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

(Report includes 11 plates)

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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 Panama 7.5-minute quadrangle, Le Flore County, Oklahoma.

This report was compiled 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 Published and unpublished publicly available information was used as the data base for this study.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 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 is within Le Flore County. The city of McAlester is 65 miles (104 km) west of the quadrangle, and the city of Tulsa is approximately 100 miles (160 km) northwest of the quadrangle.

The town of Panama is the largest settlement in the quadrangle. Other sizeable town(s) include Shady Point in the south and Sunset Corner in the north. The western edge of the town of Spiro falls just within the quadrangle boundary in the northeast.

Accessibility

The town of Panama is located slightly south and east of the center of the quadrangle. U.S. Routes 271 and 59 run north-south through town. State Route 31 intersects with Routes 271 and 59 approximately 2 miles (3.2 km) north of the town of Panama, and heads west toward Bokoshe. Five miles (9 km) north of Panama these two routes meet State Route 9 and divide: Highway 59 heads west, and Highway 271 heads east.

Railroads serving the Panama quadrangle include Kansas City Southern and the Texas and Pacific railroads, which run through the town of Panama, and the Fort Smith and Van Buren Railroad, which joins the Kansas City Southern about a mile northeast of Panama.

Many light-duty and unimproved dirt roads provide access to almost every section in the quadrangle.

Physiography

The Panama quadrangle is in the Arkoma Basin on the northern edge 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 south of the quadrangle.

Much of the region is hilly, due largely to the action of streams on bedrock strata with differing capacities for resisting erosion (Knechtel, 1949). The landscape is characterized by long, sinuous, nearly parallel 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 quadrangle is only about 220 feet (61 m) from a low elevation of about 420 feet (128 m) in the river valley to a high of about 640 feet (195 m) on the tops of hogbacks.

The Poteau River flows through the southeast quarter of the quadrangle; both the James Fork and Brazil Creek flow into the river there. Numerous other small creeks and intermittent streams also provide drainage in 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 percipitation 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 lands in the Panama quadrangle total approximately 16,400 acres (6637 hectares) or 42% of the quadrangle. Of that, 3410 acres (1380 hectares), or 20% are leased (as of October 19, 1979), 3140 acres (1270 ha) or 19% are unleased, and the remaining 9,830 acres (3978 hectares) are part of the Spiro-Bokoshe Known Recoverable Coal Resources Area (KRCRA) (Plate 2).

GENERAL GEOLOGY

Previous Work

Much work has been done on the southeastern Oklahoma coal field. The first geologic study of the region 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 Panama quadrangle was obtained from USGS files.

In recent years a number of masters theses have been done on the Southeastern Oklahoma coal field. Craney (1978) carried out a study of the Hartshorne coals in the Panama quadrangle, and much of his work has been encorporated 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, 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, 1968). 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 Panama 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 the oldest exposed formation in the quadrangle, and crops out in the central and northwestern section of it (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 irregulary bedded; however, locally it may be coarse-grained, clean, and massive to thick-bedded. The Atoka Formation thickens somewhat across the quadrangle, from about 4000 feet (1220 m) in the northwest to 8000 feet (2440 m) in the southeast (Hendricks, 1939).

The Hartshorne Formation, which forms the basal unit of the Desmoinesian Series, crops out on the limbs of the Milton and Backbone anticlines in the Panama quadrangle (Knechtel, 1949). It is most probably conformable with the underlying Atoka formation (McDaniel, 1961, Oakes and Knechtel, 1948), although the sharp and irregular contact between the Hartshorne 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 LeFlore 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 cuts across the central part of the Panama quadrangle (Plate 6). 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 discontinous 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 300 feet (92 m) thick in the Bokoshe quadrangle.

The McAlester Formation averages 1600 feet (488 m) thick in the Panama quadrangle and thins to the north. It crops out around the axis of the Bokoshe syncline in the north-northwest, and in the southern part of the quadrangle, 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 ascending 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). It varies from 575 to 775 feet (175 to 236 m) thick in the Panama quadrangle. The McCurtain Shale contains 3 thin sandstone units overlain by thin local coals (Craney, 1978).

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 45 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 northern LeFlore County ranges 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 two lenticular sandstone beds interbedded with siltstones and shales, and can include a thin local coal. In the Panama quadrangle it crops out around the Bokoshe syncline (Knechtel, 1949). The lower Lequire is present in the southern part of the quadrangle and pinches out to the north and west, and the upper Lequire sandstone is found in the north and pinches out to the south and west (Craney, 1978). Units between the Lequire and Keota Sandstone members are highly variable in thickness and lateral extent. They include two unnamed shale units and the Cameron and Tamaha

Sandstone members.

The Cameron Sandstone in the Panama area is a buff to gray, fine grained ripple-marked sandstone. It is exposed around the Bokoshe syncline and on the north side of the Cavanal syncline, where it forms prominent ridges (Knechtel, 1949). Overlying the Cameron is an unnamed gray shale unit with siderite concretions near the base and sandstone laminal throughout (Knechtel, 1949). This shale includes the Stigler (Lower McAlester) coal, which crops out in the south of the Panama quadrangle. Virtually no specific information was available for the Stigler coal in the study area, and it has not been evaluated in this report.

The Tamaha Sandstone member averages about 20 feet (6 m) thick in the area. In general, it is buff to gray, fine-grained, micaceous, cross-bedded and hard. Like the Cameron, the Tamaha Sandstone tends to be discontinuous. In the Panama quadrangle it crops out as rounded inconspicuous to prominent ridges (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. A dark fissile to blocky shale with siderite concretions marks the top of the McAlester Formation.

The Savanna Formation crops out in the northeast corner and in the southernmost part of the Panama quadrangle (Knechtel, 1949). At least 63 feet (19m) of the lowest unnamed sandstone unit of the formation is exposed. This is overlain by about 200 feet (61 m) of shale in the south. These sandstone beds are generally brown, dense, fine-grained and micaceous, and the interbedded shales are brown to grayish green. The Savanna is the youngest formation exposed in the Panama quadrangle.

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

Structure

The Panama quadrangle lies within a zone of folded Pennsylvanian rocks characterized by broad, shallow synclines and narrow anticlines (Knechtel, 1949). 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 Panama quadrangle are shown on Plate 1. These include the Milton anticline, the Bokoshe syncline, the Spiro anticline, the Coal Creek syncline, the Backbone anticline and the Backbone fault.

The Milton anticline passes through the northeast corner of the Panama quadrangle, exposing rocks of the Atoka Formation. The structure of the Milton anticline is essentially that of a great elongate asymmetrical dome, with the steeper limb on the southern side. It does, however, include a number of minor flexures and faults (Knechtel, 1949). A down-to-the-south normal fault interrupts the axis of the anticline in Secs. 13 and 23 of T. 9 N., R. 24 E., offsetting Atoka strata by about 400 feet (122 m) vertical displacement (Knechtel, 1949). Other normal faulting interrupts the Hartshorne Formation, and the outcrop of the Hartshorne coal, in Sec. 18 of T. 9 N., R. 25 E.

The Bokoshe syncline extends across the Panama quadrangle from west to northeast. The deepest part of the syncline occurs northeast of the quadrangle. The Hartshorne coal reaches a depth of about 1200 feet (366 m) in the Bokoshe syncline in the northeast corner of the quadrangle. On the north limb of the syncline of the Hartshorne coal crops out as a single seam; south of the axial trace of the structure the Upper and Lower Hartshorne coals are found.

The Spiro anticline and Coal Creek syncline are parallel structures that extend approximately 1.5 miles (2.4 km) inside the eastern boundary of the quadrangle. Both are relatively minor flexures: the Coal Creek syncline is a shallow structural depression, and the Spiro anticline is a low, westward plunging structure exposing rocks of the McAlester Formation (Knechtel, 1949).

The Backbone anticline is a long (30 miles, 48 km) westward plunging structure terminating west of the Panama area in the Bokoshe quadrangle. The anticline is broken along its crest by the Backbone fault, along which rocks on the south side have been thrust upward more than 5000 feet (1525 m) (Knechtel, 1949). Near Panama there is a local sag in the structure, west of which is an elongate dome having an apex in Sec. 7 of T. 8 N., R. 25 E. (Knechtel, 1949).

