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FEDERAL COAL RESOURCE OCCURRENCE AND FEDERAL COAL DEVELOPMENT POTENTIAL MAPS OF THE NORTHEAST QUARTER OF THE HEAVENER 15-MINUTE QUADRANGLE, LE FLORE COUNTY, OKLAHOMA

[Report includes 12 plates]

Prepared 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

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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 northeast quarter of the Heavener 15-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 Published and unpublished publicly available information was used as the data base for this study.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 were any confidential or proprietary data used. The coal data used in this map report were originally compiled on an enlarged version of the Heavener 15-minute quadrangle base. Subsequently, the Heavener 7.5-minute topographic quadranagle map base was completed by the U.S. Geological Survey. The more recent base map was used in compositing plates 1, 4, 5, 6, 7, and 8 in the accompanying map set. Minor discrepancies may exist in the locations of the traces of the coal bed outcrops and other surface data points; however, the enclosed maps are internally consistent. The decision to use a more modern and accurate base with the designated plates should not significantly affect the reserve base or reserve tonnage.

Location

The northeast quarter of the Heavener 15-minute quadrangle is located on the east side of the Howe-Wilburton mining district in the southern part

part of the southeastern Oklahoma Coal Field. All the quadrangle is within Le Flore County. The town of Heavener in the southwest corner of the study area is the largest settlement in the study area. The city of McAlester is 70 miles (112 km) west, and the city of Tulsa is approimately 120 miles (192 km) northwest of Heavener. The only other town of any size in the area is Monroe, in the northeast corner of the quadrangle.

Accessibility

The town of Heavener is accessible by U.S. Routes 59 and 270, which intersect at the north edge of town. State Route 128 runs south of Heavener out of the study area toward the small town of Hontubby. The area is also served by the Kansas City Southern Railroad, which runs along the southern and western edge of the quadrangle, and by the Chicago, Rock Island and Pacific Railroad, which runs across the northern edge of the quadrangle.

Much of the area is accessible by primary and secondary roads, with the exception of Poteau Mountain, which is accessible only by scattered jeep trails and other unimproved roads.

Physiography

The northeast quarter of the Heavener 15-minute 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 marks the southern edge of the basin, is approximately 4 miles to the south.

The Heavener area is an area of reverse topography, with synclines forming mountains and anticlines forming valleys. The major topographic feature in the northeast quarter of the Heavener 15-minute quadrangle is Poteau

Mountain, which takes up a good portion of the eastern half of the area. The mountain has a vertical relief of over 1,300 feet (397 m), reaching a height of (610 m) above sea level.

Resistant sandstone units have formed sharp ridges in the area, some of which bend through the southwestern edge of the northeast quarter of the Heavener 15-minute quadrangle. These rise 50 to 100 feet (15 to 30 m) above the intervening valleys, which average 550 to 600 feet (168 to 183 m) in elevation.

The northeast Heavener 15-minute quadrangle is drained by numerous small streams and creeks whose courses are influenced greatly by topography. The Poteau River cuts through only the extreme northwest corner of the 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

There are no designated Known Recoverable Coal Resource Areas (KRCRA) within the northeast quarter of the Heavener 15-minute quadrangle. The Federal Government holds title to the coal mineral rights for approximately 21,240 acres (54 percent) of the quadrangle. As of October 19, 1979, 8,200 acres (39 percent) of this land was unleased (plate 2).

GENERAL GEOLOGY

Previous Work

Much work has been done on the southeastern Oklahoma coal field. The first geologic study of the Howe-Wilburton district, of which the Heavener 15-minute quadrangle is a part, was published by Chance (1980) 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.

Several 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). Nonproprietary information from coal test holes drilled in various years in the Wilburton quadrangle were obtained from USGS files.

In recent years a number of masters' theses have been done on various sections of the southeastern Oklahoma coal field. Donica (1978) studies the Hartshorne coals in parts of the Heavener 15-minute quadrangle, and some 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, 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 the rock units cropping out in the northeast quarter of the Heavener 15-minute quadrangle are of Pennsylvanian age, and include the Atoka Formation, as well as the Hartshorne, McAlester, Savanna and Boggy formations of the Lower-Desmoinesian Krebs Group. The Hartshorne, McAlester and Boggy 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 study area, and crops out across the southeastern and southwestern sections of it (Hendricks, 1939). The formation consists mostly of black to gray sandy shale interbedded with ridge-forming brown or light-gray sandstone units. The shales tend to be silty and micaceous, and contain lenses of siderite nodules. The sandstones are 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 (Hendricks, 1939). The Atoka Formation thickens toward the southwest across the quadrangle from about 8,500 feet (2,592 m) in the northwest to more than 9,000 feet (2,745 m) at the Choctaw Fault in the southeast (Hendricks, 1939).

