 79	Put in thesis under BH.Prob
	Section 26	Overburden			x			Located Department Mines	a drillers log map shown
152	T 8 N R 26 E	Coal Thickness	x					Bore Hole V104	dry gas well UH too thick
	NW SE	Location					x	Sun Oil Company, Holton #1,	KB 13' above GL. E. Gamma
	Section 28	Overburden				x		1966	and Por. logs. UH not
153	T 8 N R 26 E	Coal Thickness		x					indicated.
	SW NW	Location					x	Oklahoma Department of	
	Section 29	Overburden				x		Mines Files, 1978-79,	
154	T 8 N R 26 E	Coal Thickness				x		Bore Hole P-20	

DATA POINT #	LOCATION	INCREASING RELIABILITY →	1	2	3	4	5	REFERENCE	NOTES/COMMENTS
	NE SW	Location					x	Texota Oil Company, Ball #1	D & G, E-logs. KB 12' above
	Section 29	Overburden				x		1967	GL. 1461' FWL, 1461' FSL.
155	T 8 N | R 26 E	Coal Thickness		x					
	SE NE	Location				x		Agbe-Davies 1978, p. 97	* See p. 79 & map for loca-
	Section 30	Overburden				x		Bore Hole V103	tion cored. Also from Okla-
156	T 8 N | R 26 E	Coal Thickness				x			homa Department of Mines.
	SE SW	Location					x	Dyco Petroleum Corporation	KB 15' above E, GL.
	Section 30	Overburden				x		Hardin #1, 1974	D & Gamma logs.
157	T 8 N | R 26 E	Coal Thickness		x					
	NW SE	Location				x		Agbe-Davies, 1978, p. 94	* See p. 79 & map for loca-
	Section 25	Overburden				x		Bore Hole V102	tion cored. Also from Okla-
158	T 8 N | R 25 E	Coal Thickness				x			homa Department of Mines.
	NE NW	Location			x			Knechtel, 1949, Coal pros-	Prospect pit.
	Section 36	Overburden	-	-	-	-	-	pect Measured Section #36	
159	T 8 N | R 25 E	Coal Thickness			x				
	SE NW	Location			x			Knechtel, 1949, Coal pros-	Prospect pit.
	Section 36	Overburden	-	-	-	-	-	pect Measured Section #37	
160	T 8 N | R 25 E	Coal Thickness			x				
	SW NE	Location			x			Amoco Oil Company, Basham	Gamma & Density logs.
	Section 36	Overburden			x			#1, 1972	
161	T 8 N | R 26 E	Coal Thickness		x					

APPENDIX II TABLES OF OIL AND GAS TEST HOLES

Note: "Top Log Int." refers to the measured depth to the top of the interval logged by the particular sonde. Driller log total depth, referenced to K.B. or D.F., has been abbreviated to T.D. (Note: This may vary from T.D. referenced to G.L.). The measured depth at which coal is reported on the scout card appears in the column titled "Scout Card Coal". The column titled "Harts./Drill./Scout" contains the measured depths drilled to the top of the Hartshorne Sandstone, as reported by the driller logs and the scout cards.

* Logged interval stratigraphically below Hartshorne Coals.

Sec-Tn-Rg	Operator/Farm Location	Driller Logs Coal Reported Thickness & Depth	Scout Card Coal	Harts. Drill. Scout	Top Log Int. Gamma Elec.	Top Log Int. Dens. Sonic	T.D. Year
1-8-25	Stephens/City of Spiro #1			NR			8982
	SE NE SW	NR	NR	NR			1971
12-8-25	Galaxy/#1 Kelly "C"			NR	49		9816
	SE NW	NR	NR	NR	49		1969
1-8-26	Midwest/#1 Casey			NR	615*		8525
	CNW SW NE	NR	NR	NR	615		1962
2-8-26	National/#1 Dugan			NR	*		7515
	CSE	NR	NR	NR			1979
2-8-26	Midwest/#1 Patton			NR	*		4535
	CNE SE	NR	NR	NR	595		1962
3-8-26	LeFlore Co. G&E/W-1-A Schurman			NR	*		4117
	NW NE SE		NR	NR			1945
3-8-26	LeFlore Co. G&E/#1 Sanders			NR	*		2257
	CNE SE		NR	NR			1945
3-8-26	LeFlore/W-1 Schurman			NR	*		4014
	CNE SE	NR	NR	NR			1944
3-8-26	LeFlore G & El./Sanders #W-2			NR	*		2640
	350 FSL 350 FWL of SE/4	NR					1945
5-8-26	Cleary/#1-5 Coleman			NR	502*		8841
	CSW	NR	NR	NR	502		1974
6-8-26	Sunray DX/#1 C. Craig			NR	1503*		5760
	NW	NR	NR	NR	1503*		1965
6-8-26	Cleary/#1-6 Sebo			890			7708
	CNE	NR	NR	NR			1976
9-8-26	Dyco/#1 Womack-Walters			NR			10020
	NW SW NE SW, 1785 FSL 1480 FWL	NR	NR	NR			1978