Rocks of the Atoka Formation are the oldest exposed along the Backbone anticline. On the south limb of the structure and along most of the north limb, the Atoka is bordered by narrow belts of coal-bearing Hartshorne sandstone. Farther out on both sides are broad exposures of the McAlester Formations (Knechtel, 1949).

COAL GEOLOGY

Several major coal beds have been identified in the Panama quadrangle. They include in ascending order: the Hartshorne coal bed and its lower and upper splits; an unnamed local coal; and the Stigler (Lower McAlester) and the Upper McAlester coal beds. Due to a lack of information on the latter, only the Hartshorne coals are mapped and discussed in detail in this report.

In the Panama quadrangle there is one measurement of an unnamed local coal that exceeds the Reserve Base thickness of 1 foot (0.3 m), in data point 70 (Plate 1). This has been treated as an isolated data point.

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 runs through the north half of the quadrangle. 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; south 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 100 feet (31 m).

Isopach maps for the Hartshorne coals are shown on Plate 4. The Hartshorne coal in the Panama quadrangle ranges from less than 2 feet (0.6 m) to almost 7 feet thick. Across most of the northern portion of the area it averages about 4 or 5 feet (1.2 to 1.5 m) thick. The Hartshorne coal has been mined along its cropline in the northwest corner of the quadrangle.

South of the split line the Upper Hartshorne coal varies from approximately 2 feet (0.6 m) thick to an anomalously thick measurement of 9.5 feet in Sec. 12, T. 8 N., R. 24 E. Local faulting may help to explain this.

The Lower Hartshorne varies from about 1 to 4.5 feet (0.3 to 1.4 m) thick. Both it and the Upper Hartshorne have been mined, particularly in the southern portion of the quadrangle.

Stigler (Lower McAlester) and Upper McAlester Coal Beds

Crop lines for the Stigler and Upper McAlester coals have been inferred in the southern part of the Panama quadrangle (Knechtel, 1949). However, no specific information on these coals in the study area was available, and they 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 in Table 1. Average analyses are shown here, as well as the range for all samples used to calculate each average value.

The coals are classified according to fixed carbon (FC), as determined on a dry, mineral-matter-free (mmf) basis. The "as received" FC values shown on Table 1 were coverted to dry mmf FC figures according to the following formula (American Society for Testing and Materials, 1980):

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

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

Based on the average FC shown on Table 1, all Hartshorne coals are classified as low volatile bituminous coals, with the Upper Hartshorne having an average 81% dry mmf fixed carbon, the Lower Hartshorne having an average 83% dry mmf fixed carbon, and the Hartshorne coal having an average 82% dry mmf fixed carbon.

Isolated Data Points

In instances where single or isolated measurments of coal beds thicker than 1.0 foot (0.3 m) are encountered, the standard criteria for construction

Table 1. Average chemical analyses for coals in the Panama quadrangle, LeFlore County, Oklahoma.

	Hartshorne Coal Bed				Upper Hartshorne Coal			Lower Hartshorne Coal		
ANALYSIS	Form of Analysis	# of Samples	Average	Range	# of Samples	Average	Range	# of Samples	Average	Range
PROXIMATE										
Moisture	A	5	1.5	0.9-2.0	2	2.1	---	7	3.0	2.6-3.2
	A	5	17.3	16.6-19.0	2	18.0	17.2-18.8	7	16.7	15.9-18.3
Volatile Matter	C	3	16.6	15.7-17.3	1	18.0	---	5	17.2	16.5-18.8
	A	5	71.7	56.2-78.4	2	73.0	72.1-73.9	7	75.2	73.6-77.3
Fixed Carbon	C	3	75.7	74.1-77.9	1	75.0	---	5	76.7	74.0-79.3
	A	5	9.5	4.1-23.4	2	6.9	6.8-7.0	7	5.2	3.8-6.9
Ash	C	3	7.3	6.5-7.9	1	7.0	---	5	5.8	4.2-7.1
ULTIMATE										
	A	5	1.3	0.5-2.7	2	0.8	0.8	7	0.9	0.8-1.3
Sulfur	C	3	1.7	1.3-2.3	1	0.8	---	5	1.0	0.7-1.3
	A	2	4.2	---	1	4.2	---	1	4.8	---
Hydrogen	C	2	4.2	4.1-4.2	1	4.1	---	1	4.6	---
	A	2	81.3	81-81.5	1	82.8	---	1	84.0	---
Carbon	C	2	82.0	81.7-82.3	1	84.6	---	1	86.6	---
	A	2	1.7	---	1	1.9	---	1	1.7	---
Nitrogen	C	2	1.7	---	1	1.9	---	1	1.8	---
	A	2	3.8	---	1	3.5	---	1	4.6	---
Oxygen	C	2	3.1	3.0-3.1	1	1.6	---	1	2.0	---
HEATING VALUE										
	A	0	---	---	2	7847	7844-	7	7949	7760-8078
Calories	C	0	---	---	---	---	7850	1	8322	---
BTU/lb	A	5	13,477	10,811-14,694	---	14,125	14,120-	7	14,310	13,970-
					---	---	14,130	1	14,980	14,800

Form of Analysis: A = as received, C = moisture free.
To convert Btu/lb to Kj/Kg, multiply by 2.326
Source of data: Knechtel, (1949) and Craney (1978).

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 should on Plate 2.

The only isolated data point in the Panama quadrangle is a measurement of an unnamed local coal in data point 70 (see plate 1 for location).

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 Panama 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 miles (3.6 km) 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 resources are those more than 3 miles (4.8 km) from the nearest measurement point. There are no hypothetical resources in this quadrangle.

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 were calculated using data obtained from the 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 measured, 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 and 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 Reserve Base coal, including both surface and subsurface-minable coal, is shown in the northwest corner of the Federal coal land in each section on Plate 2. All values shown on Plate 2 are rounded to the nearest 10,000 short tons (9,072 metric tons), and total approximately 132.91 million short tons (120.58 million metric tons) for the entire quadrangle, including tonnages in the isolated data points. Reserve Base and hypothetical 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-ha) lot, tract, or parcel be applied to that entire lot, tract, or parcel. For example, if 5 acres (2 hectare) within a parcel meet the criteria for a high development potential; 25 acres (10 hectare), a moderate development potential; and 10 acres (4 hectare), a low development potential; then the entire 40 acres (16 hectare) are assigned a high development potential. For purposes of this report, any lot or tract assigned a coal 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 beds 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

Table 2. Coal Reserve Base data for surface mining methods for Federal Coal Land (in short tons) in the Panama 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	550,000	200,000	3,480,000	---	4,230,000
Hartshorne	60,,000	20,000	210,000	---	290,000
Lower Hartshorne	530,000	260,000	3,610,000	---	4,400,000
Isoldated Data Points	---	---	---	---	---
Total	1,140,000	480,000	7,300,000	---	8,920,000

Table 3. Coal Reserve Base data for subsurface mining and in-situ gasification methods for Federal coal land (in short tons) in the Panama 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	25,920,000	16,640,000	--	3,240,000	--	45,800,000
Hartshorne	580,000	25,170,000	--	2,040,000	--	27,790,000
Lower Hartshorne	27,200,000	20,140,000	--	2,830,000	--	50,170,000
Isolated Data Points	--	--	--		230,000	230,000
TOTAL	53,700	61,950,000	--	8,110,000	230,000	123,990,000

for surface mining.

The coal development potential for surface mining methods is shown on Plate 10. All tonnage values are summarized on 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, 10 percent is rated high, 1 percent is rated moderate, and 7 percent is rated low. The remaining Federal land (82 percent) are classified as having unknown or 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.

Areas where the coal data are absent or extremely limited between 150 and 3,000 feeet (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 approximatlely 0.23 million short tons (0.21 million metric tons) of coal available for conventional subsurface mining.

The coal development potential for conventional subsurface mining or in-situ gasification methods is shown on plate 11. A summary of all tonnage values is presented on Table 3. Of Federal coal land areas having a known development potential for these mining methods, 56 percent is rated high, 36 percent is rated moderate, and none is rated low. Four percent of the remaining Federal land in the quadrangle is classified as having unknown or no development potential for either conventional subsurface mining or in-situ gasification methods.