The Hartshorne Formation, which forms the basal unit of the Desmoinesian Series, crops out in a band paralleling the southeastern edge of Poteau Mountain and in a gentle arc in the southwest corner of the quadrangle (Hendricks, 1939). 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 led 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 1980. 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 lies far to the north of the Heavener quadrangle. The present 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 throughout the Howe-Wilburton district. 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, white 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 Heavener area.

The McAlester Formation lies conformably on the Hartshorne Formation, and is approximately 2,200 feet (670 m) thick in the Heavener quadrangle. Hendricks (1939) shows a dramatic thinning of the McAlester Formation in the Heavener area; however, the authors of this report believe he made an error in correlation, based on several factors. Hendricks labels a coal cropping out around Poteau Mountain as the McAlester coal (plate 1). However, based on later geologic mapping to the north by Knechtel (1949) and on a well log from Sec. 29 of T. 6 N. R. 26 E., it is believed that this coal is in fact a local coal above the Warner Sandstone (see below) stratigraphically much lower than the McAlester coal. Thus, much of what Hendricks showed as Savanna Formation on Poteau Mountain is more probably the McAlester Formation.

(Knechtel mentioned the discrepancy between his map and Hendricks' in his 1949 publication, specifically referring to the correlation of units on Sugarloaf Mountain to the north of the Heavener quadrangle.)

The McAlester Formation consists mostly of gray shale and silstone interbedded with several sandstone members. In ascending order, it comprises the McCurtain Shale Member, and the Warner, Lequire, Cameron, Tamaha and Keota Sandstone Members.

The lowermost unit of the McAlester Formation is the McCurtain Shale Member, a dark-gray, clayey shale with numerous siderite concretions and plant material (Hendricks, 1939). 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 (Oakes and Knechtel, 1948), 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 contains a local coal mapped by Hendricks (1939) as the McAlester coal.

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. 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 Member is a buff, non-fossiliferous, fine-grained sandstone (Knechtel, 1949). The overlying shale includes the Upper and Lower McAlester coals, though the exact correlation of these coals through the Heavener area has not yet been determined (Donica, 1978). The overlying Tamaha Sandstone Member is a relatively thin, somewhat irregular bed of buff, rippled, flaggy and calcareous sandstone roughly 15 feet (5 m) thick (Knechtel, 1949). The Keota Sandstone Member, separated from the Tamaha by a fairly thick (up to 500 feet, 150 m) unnamed dark-gray shale unit, is the uppermost sand member of the McAlester Formation (Knechtel, 1949). It is generally a silty, buff, fine-grained sandstone, ranging in thickness from 30 to 70 feet (9 to 21 m). Both the Tamaha and Keota Sandstones tend to be erratic and discontinuous (Russell, 1960). A dark, fissile to blocky shale with siderite concretions marks the top of the McAlester Formation.

The Savanna Formation crops out in a series of alternate shale and sandstone bands on Poteau Mountain (Hendricks, 1939). In some places the boundary between it and the McAlester Formation appears to be gradational, while in others it is highly irregular. The sandstones of the Savanna Formation form prominent ridges, as evidenced by the southern edge of the Sanbois Mountains. These sandstone beds are generally brown, dense, finegrained and micaceous, and the interbedded shales are brown to grayish green.

The Boggy Formation is the upper unit of the Kreb Group in the Desmoinesian Series. It lies conformably on the Savanna Formation, and is the youngest unit exposed in the area. In the northeast quarter of the Heavener 15-minute quadrangle it crops out on the top of Poteau Mountain, as mapped by Hendricks (1939). The formation consists of alternating shale and sandstone units, and its lower boundary is defined as the base of the Bluejacket Sandstone (Russell, 1960).

The Secor coal, part of the Boggy Formation, does not crop out in the northwest quarter of the Heavener quadrangle.