Sec-Tn-Rg	Operator/Farm Location	Driller Logs Coal Reported Thickness & Depth	Scout Card Coal	Harts. Drill. Scout	Top Log Int. Gamma Elec.	Dens. Sonic	T.D. Year
1-8-25	Stephens/City of Spiro #1			NR			8982
	SE NE SW	NR	NR	NR			1971
10-8-26	Midwest/#1 Mullens			NR	600*		4805
	NW SE NE, 3940 FSL 4040 FWL	NR	NR	NR			1963
11-8-26	Midwest/#1 Smith			NR			7497
	NW NW SE or 2615 FSL 2800 FWL	NR	NR	1854	1650*		1961
12-8-26	Midwest/#1 F. Morris			NR		3000*	9216
	SW NE, 3300 FSL 2840 FWL	NR	NR	NR	3016*		1961
13-8-26	Steve Gose/#1 A.F. Abbott			NR		5000*	6507
	NW NE SW, 2500 FSL 1640 FWL	NR	NR	NR	1370*		1962
20-8-26	Pan Amer./#1 Anthony			NR	1660*	6100*	9400
	CNW SE	NR	NR	NR	1660*		1965
21-8-26	Pan Amer./#1 C.C. Caldwell			NR	1050		8853
	CNW SE	NR	NR	1382	1050	1050	1964
22-8-26	Pan Amer./#1 Hicks			NR	1682		6925
	SE SE NW 200 FSL 2440 FWL	NR	NR	NR	1682	1682	1965
25-8-26	Lenen/#1-25 Needham			1315	100		6300
	SE NE SE or 1600 FSL 2300 FWL	NR	NR	1315	100		1970
26-6-26	Headington/#1 Reed			NR	962		6111
	CSE	NR	NR	NR	962		1972
26-8-26	LeFlore G&E/Mitchell #38			NR			1885
	SW SW SW	NR		NR			1923
27-8-26	Davis Bros./#1 Tucker			1090			6000
	SE NE SW	NR	NR				1979
28-8-26	Sun/#1 F. L. Holten			1050	815	1000	7077
	NW SE	NR	NR	1050	815		1966
28-8-26	Texas O&G/#1 Holten B			1780			7038
	CNW	NR	NR				1979
28-8-26	Texas O&G/#1 Holten "A"			NR			6479
	C S/2 S/2	NR	NR	NR			1979
29-8-26	Texota/#1 Ball			NR	596	900	6000
	SW NE SW, 1461 FSL 1461 FEL	NR	NR	1905	596		1967
30-8-26	Dyco/#1 Hardin			994	645	950	6200
	W/2 W/2 E/2 SW, 1320 FSL 1420 FWL	NR	NR	994	645		1974
34-8-26	LeFlore G&E/#40 Sparks			NR			1477
	SW NE NW	NR					1924
35-8-26	Cotton/#2 Needham "A"			1384	768	1300	6003
N/2 N/2	S/2 NW, 1220 FSL 1320 FWL of NW/4	NR	NR	1384	768		