Based on criteria provided by the U.S. Geological Survey, coal beds of Reserve Base thickness dipping between 15° and 35°, regardless of tonnage, have a low development potential for in-situ coal gasification methods. Beds dipping from 35° to 90°, 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.

In the Panama quadrangle, 14% of all Federal coal land has a low development potential for in-situ gasification methods. However, 70% of this land also has development potential for conventional subsurface mining methods. There is no land with a moderate development potential for in-situ gasification.

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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
	NE SW	Location			x			Craney, 1978, plates 8 & 9	
	Section 17	Overburden		x				Bore Hole	
1	T 9 N | R 25 E	Coal Thickness			x				
	SE SE	Location				x		Craney, 1978, plates 8 & 9	
	Section 18	Overburden		x				Bore Hole	
2	T 9 N | R 25 E	Coal Thickness			x				
	SE SE	Location				x		Craney, 1978, plates 8 & 9	
	Section 18	Overburden		x				Bore Hole	
3	T 9 N | R 25 E	Coal Thickness			x				
	SW SE	Location				x		Craney, 1978, plates 8 & 9	Hartshorne faulted out.
	Section 18	Overburden		x				Bore Hole	
4	T 9 N | R 25 E	Coal Thickness			x				
	NW SE	Location				x		Craney, 1978, plates 8 & 9	
	Section 18	Overburden		x				Bore Hole	
5	T 9 N | R 25 E	Coal Thickness			x				
	SW SE	Location				x		Craney, 1978, plates 8 & 9	
	Section 18	Overburden		x				Bore Hole	
6	T 9 N | R 25 E	Coal Thickness			x				
	SW SE	Location				x		Craney, 1978, plates 8 & 9	
	Section 18	Overburden		x				Bore Hole	
7	T 9 N | R 25 E	Coal Thickness			x				
	SE SW	Location				x		Craney, 1978, plates 8 & 9	Hartshorne probably faulted
	Section 18	Overburden		x				Bore Hole	
8	T 9 N | R 25 E	Coal Thickness			x				
	SE SW	Location				x		Craney, 1978, column 1,	
	Section 18	Overburden		x				plates 8 & 9, Bore Hole	
9	T 9 N | R 25 E	Coal Thickness			x				
	SW SE	Location				x		Craney, 1978, plates 8 & 9	
	Section 24	Overburden		x					
10	T 9 N | R 24 E	Coal Thickness			x				
	SW SE	Location			x			Knechtel, 1949, Bore Hole	
	Section 24	Overburden			x			#8	
11	T 9 N | R 24 E	Coal Thickness			x				

DATE POINT #	LOCATION	INCREASING RELIABILITY	1	2	3	4	5	REFERENCE	NOTES/COMMENTS
	SW SE	Location				x		Craney, 1978, plates 8 & 9	
	Section 24	Overburden		x				Bore Hole	
12	T 9 N R 24 E	Coal Thickness			x				
	SE SE	Location				x		Craney, 1978, plates 8 & 9	
	Section 24	Overburden		x				Bore Hole	
13	T 9 N R 24 E	Coal Thickness			x				
	NE SE	Location			x			Knechtel, 1949, Bore Hole	Upper and lower Hartshorne
	Section 24	Overburden			x			#7	benches.
14	T 9 N R 24 E	Coal Thickness			x				
	SE SE	Location				x		Craney, 1978, plates 8 & 9	
	Section 24	Overburden		x				Bore Hole	
15	T 9 N R 24 E	Coal Thickness			x				
	NE SE	Location				x		Craney, 1978, plates 8 & 9	
	Section 24	Overburden		x				Bore Hole	
16	T 9 N R 24 E	Coal Thickness			x				
	NW SW	Location			x			Knechtel, 1949, Bore Hole	Upper bench of Hartshorne
	Section 19	Overburden			x			#3	coal only.
17	T 9 N R 25 E	Coal Thickness	x						
	SW NW	Location			x			Knechtel, 1949, Bore Hole	Upper and lower Hartshorne
	Section 19	Overburden			x			#2	benches.
18	T 9 N R 25 E	Coal Thickness			x				
	SW NW	Location				x		Craney, 1978, plates 8 & 9	
	Section 19	Overburden		x				Bore Hole	
19	T 9 N R 25 E	Coal Thickness			x				
	NW NW	Location			x			Knechtel, 1949, Bore Hole	Upper and lower Hartshorne
	Section 19	Overburden			x			#1	benches.
20	T 9 N R 25 E	Coal Thickness			x				
	SW NW	Location				x		Craney, 1978, plates 8 & 9	
	Section 19	Overburden		x				Bore Hole	
21	T 9 N R 25 E	Coal Thickness			x				
	NE SW	Location				x		Craney, 1978, plates 8 & 9	
	Section 19	Overburden		x				Bore Hole	
22	T 9 N R 25 E	Coal Thickness			x				
	NW NE	Location					x	Craney, 1978, p. 98,	
	Section 19	Overburden					x	Bore Hole	
23	T 9 N R 25 E	Coal Thickness					x		
	NE SE	Location				x		Craney, 1978, plates 8 & 9	
	Section 19	Overburden		x				Bore Hole	
24	T 9 N R 25 E	Coal Thickness			x				

DATE POINT #	LOCATION	INCREASING RELIABILITY	1	2	3	4	5	REFERENCE	NOTES/COMMENTS
	SE SE	Location				x		Craney, 1978, plates 8 & 9	
	Section 19	Overburden		x				and column 3, plate 4,	
25	T 9 N | R 25 E	Coal Thickness			x			Bore Hole	
	N/2 NE SW	Location					x	Pan American Petroleum	Ref. datum 17' above GL.
	Section 20	Overburden			x			Corporation, 1962, #1	IES, G & V logs.
26	T 9 N | R 25 E	Coal Thickness		x				Zoe Holt	
	NW NE	Location				x		Craney, 1978 Map, plates	
	Section 20	Overburden		x				8 & 9, Bore Hole	
27	T 9 N | R 25 E	Coal Thickness			x				
	NW SE	Location				x		Craney, 1978, plates 8 & 9	
	Section 20	Overburden		x				Bore Hole	
28	T 9 N | R 25 E	Coal Thickness			x				
	SW NE	Location					x	Pan American Petroleum	Ref. datum 14' above GL.
	Section 21	Overburden			x			Coporation, #1 Garrett,	IES, G & V logs. 180' N
29	T 9 N | R 25 E	Coal Thickness		x				1965	100' E of center.
	E/2 E/2 E/2	Location				x		Craney, 1978, plates 8 & 9	
	Section 21	Overburden		x				Bore Hole	
30	T 9 N | R 25 E	Coal Thickness			x				
	NE SE	Location		x				Craney, 1978, p. 99-100,	Location on logs calls for
	Section 22	Overburden					x	Bore Hole	NE NE. Upper and lower
31	T 9 N | R 25 E	Coal Thickness					x		Hartshorne benches.
	SW NW	Location				x		Craney, 1978, plates 8 & 9	
	Section 26	Overburden		x				and column 9, plate 2,	
32	T 9 N | R 25 E	Coal Thickness			x			Bore Hole	
	SW NW	Location				x		Craney, 1978, plates 8 & 9	
	Section 27	Overburden		x				and column 8, plate 2,	
33	T 9 N | R 25 E	Coal Thickness			x			Bore Hole	
	NW SW	Location				x		Craney, 1978, plate 2	
	Section 28	Overburden		x				column 7, plates 8 & 9,	
34	T 9 N | R 25 E	Coal Thickness			x			Bore Hole	
	SE NE	Location				x		Craney, 1978, plate 2	
	Section 30	Overburden		x				column 6, plate 4 column	
35	T 9 N | R 25 E	Coal Thickness			x			4, plates 8 & 9, Bore Hole	
	NE SE	Location				x		Craney, 1978, plate 2	
	Section 25	Overburden		x				column 5, plates 8 & 9	
36	T 9 N | R 24 E	Coal Thickness			x				
	NE NW	Location			x			Knechtel, 1949, Bore Hole	
	Section 25	Overburden			x			#9	
37	T 9 N | R 24 E	Coal Thickness			x				