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

Structure

The Heavener 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 a few miles south of the study area. The principal surface structures in the northeast quarter of the Heavener 15-minute quadrangle are shown on plate 1. They include the Hartford anticline, the Poteau syncline, the Heavener anticline and the Pine Mountain syncline. No major faults have been recognized in the northeast Heavener area.

The Hartford anticline cuts across the northern portion of the study area and extends eastward into Arkansas. It trends northeast-southwest across the region, and is divided by a structural saddle (plate 6) into two sections: the southwest section plunges to the northeast, and the northeast section plunges to the southwest (Donica, 1978). The anticline is symmetrical and the beds are gently folded, exposing strata of the McAlester Formation.

The Poteau syncline bends through the central part of the northeast quarter of the Heavener 15-minute quadrangle in a general east-west direction, beginning in sec. 31, T. 6 N., R. 26 E., and extending eastward into Arkansas. It is a symmetrical structure, with dips of 6° to 18° on both limbs (Donica, 1978), and forms the prominent topographic feature, Poteau Mountain.

South of the Poteau syncline is the Heavener anticline, which begins in sec. 10, T. 5 N., R. 26 E., and extends west out of the area. The anticline is tightly and symmetrically folded, with dips up to 40° to 65° on both flanks (Hendricks, 1939). Many of the beds exposed near the crest of the fold are broken and slickensided, and it is likely that much minor faulting has taken place near the axes and on the flanks of the anticline (Hendricks, 1939).

Only a few miles of the Pine Mountain syncline extend into the southern edge of the northeast quarter of the Heavener quadrangle. This structure trends east and plunges to the east. This syncline is gently and symmetrically folded, with dips of 5° to 9°.

COAL GEOLOGY

The only major coal beds that have been identified and mapped in the northeast quarter of the Heavener 15-minute quadrangle are the Upper and Lower Hartshorne coals. Hendricks (1939) mapped the McAlester coal around Poteau Mountain. However, as discussed above, this is thought to be a local coal above the Warner Sandstone.

Upper and Lower Hartshorne Coal Beds

The Upper and Lower Hartshorne coals crop out along the south side of Poteau Mountain and in the wide arcuate valley to the west (plate 1). Their dip is very generally toward the north and east. The structure on both the Upper and Lower Hartshorne coals is shown on plate 6, and their position within the Hartshorne Formation is shown on the composite columnar section on plate 3.

The primary souce of specific information on the Hartshorne coals in the Heavener area for this report was Donica (1978), as most of the information on file at the USGS was proprietary. Very few "original" data were available for use in this report, and those came from Hendricks (1939), Moose and Searle

(1929), Senate Document 390 (1910) and oil and gas well logs. Appendix I provides a complete list of references for all data points shown on plate 1.

The Lower Hartshorne coal is generally thicker than the Upper Hartshorne. As the isopach (page 5) shows, measurement of the Lower Hartshorne vary from about 2 feet (0.6 m) to as much as 6.7 feet (2 m) in the southeast corner of the quadrangle. Not enough data were available to extend the isopach contours into the east-central portion of the quadrangle. This also holds true for the Upper Hartshorne coal.

The Upper Hartshorne varies from only 0.1 foot (0.03 m) to an estimated 4 feet (1.2 m) in thickness. The coal experiences some localized thinning near the west-central edge of the quadrangle. The interburden between the Upper and Lower Hartshorne coals is shown on page 7, and varies from less than 40 feet (12 m) in the southeast to more than 120 feet (37 m) in the west. Once again there were insufficient data to map the interburden on Poteau Mountain.

As shown on plate 1, only the Lower Hartshorne coal has been mined in the northeast quarter of the Heavener area.

Chemical Analyses of Coal

The only chemical analyses available for coal in the Heavener area were from an appendix in Donica's thesis (1978). He does not specify which coal (Upper or Lower Hartshorne) his information pertains to, and for the purposes of this report it is assumed that all data are on the Lower Hartshorne coal, since that is the only coal that has been mined in northeast quarter of the Heavener 15-minute quadrangle.

Table 1 presents a summary of the above-mentioned chemical analyses. Average analyses are given, as well as the range for all samples used to calculate each average value. Donica does not present sufficient information on the chemical analyses for data points within the northeast quarter of the Heavener quadrangle to determine a rank for the Lower Hartshorne coal: no data were available on the heating value (Btu) or moisture content. However, based on information in areas adjacent to the area considered by this report, he ranks the coal as being low to medium volatile bituminous. He bases this on a dry, mineral-matter-free fixed carbon percentage, which in the Heavener area he places at 70 to 84 percent.