Sec-Tn-Rg	Operator/Farm Location	Driller Logs Coal Reported Thickness & Depth	Scout Card Coal	Harts. Drill. Scout	Top Log Int. Gamma Elec.	Top Log Int. Dens. Sonic	T.D. Year
35-8-26	LeFlore G&E/#34 Merriman			NR			1537
	NW NE SE NW	NR					1923
35-8-26	LeFlore G&E/#36 J.P. McDow						1439
	NE NW SW NW	NR					1923
36-8-26	Amoco/#1 Bashman			NR	755	1424	6564
	CSW NE	NR	NR		755		1972
36-8-26	LeFlore G&E/McMurtrey #28			NR			2065
	NE SW SW NW	NR					1923
36-8-27	No information, location only:						
	NW NW						
18-8-27	LeFlore G&E/#25 Littman			NR			1607
	SE SW NW NW	NR	NR				1922
30-8-27	Headington/#1 Ferrar			NR			6000
	CSW	NR	NR	NR			1974
31-8-26	Trigg/#1 Basham French			1360			6600
	CNW	NR	NR	1360			1977
13-9-26	LeFlore Gas/#1 H.C. Goins			NR			7073
	SE NE SW	NR	NR	NR			1963
16-9-26	Samson/Davis #1			NR			7506
	SW SW	NR					1979
19-9-26	Monsanto/#1 Cox			NR	512		8410
	SW NE SW	NR	NR	NR	512		1968
19-9-26	Samson/#1 Watkins			NR			8500
	C W/2 SE	NR	NR	NR			1979
20-9-26	Kerr McGee/#1 Collins						1099
	NE NE NE				22		1959
20-9-26	Galaxy/# Mainard			NR	557	2550	8095
	NE SW SE NE	NR	NR	NR	557		1969
20-9-26	French & Walker/#1 Mackey			1075			8070
	N/2 S/2 NE NE	NR	NR	1075			1979
21-9-26	Stephens/#2 R. McDonald			NR		7000	8150
	C W/2 NE	NR	NR	NR	1109		1977
21-9-26	Stephens/#2 McDonald			NR			6134
	SE SE NE SW	NR	NR	NR			
22-9-26	Seneca/#1 Parsons			NR	1100*	2000*	7978
	CNW	NR	NR	NR	1100*		1978

Sec-Tn-Rg	Operator/Farm Location	Driller Logs Coal Reported Thickness & Depth	Scout Card Coal	Harts. Drill. Scout	Top Log Int. Gamma Elec.	Dens. Sonic	T.D. Year
22-9-26	Wittington/Aishman			NR	100	2250	7850
	600 FSL 900 FWL of NE/4	NR	NR	NR	100		1970
22-9-26	Seneca/#1 Cram						7698
	CSW SW	NR	NR				1980
23-9-26	Sunset/Conrad #1			NR	50	1700	7115
	660 FSL 325 FWL of NE/4	NR	NR	NR	1049		1969
24-9-26	LeFlore Co. Gas/#1 M.S. Tidwell			NR	1431	6100	7464
	SW NW SW NE	NR	NR	NR			1963
25-9-26	LeFlore/#1 Bolt			NR			4417
	SW SW SE	NR	NR	NR			1936
26-9-26	Ferguson/#1 Kannady			NR		6700	7988
	CNW NE	NR	NR	NR	623*		1971
27-9-26	Stephens/#1 Myers			NR			7503
	1290 FSL 1350 FWL of NW/4	NR	NR	NR			1978
28-9-26	Stephens/#1-28 R. Reed			NR			8081
	C W/2 NE	NR	NR	NR			1977
28-9-26	LeFlore Co. O&G/#3 M. Johnson			NR			1191
	NE NE NW	NR	NR	NR			1946
29-9-26	LeFlore G&E/#2 Greenwood			NR			3021
	NE SE SW SW	NR	NR	NR			1946
29-9-26	Hanna O&G/#1 Welker			1200			8500
	S/2 S/2 S/2 NE	200' @ 1200	NR	1200			1978
30-9-26	Gose/#1 Walker			NR	1440*	5500*	8600
	CNE SW	NR	975	NR	1440*		1967
30-9-26	Hanna/#1 Race Track			NR			8583
	2540 FSL 1320 FWL of SW/4	NR	NR	NR			1979
31-9-26	Sunray DX/#1 J. Craig			NR			8686
	CNW	NR	973	NR	1494*	4800	1963
32-9-26	Sunray DX/#1 J.H. Greenwood			NR	1553	3850	8691
	NE SE NW	NR	NR	NR	1553		1964
32-9-26	Seneca/#1 Watts			NR			8417
	CSW	NR	NR	NR			1978
33-9-26	Hanna/#1 Ellen Christain			NR	1520	0	8025
	C N/2	NR	NR	NR	1520		1978
34-9-26	Seneca/#1 Tojac			NR			7978
	1280 FSL 2610 FWL of NW/4	NR	NR	NR			1978

Sec-Tn-Rg	Operator/Farm Location	Driller Logs Coal Reported Thickness & Depth	Scout Card Coal	Harts. Drill. Scout	Top Log Int. Gamma Elec.	 Dens. Sonic	T.D. Year
34-9-26	E. Cox/#1 Branston			NR	1370		7923
	CNW	NR			1370		1979
35-9-26	Stephens/#1 Tojac			NR			7623
	1590 FNL 825 FWL of NW/4	NR	NR	NR			1978