DATA POINT #	LOCATION	INCREASING RELIABILITY	1	2	3	4	5	REFERENCE	NOTES/COMMENTS
	NE NW	Location			x			USGS files, Bore Hole #76,	Note: Crop line reported
	Section 25	Overburden			x			1978, KRCRA Map	for coal-assume 1+ partial
38	T 9 N | R 24 E	Coal Thickness	x						coal thickness.
	NE NW	Location			x			Knechtel, 1949, Bore Hole	Also on KRCRA Map.
	Section 25	Overburden			x			#10	
39	T 9 N | R 24 E	Coal Thickness			x				
	NE NW	Location			x			USGS files, Bore Hole #77,	Upper bench thickness re-
	Section 25	Overburden			x			1978, KRCRA Map	ported only.
40	T 9 N | R 24 E	Coal Thickness	x						
	NW NW	Location			x			USGS files, Bore Hole #75,	Upper and lower Hartshorne
	Section 25	Overburden			x			1978, KRCRA Map	benches.
41	T 9 N | R 24 E	Coal Thickness			x				
	--------	Location		x				Knechtel, 1949, Measured	
	Section 25	Overburden	-	-	-	-	-	Section #11	
42	T 9 N | R 24 E	Coal Thickness			x				
	SW NW	Location			x			Knechtel, 1949, Bore Hole	Upper and lower Hartshorne
	Section 25	Overburden			x			#12	benches.
43	T 9 N | R 24 E	Coal Thickness			x				
	SE NE	Location			x			USGS files, Bore Hole #85,	
	Section 26	Overburden			x			1978, KRCRA Map	
44	T 9 N | R 24 E	Coal Thickness			x				
	SE NE	Location			x			USGS files, Bore Hole #86,	
	Section 26	Overburden			x			1978, KRCRA Map	
45	T 9 N | R 24 E	Coal Thickness			x				
	SE NE	Location			x			USGS files, Bore Hole #87,	Hit old mine at 57 ft.
	Section 26	Overburden			x			1978, KRCRA Map	
46	T 9 N | R 24 E	Coal Thickness	-	-	-	-	-		
	--------	Location		x				Knechtel, 1949, Measured	Upper and lower Hartshorne
	Section 26	Overburden	-	-	-	-	-	Section #13	benches. Slope mine.
47	T 9 N | R 24 E	Coal Thickness			x				
	SE NE	Location			x			USGS files, Bore Hole #84,	
	Section 26	Overburden			x			1978, KRCRA Map	
48	T 9 N R 24 E	Coal Thickness			x				
	SE NE	Location		x				Knechtel, 1949, Bore Hole	Upper and lower Hartshorne
	Section 26	Overburden			x			#14	benches.
49	T 9 N | R 24 E	Coal Thickness			x				
	SW NE	Location			x			Knechtel, 1949, Bore Hole	Upper and lower Hartshorne
	Section 26	Overburden			x			#15	benches. Knechtel and KRCRA
50	T 9 N | R 24 E	Coal Thickness			x				Map overburden don't agree.

DATA POINT #	LOCATION		INCREASING RELIABILITY	1	2	3	4	5	REFERENCE	NOTES/COMMENTS
	SW NE		Location			x			USGS files, Bore Hole #81,	
	Section 26		Overburden			x			1978, KRCRA Map	
51	T 9 N	R 24 E	Coal Thickness			x				
	NW SE		Location			x			USGS files, Bore Hole #82,	
	Section 26		Overburden			x			1978, KRCRA Map	
52	T 9 N	R 24 E	Coal Thickness			x				
	NW SE		Location			x			USGS files, Bore Hole #83,	
	Section 26		Overburden			x			1978, KRCRA Map	
53	T 9 N	R 24 E	Coal Thickness			x				
	--------		Location		x				Knechtel, 1949, Measured	Slope mine.
	Section 26		Overburden	-	-	-	-	-	Section #16	
54	T 9 N	R 24 E	Coal Thickness			x				
	NE SW		Location			x			Knechtel, 1949, Bore Hole	Upper and lower Hartshorne
	Section 26		Overburden			x			#17	benches.
55	T 9 N	R 24 E	Coal Thickness			x				
	--------		Location		x				Knechtel, 1949, Measured	Upper and lower Hartshorne
	Section 26		Overburden	-	-	-	-	-	Section #18	benches. Slope mine.
56	T 9 N	R 24 E	Coal Thickness			x				
	--------		Location		x				Knechtel, 1949, Measured	Slope mine.
	Section 27		Overburden	-	-	-	-	-	Section #19	
57	T 9 N	R 24 E	Coal Thickness			x				
	NW NE		Location			x			Knechtel, 1949, Bore Hole	
	Section 34		Overburden			x			#27	
58	T 9 N	R 24 E	Coal Thickness			x				
	SE NE		Location			x			Craney, 1978, plate 2,	
	Section 34		Overburden		x				column 2, plates 8 & 9,	
59	T 9 N	R 24 E	Coal Thickness			x			Bore Hole	
	SW NW		Location				x		Craney, 1978, plates 8 & 9	
	Section 35		Overburden		x				Bore Hole	
60	T 9 N	R 24 E	Coal Thickness			x				
	NE SW		Location					x	Athletic Mining & Smelting	Ref. Datum 11.5 feet above
	Section 35		Overburden			x			Company, 1952, #1 Dunn	GL. IES log.
61	T 9 N	R 24 E	Coal Thickness	-	-	-	-	-		
	S/2 NE		Location				x		Craney, 1978, plates 8 & 9	
	Section 35		Overburden		x				Bore Hole	
62	T 9 N	R 24 E	Coal Thickness			x				
	NE NE		Location					x	USGS files, 1952, Bore	
	Section 35		Overburden					x	Hole #19	
63	T 9 N	R 24 E	Coal Thickness					x		

DATA POINT #	LOCATION	INCREASING RELIABILITY	1	2	3	4	5	REFERENCE	NOTES/COMMENTS
	NE SE	Location				x		Craney, 1978, plates 5, 7,	
	Section 35	Overburden		x				8 & 9, Bore Hole	
64	T 9 N R 24 E	Coal Thickness			x				
	N/2 N/2	Location					x	USGS files, 1952, Bore	Upper and lower Hartshorne
	Section 36	Overburden					x	Hole #22	benches.
65	T 9 N R 24 E	Coal Thickness					x		
	SE NW	Location					x	Snee & Eberly, 1963, #A-1	Ref. Datum 14' above GL.
	Section 31	Overburden			x			Dee King	IG & IES (SP through Hart-
66	T 9 N R 25 E	Coal Thickness		x					shorne).
	SE SW	Location					x	USGS files, 1952, Bore	
	Section 31	Overburden					x	Hole #20	
67	T 9 N R 25 E	Coal Thickness					x		
	NW SE	Location					x	Pan American Petroleum	Ref. Datum 16' above GL.
	Section 31	Overburden			x			Corporation, 1960, #1 Dee	IES, V, C logs
68	T 9 N R 25 E	Coal Thickness		x				King	
	SE NE	Location				x		Craney, 1978, plates 5, 7,	
	Section 31	Overburden		x				8 & 9, column 4, plate 4,	
69	T 9 N R 25 E	Coal Thickness			x			Bore Hole	
	CNE SW	Location					x	Pan American Petroleum	Ref. Datum 18' above GL.
	Section 34	Overburden			x			Corporation, 1966, #1	IES - IG, D, C logs.
70	T 9 N R 25 E	Coal Thickness		x				Bailey	
	SE SW	Location					x	BLM Emria Project, Bore	Coal not reached.
	Section 4	Overburden					x	Hole #DH-AB-11, 1979	
71	T 8 N R 25 E	Coal Thickness	-	-	-	-	-		
	NE SW	Location				x		Craney, 1978, p. 93, Bore	
	Section 5	Overburden					x	Hole	
72	T 8 N R 25 E	Coal Thickness					x		
	--------	Location		x				Knechtel, 1949, Measured	Slope mine.
	Section 5	Overburden	-	-	-	-	-	Section #2	
73	T 8 N R 25 E	Coal Thickness			x				
	NW SE	Location					x	Senate Document #390, 1910	No workable coal, possible
	Section 1	Overburden					x	p. 69, Bore Hole #36	faulting. Shale-289' to
74	T 8 N R 24 E	Coal Thickness					x		404'. Dip of strata 12°
	CSE	Location					x	Mustang Production Company	Ref. Datum 15' above GL.
	Section 1	Overburden			x			1972, #1-1 Turman	IG log.
75	T 8 N R 24 E	Coal Thickness		x					
	SE SW	Location					x	USGS files, 1952, Bore	
	Section 1	Overburden					x	Hole #2	
76	T 8 N R 24 E	Coal Thickness					x		