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 Upper and Lower Hartshorne coal beds in the northeast quarter of the Heavener 15-minute quadrangle. 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 geological evidence supported by specific measurements, while Undiscovered Resources are bodies of coal which are thought to exist, based on board 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)

Table 1. Average chemical composition of coal beds in the northeast quarter of the Heavener 15-minute quadrangle, Le Flore County, Oklahoma

LOWER HARTHSHORNE COAL BED			
ANALYSIS (%)	NUMBER OF SAMPLES	AVERAGE	RANGE
PROXIMATE			
Moisture	--	--	--
Volatile Matter	26	18.62	16.51 - 21.60
Fixed Carbon	26	70.64	41.31 - 75.33
Ash	26	11.56	5.38 - 42.18
ULTIMATE			
Sulfur	26	1.00	0.54 - 1.76
Hydrogen	--	--	--
Carbon	--	--	--
Nitrogen	--	--	--
Oxygen	--	--	--
Heating Value			
Calories	--	--	--
Btu/lb.	--	--	--

Information presented on this table is from Donica (1978). The Form of Analysis was not given, nor were any Heating Values.

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 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 Upper and Lower Hartshorne coals were calculated using data obtained from their coal isopach maps (plates 4 and 5, respectively). 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 1,800 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 measured, indicated, and inferred categories for unleased Federal coal lands. All coal beds thicker than 1 foot (0.305 m) that lie less than 3,000 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 1,000 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 9 and 10, 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 Reserve Base coal, and a recovery factor of 50 percent is applied toward sub-surface-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 44.48 million short tons (40.35 million metric tons) for the entire quadrangle. 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 the 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-hectare) 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; then the entire 40 acres 16-hectares) 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 considred 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 to 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 ratio

t_o = thickness of overburden 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. 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. There are no such areas in this quadrangle.

The coal development potential for surface mining methods is shown on plate 11. All tonnage values are summarized 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, 6 percent is rated high, less than 1 percent is rated moderate, and 5 percent is rated low. The remaining Federal lands (89 percent) 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

Table 2. Coal Reserve Base data for surface mining methods for Federal coal land (in short tons) in the northeast quarter of the Heavener 15-minute quadrangle, Le Flore County, Oklahoma.

COAL	HIGH DEVELOPMENT POTENTIAL	MODERATE DEVELOPMENT POTENTIAL	LOW DEVELOPMENT POTENTIAL	TOTAL
Upper Hartshorne	20,000	10,000	250,000	280,000
Lower Hartshorne	180,000	100,000	910,000	1,190,000
Total	200,000	110,000	1,160,000	1,470,000

thickness are between 150 and 3,000 feet (46 and 914 m) below the ground surface and have dips of 15° or less. 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 to 3,000 feet (610 to 914 m), respectively.

Areas where the coal data are absent or extremely limited between 150 and 3,000 feet (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. There are no such areas in this quadrangle.

The coal development potential for conventional subsurface mining methods is shown on plate 12. A summary of all tonnage values is presented in Table 3. Of the Federal land areas having a known development potential for either conventional subsurface mining or in-site gasification methods, 36 percent is rated high, 51 percent is rated moderate, and none is rated low. Four percent of remaining Federal land in the area 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° 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. Coal laying

Table 3. Coal Reserve Base data for subsurface mining and in-situ gasification methods for Federal coal land (in short tons) in the northeast quarter of the Heavener 15-minute quadrangle, Le Flore County, Oklahoma.

COAL	HIGH DEVELOPMENT POTENTIAL	MODERATE DEVELOPMENT POTENTIAL	LOW DEVELOPMENT POTENTIAL	LOW IN-SITU DEVELOPMENT POTENTIAL	TOTAL
Upper Hartshorne	4,910,000	1,670,000	---------	30,000	6,610,000
Lower Hartshorne	7,260,000	24,240,000	10,000	4,890,000	36,400,000
Total	12,170,000	25,910,000	10,000	4,920,000	43,010,000