DATA POINT #	LOCATION	INCREASING RELIABILITY	1	2	3	4	5	REFERENCE	NOTES/COMMENTS
	SE NW	Location					x	Pan American Petroleum	Ref. Datum 16.5 above GL.
	Section 1	Overburden			x			Corporation, 1966, #1 "B"	IES, G & V logs.
77	T 8 N | R 24 E	Coal Thickness		x				Tackett	
	NE SW	Location					x	USGS files, 1952, Bore	
	Section 1	Overburden					x	Hole #1	
78	T 8 N | R 24 E	Coal Thickness					x		
	NW NW	Location					x	USGS files, 1952, Bore	Near split line, yet inter-
	Section 1	Overburden					x	Hole #3	burden greater than 1'.
79	T 8 N | R 24 E	Coal Thickness					x		
	NE NW	Location				x		Craney, 1978, plate 2,	Coal thickness not reported
	Section 2	Overburden		x				column 1, plates 8 & 9,	in Craney thesis.
80	T 8 N | R 24 E	Coal Thickness			x			Bore Hole	
	NW SW	Location			x			USGS files, Bore Hole #41,	
	Section 11	Overburden			x			KRCRA Map	
81	T 8 N | R 24 E	Coal Thickness			x				
	NW SW	Location			x			USGS files, Bore Hole #46,	
	Section 11	Overburden			x			1978, KRCRA Map	
82	T 8 N | R 24 E	Coal Thickness			x				
	NW SW	Location			x			USGS files, Bore Hole #40,	
	Section 11	Overburden			x			1978, KRCRA Map	
83	T 8 N | R 24 E	Coal Thickness			x				
	NE SW	Location			x			USGS files, Bore Hole #45,	Note: 62.4 TD reported on
	Section 11	Overburden			x			1978, KRCRA Map	KRCRA Map.
84	T 8 N | R 24 E	Coal Thickness			x				
	NE SW	Location		x				Knechtel, 1949, Bore Hole	
	Section 11	Overburden			x			#13	
85	T 8 N | R 24 E	Coal Thickness			x				
	NE SW	Location		x				Knechtel, 1949, Bore Hole	3 ft. 1 in. coal; dirty,
	Section 11	Overburden			x			#14	reported.
86	T 8 N | R 24 E	Coal Thickness			x				
	NE SW	Location		x				Knechtel, 1949, Bore Hole	
	Section 11	Overburden			x			#15	
87	T 8 N | R 24 E	Coal Thickness			x				
	NE SW	Location			x			USGS files, Bore Hole #47,	
	Section 11	Overburden			x			1978, KRCRA Map	
88	T 8 N | R 24 E	Coal Thickness			x				
	NE SW	Location			x			USGS files, Bore Hole #42,	Interburden 23.9' on KRCRA
	Section 11	Overburden		x				1978, KRCRA Map	tables.
89	T 8 N | R 24 E	Coal Thickness			x				

DATE POINT #	LOCATION	INCREASING RELIABILITY →	1	2	3	4	5	REFERENCE	NOTES/COMMENTS
	S/2 N/2	Location					x	USGS files, 1952, Bore	
	Section 11	Overburden					x	Hole #11	
90	T 8 N R 24 E	Coal Thickness					x		
	SW NE	Location			x			USGS files, Bore Hole #26,	
	Section 11	Overburden			x			1978, KRCRA Map	
91	T 8 N R 24 E	Coal Thickness	x						
	SW NE	Location			x			USGS files, Bore Hole #39,	
	Section 11	Overburden			x			1978, KRCRA Map	
92	T 8 N R 24 E	Coal Thickness			x				
	--------	Location		x				Knechtel, 1949, Measured	
	Section 11	Overburden	-	-	-	-	-	Slope, Mine Section #16	
93	T 8 N R 24 E	Coal Thickness			x				
	NW SE	Location		x				Knechtel, 1949, Measured	In prospect pit.
	Section 11	Overburden	-	-	-	-	-	Section #17	
94	T 8 N R 24 E	Coal Thickness			x				
	SW NE	Location		x				Knechtel, 1949, Bore Hole	
	Section 11	Overburden			x			#19	
95	T 8 N R 24 E	Coal Thickness			x				
	SW NE	Location			x			USGS files, Bore Hole 43,	
	Section 11	Overburden			x			1978, KRCRA Map	
96	T 8 N R 24 E	Coal Thickness			x				
	SW NE	Location		x				Knechtel, 1949, Bore Hole	
	Section 11	Overburden			x			#18	
97	T 8 N R 24 E	Coal Thickness			x				
	SE NE	Location			x			USGS files, Bore Hole /38,	
	Section 11	Overburden			x			1978, KRCRA Map	
98	T 8 N R 24 E	Coal Thickness			x				
	SE NE	Location			x			USGS files, Bore Hole #44,	
	Section 11	Overburden			x			1978, KRCRA Map	
99	T 8 N R 24 E	Coal Thickness			x				
	NE NE	Location			x			USGS files, Bore Hole #24	
	Section 11	Overburden			x			1978, KRCRA Map	
100	T 8 N R 24 E	Coal Thickness	x						
	NE NE	Location					x	USGS files, 1952, Bore	Possible error in overbur-
	Section 11	Overburden		x				Hole #9	den. Not sure of DL.
101	T 8 N R 24 E	Coal Thickness					x		
	SE NE	Location			x			Knechtel, 1949, Measured	Prospect pit.
	Section 11	Overburden	-	-	-	-	-	Section #20	
102	T 8 N R 24 E	Coal Thickness			x				

DATE POINT #	LOCATION	INCREASING RELIABILITY	1	2	3	4	5	REFERENCE	NOTES/COMMENTS
	SW NW	Location		x				Knechtel, 1949, Bore Hole	
	Section 12	Overburden			x			#21	
103	T 8 N | R 24 E	Coal Thickness			x				
	NW NW	Location			x			USGS files, Bore Hole #51,	
	Section 12	Overburden			x			1978, KRCRA Map	
104	T 8 N | R 24 E	Coal Thickness			x				
	NW NW	Location					x	BLM Emria Project, 1979,	Coal not reached.
	Section 12	Overburden					x	Bore Hole, DH-AB-13	
105	T 8 N | R 24 E	Coal Thickness	-	-	-	-	-		
	NW NW	Location			x			USGS files, Bore Hole #53,	
	Section 12	Overburden			x			1978, KRCRA Map	
106	T 8 N | R 24 E	Coal Thickness			x				
	NW NW	Location			x			USGS files, Bore Hole #54,	
	Section 12	Overburden			x			1978, KRCRA Map	
107	T 8 N | R 24 E	Coal Thickness			x				
	NW NW	Location			x			USGS files, Bore Hole #52,	Coal not reached.
	Section 12	Overburden	-	-	-	-	-	1978, KRCRA Map	
108	T 8 N | R 24 E	Coal Thickness	-	-	-	-	-		
	NE NW	Location		x				Knechtel, 1949, Bore Hole	Coal thickness anomalously
	Section 12	Overburden			x			#22	high.
109	T 8 N | R 24 E	Coal Thickness	x						
	--------	Location		x				Knechtel, 1949, Measured	Slope mine.
	Section 12	Overburden	-	-	-	-	-	Section #23	
110	T 8 N | R 24 E	Coal Thickness			x				
	NE NW	Location			x			USGS files, Bore Hole #48,	Coal thickness anomalously
	Section 12	Overburden			x			1978, KRCRA Map	high.
111	T 8 N | R 24 E	Coal Thickness	x						
	NW NE	Location					x	USGS files, 1952, Bore	
	Section 12	Overburden					x	Hole #7	
112	T 8 N | R 24 E	Coal Thickness					x		
	SW NE	Location			x			USGS files, Bore Hole #55,	
	Section 9	Overburden			x			1978, KRCRA Map	
113	T 8 N | R 25 E	Coal Thickness			x				
	SW NE	Location			x			USGS files, Bore Hole #58,	
	Section 9	Overburden			x			1978, KRCRA Map	
114	T 8 N | R 25 E	Coal Thickness			x				
	SW NE	Location			x			USGS files, Bore Hole #61,	
	Section 9	Overburden			x			1978, KRCRA Map	
115	T 8 N | R 25 E	Coal Thickness			x				

DATE POINT #	LOCATION	INCREASING RELIABILITY	1	2	3	4	5	REFERENCE	NOTES/COMMENTS
	SW NE	Location			x			USGS files, Bore Hole #60,	
	Section 9	Overburden			x			1978, KRCRA Map	
116	T 8 N R 25 E	Coal Thickness			x				
	SW NE	Location			x			USGS files, Bore Hole #56,	
	Section 9	Overburden			x			1978, KRCRA Map	
117	T 8 N R 25 E	Coal Thickness			x				
	SW NE	Location			x			USGS files, Bore Hole #63,	
	Section 9	Overburden			x			1978, KRCRA Map	
118	T 8 N R 25 E	Coal Thickness	x						
	SW NE	Location			x			USGS files, Bore Hole #62,	
	Section 9	Overburden			x			1978, KRCRA Map	
119	T 8 N R 25 E	Coal Thickness			x				
	SW NE	Location			x			USGS files, Bore Hole #65,	
	Section 9	Overburden			x			1978, KRCRA Map	
120	T 8 N R 25 E	Coal Thickness			x				
	SW NE	Location			x			USGS files, Bore Hole #64,	
	Section 9	Overburden			x			1978, KRCRA Map	
121	T 8 N R 25 E	Coal Thickness	x						
	SW NE	Location			x			USGS files, Bore Hole #59,	
	Section 9	Overburden			x			1978, KRCRA Map	
122	T 8 N R 25 E	Coal Thickness			x				
	SW NE	Location			x			USGS files, Bore Hole #66,	
	Section 9	Overburden			x			1978, KRCRA Map	
123	T 8 N R 25 E	Coal Thickness	x						
	SW NE	Location			x			USGS files, Bore Hole #57,	
	Section 9	Overburden			x			1978, KRCRA Map	
124	T 8 N R 25 E	Coal Thickness			x				
	SE NE	Location			x			USGS files, Bore Hole #67,	
	Section 9	Overburden			x			1978, KRCRA Map	
125	T 8 N R 25 E	Coal Thickness	x						
	SE NE	Location			x			USGS files, Bore Hole #68,	
	Section 9	Overburden			x			1978, KRCRA Map	
126	T 8 N R 25 E	Coal Thickness	x						
	SE NE	Location				x		Craney, 1978, plates 7, 8	
	Section 9	Overburden		x				& 9, Bore Hole	
127	T 8 N R 25 E	Coal Thickness			x				
	SE NE	Location			x			USGS files, Bore Hole #69,	
	Section 9	Overburden			x			1978, KRCRA Map	
128	T 8 N R 25 E	Coal Thickness	x						

DATE POINT #	LOCATION	INCREASING RELIABILITY	1	2	3	4	5	REFERENCE	NOTES/COMMENTS
	SW NW	Location				x		Craney, 1978, plates 8 & 9	
	Section 12	Overburden		x				Bore Hole	
129	T 8 N | R 25 E	Coal Thickness			x				
	SW NW	Location			x			Oklahoma Department of	
	Section 12	Overburden					x	Mines files, 1979-1980,	
130	T 8 N | R 25 E	Coal Thickness					x	Bore Hole	
	SE SE	Location			x			Knechtel, 1949, Bore Hole	
	Section 18	Overburden			x			#8	
131	T 8 N | R 25 E	Coal Thickness			x				
	SW SE	Location			x			Knechtel, 1949, Bore Hole	
	Section 18	Overburden			x			#7	
132	T 8 N | R 25 E	Coal Thickness			x				
	SE SW	Location			x			Knechtel, 1949, Bore Hole	
	Section 18	Overburden			x			#5	
133	T 8 N | R 25 E	Coal Thickness			x				
	SE SW	Location		x				Knechtel, 1949, Bore Hole	
	Section 18	Overburden			x			#6	
134	T 8 N | R 25 E	Coal Thickness			x				
	SW SW	Location		x				Knechtel, 1949, Bore Hole	
	Section 18	Overburden			x			#3	
135	T 8 N | R 25 E	Coal Thickness			x				
	SW SW	Location		x				Knechtel, 1949, Bore Hole	
	Section 18	Overburden			x			#4	
136	T 8 N | R 25 E	Coal Thickness			x				
	SE SE	Location			x			Knechtel, 1949, Bore Hole	
	Section 13	Overburden			x			#25	
137	T 8 N | R 24 E	Coal Thickness			x				
	SE SE	Location		x				Knechtel, 1949, Bore Hole	
	Section 13	Overburden			x			#24	
138	T 8 N | R 24 E	Coal Thickness			x				
	SE SW	Location			x			Knechtel, 1949, Bore Hole	
	Section 13	Overburden			x			#27	
139	T 8 N | R 24 E	Coal Thickness			x				
	SE SW	Location			x			Knechtel, 1949, Bore Hole	
	Section 13	Overburden			x			#26	
140	T 8 N | R 24 E	Coal Thickness			x				
	SW SW	Location			x			Knechtel, 1949, Bore Hole	
	Section 13	Overburden			x			#28	
141	T 8 N | R 24 E	Coal Thickness			x				

DATA POINT #	LOCATION	INCREASING RELIABILITY →	1	2	3	4	5	REFERENCE	NOTES/COMMENTS
	SW SW	Location			x			Knechtel, 1949, Bore Hole	
	Section 13	Overburden			x			#29	
142	T 8 N R 24 E	Coal Thickness			x				
	SW SE	Location			x			Knechtel, 1949, Bore Hole	
	Section 14	Overburden			x			#30	
143	T 8 N R 24 E	Coal Thickness			x				
	SE SW	Location			x			Knechtel, 1949, Bore Hole	
	Section 14	Overburden			x			#14	
144	T 8 N R 24 E	Coal Thickness			x				
	SW SW	Location			x			Knechtel, 1949, Bore Hole	
	Section 14	Overburden			x			#32	
145	T 8 N R 24 E	Coal Thickness			x				
	NW NW	Location			x			Knechtel, 1949, Bore Hole	Cover not recorded.
	Section 23	Overburden			x			#55	
146	T 8 N R 24 E	Coal Thickness			x				
	NE NW	Location			x			Knechtel, 1949, Bore Hole	
	Section 23	Overburden			x			#56	
147	T 8 N R 24 E	Coal Thickness			x				
	NW NE	Location			x			Knechtel, 1949, Bore Hole	
	Section 23	Overburden			x			#57	
148	T 8 N R 24 E	Coal Thickness			x				
	NE NE	Location			x			Knechtel, 1949, Bore Hole	
	Section 23	Overburden			x			#58	
149	T 8 N R 24 E	Coal Thickness			x				
	NW SE	Location					x	USGS files, 1952, Bore	
	Section 23	Overburden					x	Hole #H-1	
150	T 8 N R 24 E	Coal Thickness					x		
	NW SE	Location					x	Pan American Petroleum	Ref. Datum 18.5' above GL.
	Section 24	Overburden			x			Corporation, 1965, #1	IES, C & V logs.
151	T 8 N R 24 E	Coal Thickness		x				"D" Johnson	
	N/2 N/2	Location					x	Senate Document #390, 1910	Last 6.2' contained a few
	Section 19	Overburden					x	p. 67, Bore Hole #30	thin coal seams. Dip of
152	T 8 N R 25 E	Coal Thickness					x		strata 12°
	NW NE	Location			x			Knechtel, 1949, Bore Hole	
	Section 19	Overburden			x			#9	
153	T 8 N R 25 E	Coal Thickness			x				
	--------	Location		x				Knechtel, 1949, Measured	Coal; top only of LH un-
	Section 19	Overburden	-	-	-	-	-	Section #11, Slope Mine.	covered.
154	T 8 N R 25 E	Coal Thickness	x						

DATA POINT #	LOCATION	INCREASING RELIABILITY →	1	2	3	4	5	REFERENCE	NOTES/COMMENTS
	NW NW	Location			x			Knechtel, 1949, Bore Hole	
	Section 20	Overburden			x			#12	
155	T 8 N | R 25 E	Coal Thickness			x				
	NW NW	Location			x			Knechtel, 1949, Bore Hole	
	Section 20	Overburden			x			#13	
156	T 8 N | R 25 E	Coal Thickness			x				
	NE NW	Location			x			Knechtel, 1949, Bore Hole	Coal; dirty.
	Section 20	Overburden			x			#14	
157	T 8 N | R 25 E	Coal Thickness			x				
	NE SW	Location					x	Midwest Oil Corporation,	Ref. Datum 17' above GL.
	Section 20	Overburden			x			1974, #1 Rust	Gamma log (thru casing).
158	T 8 N | R 25 E	Coal Thickness		x					
	NW NE	Location			x			Knechtel, 1949, Bore Hole	
	Section 20	Overburden			x			#15	
159	T 8 N | R 25 E	Coal Thickness			x				
	NE NE	Location			x			Knechtel, 1949, Bore Hole	
	Section 20	Overburden			x			#15	
160	T 8 N | R 25 E	Coal Thickness			x				
	NE NE	Location			x			Knechtel, 1949, Bore Hole	
	Section 20	Overburden			x			#17	
161	T 8 N | R 25 E	Coal Thickness			x				
	SE NE	Location				x		Craney, 1978, plates 8 & 9	
	Section 21	Overburden		x				Bore Hole	
162	T 8 N | R 25 E	Coal Thickness			x				
	SE NE	Location				x		Craney, 1978, plates 5 & 6	
	Section 21	Overburden		x				Bore Hole	
163	T 8 N | R 25 E	Coal Thickness			x				
	SE NW	Location				x		Craney, 1978, plates 5 & 6	
	Section 22	Overburden		x				Bore Hole	
164	T 8 N | R 25 E	Coal Thickness			x				
	SE NW	Location				x		Craney, 1978, plate 9,	
	Section 22	Overburden		x				plate 3 column 6, Bore	
165	T 8 N | R 25 E	Coal Thickness			x			Hole	
	SE NE	Location			x			Knechtel, 1949, Bore Hole	
	Section 22	Overburden			x			#18	
166	T 8 N | R 25 E	Coal Thickness			x				
	SE NE	Location			x			Knechtel, 1949, Bore Hole	
	Section 22	Overburden			x			#19	
167	T 8 N | R 25 E	Coal Thickness			x				

DATE POINT #	LOCATION	INCREASING RELIABILITY	1	2	3	4	5	REFERENCE	NOTES/COMMENTS
	SW NW	Location			x			Knechtel, 1949, Bore Hole	
	Section 23	Overburden			x			#20	
168	T 8 N | R 25 E	Coal Thickness			x				
	NW SW	Location			x			Knechtel, 1949, Bore Hole	
	Section 23	Overburden			x			#21	
169	T 8 N | R 25 E	Coal Thickness			x				
	NE SW	Location			x			Knechtel, 1949, Bore Hole	
	Section 23	Overburden			x			#22	
170	T 8 N | R 25 E	Coal Thickness			x				
	NE SW	Location			x			Knechtel, 1949, Bore Hole	Coal with a little dirt.
	Section 23	Overburden			x			#23	
171	T 8 N | R 25 E	Coal Thickness			x				
	SE SW	Location					x	Oklahoma Dept. of Mines	
	Section 23	Overburden				x		files, 1978-1979, Bore	
172	T 8 N | R 25 E	Coal Thickness					x	Hole G-6	
	NE SW	Location					x	Oklahoma Dept. of Mines	
	Section 23	Overburden				x		files, 1978-1979, Bore	
173	T 8 N | R 25 E	Coal Thickness					x	Hole G-4	
	NW SE	Location			x			Knechtel, 1949, Bore Hole	
	Section 23	Overburden			x			#24	
174	T 8 N | R 25 E	Coal Thickness			x				
	NE SE	Location					x	Senate Document #390, 1910	Stop in very hard ss caus-
	Section 23	Overburden					x	p. 66, Bore Hole #27	ing great wear to diamond
175	T 8 N | R 25 E	Coal Thickness					x		drill. Dip of strata 14°.
	NW SE	Location			x			Knechtel, 1949, Bore Hole	
	Section 23	Overburden			x			#26	
176	T 8 N | R 25 E	Coal Thickness			x				
	SW SE	Location				x		Craney, 1978, plates 5, 7,	
	Section 23	Overburden		x				8 & 9, Bore Hole	
177	T 8 N | R 25 E	Coal Thickness			x				
	SE SE	Location					x	Oklahoma Dept. of Mines	
	Section 23	Overburden				x		files, 1978-1979, Bore	
178	T 8 N | R 25 E	Coal Thickness					x	Hole G-1	
	SE SE	Location					x	Oklahoma Dept. of Mines	
	Section 23	Overburden				x		files, 1978-1979, Bore	
179	T 8 N | R 25 E	Coal Thickness					x	Hole G-2	
	NE SE	Location			x			Knechtel, 1949, Bore Hole	
	Section 23	Overburden			x			#27	
180	T 8 N | R 25 E	Coal Thickness			x				

DATA POINT #	LOCATION		INCREASING RELIABILITY	1	2	3	4	5	REFERENCE	NOTES/COMMENTS
	NE SE		Location			x			Knechtel, 1949, Bore Hole	
	Section 23		Overburden			x			#28	
181	T 8 N	R 25 E	Coal Thickness			x				
	NW SW		Location			x			Knechtel, 1949, Bore Hole	
	Section 24		Overburden			x			#30	
182	T 8 N	R 25 E	Coal Thickness			x				
	NW SW		Location			x			Knechtel, 1949, Bore Hole	
	Section 24		Overburden			x			#29	
183	T 8 N	R 25 E	Coal Thickness			x				
	SW SW		Location					x	Oklahoma Dept. of Mines	
	Section 24		Overburden				x		files, 1978-1979, Bore	
184	T 8 N	R 25 E	Coal Thickness					x	Hole #p-4	
	NW SW		Location				x		Craney, 1978 Map, plates	
	Section 24		Overburden		x				5, 7, 8 & 9, Bore Hole	
185	T 8 N	R 25 E	Coal Thickness			x				
	SE NE		Location					x	Oklahoma Dept. of Mines	
	Section 26		Overburden				x		files, 1978-1979, Bore	
186	T 8 N	R 25 E	Coal Thickness					x	Hole G-3	
	SE SE		Location					x	Oklahoma Dept. of Mines	
	Section 26		Overburden				x		files, 1978, 1979, Bore	
187	T 8 N	R 25 E	Coal Thickness					x	Hole G-10	
	SE SE		Location					x	Craney, 1978, p. 94-95,	
	Section 26		Overburden					x	Bore Hole	
188	T 8 N	R 25 E	Coal Thickness					x		
	SW SE		Location					x	Oklahoma Dept. of Mines	
	Section 26		Overburden				x		files, 1978-1979, Bore	
189	T 8 N	R 25 E	Coal Thickness					x	Hole G-8	
	SE NW		Location					x	Oklahoma Dept. of Mines	No coal reported for LH -
	Section 26		Overburden				x		files, 1978-1979, Bore	seam thickness could not be
190	T 8 N	R 25 E	Coal Thickness					x	Hole G-7	verified.
	NW NE		Location					x	Oklahoma Dept. of Mines	
	Section 26		Overburden				x		files, 1978-1979, Bore	
191	T 8 N	R 25 E	Coal Thickness					x	Hole G-9	
	S/2 NW		Location					x	Eberly & Meade, 1978,	Ref. datum 14' above GL.
	Section 28		Overburden			x			#1-28 Butler	IES log.
192	T 8 N	R 25 E	Coal Thickness		x					
	SE NE		Location				x		Craney, 1978 map, plate 9,	
	Section 30		Overburden		x				plate 3, column 5, Bore	
193	T 8 N	R 25 E	Coal Thickness			x			Hole	

DATE POINT #	LOCATION		INCREASING RELIABILITY	1	2	3	4	5	REFERENCE	NOTES/COMMENTS
	NW NE		Location					x	Craney, 1978, p. 92,	2300' W 1300' S of NE
	Section 25		Overburden					x	Bore Hole	corner.
194	T 8 N	R 24 E	Coal Thickness					x		
	NE SW		Location					x	Monsanto Company, 1969,	Ref. datum 15' above GL.
	Section 26		Overburden			x			#1 Holeton	IG log.
195	T 8 N	R 24 E	Coal Thickness		x					
	SE NW		Location					x	Pan American Petroleum	Ref. datum 17.8 above GL.
	Section 35		Overburden			x			Corporation, 1967, #1	IG log.
196	T 8 N	R 24 E	Coal Thickness		x				Masters	
	SW NE		Location					x	Pan American Petroleum	Ref. datum 18' above GL.
	Section 35		Overburden			x			Corporation, 1965, #1	IES, G & V logs.
197	T 8 N	R 25 E	Coal Thickness		x				Davidson	

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
1-8-24	Pan Am./Tackett "B"	C. int. 75-132		NR	381		11130
	560 FSL 660 FEL of NW/4	C. int. 1063-1186	NR	1605	381	381	1966
1-8-24	Mustang/#1-1 Turman			NR	529		7513
	CSE	NR	NR	NR	529		1972
2-8-24	Reserve/#2-1 H. Wegert			NR			7730
	CSE	NR	NR	NR			1979
11-8-24	Mustang/#1-11 J. D. Blair			NR			7000
	CSE SE NW	NR	NR	NR			1978
12-8-24	Mustang/#1-12 Redwine			NR		3200	8511
	CNE	NR	NR	NR	500		1976
13-8-24	Mustang/#1-13 J. Daniel			NR			6600
	CNE	NR	NR	NR			1977
14-8-24	Mustang/#1-14 Chitwood			NR			10302
	CNE	NR	NR	NR			1973
22-8-24	Getty Reserve Oil/#1-22 Couch			NR			7600
	CSE	NR	NR	NR			1979
23-8-24	Montgomery/#1-23 Wiles			988		950	6800
	C E/2 SE SW	NR	NR	988			1979
24-8-24	Pan Am./#1 Johnson "D"			NR	57		9450
	C NW SE	NR	NR	752	57	57	1965
26-8-26	Monsanto/#1 Holten			NR	100	4800	7400
	1933 FSL 1933 FWL	NR	NR	NR	2080		1969
35-8-25	Dyco/#1 Helton			2262	700		8100
	CNW NW	NR	NR	2262	700		1978
35-8-25	Pan Am./#1 Masters			NR	100	7892	8200
		NR	NR	2540	100		1967

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
4-8-25	Snee & Eberly/Standler #1			NR			8226
	1520 FSL 1565 FWL of SE/4	NR	NR	NR			1977
5-8-25	LeFlore Gas & El./#4 McCalip						2621
	CSE SE		NR	NR			1940
5-8-25	Mustang/#1-5 D. Turman			NR			6350
	2417 FSL 1320 FWL	NR	NR	NR			1973
6-8-25	Galaxy I.A./#1 Daniel			NR			9675
	2690 FSL 2465 FWL	NR	NR	NR			1970
7-8-25	LeFlore Co./#P-5 Redwine			NR			2131
	WC NW SW SE	NR	NR	NR			1951
7-8-25	Galaxy, I.A./#1 Redwine			NR			7000
	100 FNL 1800 FWL	NR	NR	NR			1970
8-8-25	LeFlore O & G/#2 Hickman						2340
	C S/2 S/2		NR	NR			1939
8-8-25	LeFlore O & G/#1 Hickman						5972
	NE NE SE		NR	NR			1940
8-8-25	Hamon/#1 E. Hickman			NR			9976
	1240 FSL 1400 FWL of SE/4	NR	NR	NR			1971
8-8-25	Mustang/#1-8 Goins			NR			6350
	CNW	NR	NR	NR			1973
9-8-25	LeFlore/Mosley #3						2448
	C S/2 S/2 N/2 N/2 SW	NR	NR	NR			1940
11-8-25	Stephens/# J. C. Sadler			NR	1147		9068
	NE SW SW NE	NR	NR	NR	1147		1972
17-8-25	Athletic M & S/#1 Hickman						7650
	3940 FSL 1320 FWL		NR	NR	400*		1952
18-8-25	Mustang/#1-18 Kennedy			NR			
	CSW	NR	NR	NR			
20-8-25	Midwest/#1 Rust			NR	150	1150*	10533
	NE SE NE SW	NR	NR	790	150		1974
21-8-25	Eberly & Meade/#1-21 Long			1343	1082*	1300*	11534
	CNE	NR	NR	1343	1082*		1980
23-8-25	Pan Am./#1 Parks			NR			10615
	SW SW NE	NR	NR	NR	60*	60*	1963
23-8-25	Wagner & Brown/#1-23 Cannon			NR			10277
	100 FSL 330 FWL of NE/4	NR	NR	950			1978

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
26-8-25	Unit Drilling/#1 Johnson			1888			7574
	2440 FSL 1320 FWL of SE/4	NR	NR	1888			1980
28-8-25	Eberly & Meade/#1-28 Butler			1365			11292
	C S/2 NW	NR	NR	1365	867		1978
22-9-24	Western Okla./#1 Bryn			NR	B		5550
	SW NW SE	NR	NR	NR	300B		1941
23-9-24	Western Okla./#1 Statham				B		5520
	SE NE NE				133B		1942
23-9-24	Fed. Bank Oil Co./Fee #1				B		6300
	SE SW NW						1930
24-9-24	Stephens/#1 L. G. Stroud			NR	B		4965
	3540 FSL 2740 FWL	NR	NR	NR	1484B		1969
25-9-24	Monsanto/#1 Cragon			NR	1305		5801
	CNE SE SW	NR	NR	NR	1305		1970
25-9-24	An-Son/#1 Woods			1105		2900B	6345
	CSE/4	NR	NR	NR	1300B		1971
26-9-24	Galaxy & I.A./#1 Fesperman			NR			5074
	1370 FSL 1456 FEL of SE/4	NR	NR	NR			1970
27-9-24	Ark. Okla./#1 G. D. Cloud						6035
	SE SE NW		NR	NR	135B		1946
27-9-24	Western Okla./#1 Ward						5795
	NW SE NW		NR	NR			1941
19-9-25	Whitmar Expl./Evans Coal						
			NR	NR			1980
19-9-25	Snee & Eberly/#1 R.L. White			40@900	1046*	1350*	6800
	SE NW SE		NR	NR	1046*		1970
20-9-25	Pan Am./#1 Zoeholt			NR	524		8342
	C N/2 NE SW	NR	NR	NR	524	524	1963
21-9-25	Pan Amer./#1 Garrett			NR	650	7000	7600
	SW SW NE	NR	NR	NR	650	650	1965
30-9-25	Tenneco/#1-30 L. J. Woods			NR			6540
	CSW	NR	NR	NR			1971
31-9-25	Pan Am./#1 D. King			NR			9872
	CNW SE	NR	NR	NR	223	223	1961
31-9-25	Snee & Eberly/#1-A. D. King			1048	343		6820
	CSE NE	NR	NR	1047	343		1963

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
31-9-25	Galaxy/#1 Chapple			NR			6785
	SW SE NE SW	NR	NR	NR	1350		1972
32-9-25	Galaxy/#1 Wood			NR			7000
	NE NE SW SW	NR	NR	NR			1970
33-9-25	Galaxy/#1 Avery			NR			9231
	936 FSL 100 FWL of NE/4	NR	NR	NR			1969
34-9-25	Pan Am./#1 Baily			NR	60	392	8625
	CNE SW	NR	NR	NR	60		1966
35-9-25	LeFlore O & G/#1 Wilson			1087			2986
	C N/2 NW	NR	1079	1087			1946