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 northeast quarter of the Heavener 15-minute quadrangle, 13 percent of Federal coal land has a low development potential for in-situ gasification methods. However, 35 percent of this land also has a potential for conventional subsurface mining methods. No land in the area has a moderate development potential for in-situ coal 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
	SE SW	Location					x	Donica, 1978, p. 90 & 102,	
	Section 13	Overburden					x	App 1., Bore Hole #22	
1	T 6 N R 26 E	Coal Thickness					x		
	SE SW	Location			x			Donica, 1978, p. 90 App. 1,	Donica's est. elev. of 600
	Section 14	Overburden		x				Pl. 7, Bore Hole #23	not used
2	T 6 N R 26 E	Coal Thickness			x				
	NE SE	Location			x			Donica, 1978, p. 90, Pl. 7,	
	Section 16	Overburden			x			App. 1, Bore Hole #24	
3	T 6 N R 26 E	Coal Thickness			x				
	NW SE	Location					x	Senate Document 390, 1910,	Believed to be same as
	Section 20	Overburden				x		p. 65, Bore Hole #23	Donica's, Bore Hole #25
4	T 6 N R 26 E	Coal Thickness				x			
	NW SW	Location			x			Donica, 1978, App. 1, p. 90	
	Section 19	Overburden			x			Bore Hole #36	
5	T 6 N R 27 E	Coal Thickness			x				
	NE NE	Location					x	USGS files, 1966, Bore Hole	Also in Donica, 1978, BH
	Section 28	Overburden					x	B-19-A	#26, p. 90, 885'S 375'W of
6	T 6 N R 26 E	Coal Thickness					x		NE corner
	NE SW	Location					x	Mobil Oil Co. Ann Lyons	KB is 18.2' above GL, IES,
	Section 29	Overburden				x		Unit #1, 1966	FDC, G, BS-CRC, GL 630.3 on
7	T 6 N R 26 E	Coal Thickness		x					Sonic Log
	SE NE	Location		x				Donica, 1978, p. 90, Pl. 7,	Not confident of depth to
	Section 30	Overburden	x					Bore Hole #27	LH: big discrepancy in
8	T 6 N R 26 E	Coal Thickness			x				Donica's App. 1.
	NE SE	Location			x			Donica, 1978, p. 89, 96-97,	
	Section 25	Overburden				x		Pl. 7, Bore Hole #2	
9	T 6 N R 25 E	Coal Thickness		x					
	Cen N line	Location			x			Donica, 1978, p. 89, Pl. 7,	
	Section 36	Overburden			x			Bore Hole #17	
10	T 6 N R 25 E	Coal Thickness			x				
	SE SW	Location			x			Donica, 1978, App. 1, p. 90	1' discrepancy in App. 1,
	Section 36	Overburden			x			Bore Hole #21	depth to coal was used
11	T 6 N R 25 E	Coal Thickness			x				

DATA POINT #	LOCATION	INCREASING RELIABILITY →	1	2	3	4	5	REFERENCE	NOTES/COMMENTS
	SE NE	Location			x			Donica, 1978, App. 1, p. 89	
	Section 36	Overburden		x				Bore Hole #19	
12	T 6 N | R 25 E	Coal Thickness			x				
	SW SW	Location			x			Donica, 1978, App. 1, p. 90	
	Section 31	Overburden			x			Bore Hole #31	
13	T 6 N | R 26 E	Coal Thickness			x				
	NW NW	Location			x			Donica, 1978, App. 1, p. 90	Donica's est. elev. of 490'
	Section 31	Overburden		x				Bore Hole #29	not used
14	T 6 N | R 26 E	Coal Thickness			x				
	SW SW	Location			x			Donica, 1978, App. 1, p. 90	UH thickness not known by
	Section 31	Overburden		x				Pl. 9, Bore Hole #32	Donica
15	T 6 N | R 26 E	Coal Thickness		x					
	NE SW	Location			x			Donica, 1978, App. 1, p. 90	8' discrepancy in table,
	Section 31	Overburden	x					Pl. 9, Bore Hole #30	App. 1, used depth to coal
16	T 6 N | R 26 E	Coal Thickness			x				
	NW NE	Location			x			Donica, 1978, App. 1, p. 90	1' discrepancy in App. 1
	Section 31	Overburden		x				Pl. 8, Bore Hole #28	table
17	T 6 N | R 26 E	Coal Thickness			x				
	SW SE	Location					x	Donica, 1978, App. 1, p.	2028'W and 380'N of SE
	Section 31	Overburden					x	90, 103, Bore Hole #33	corner
18	T 6 N | R 26 E	Coal Thickness					x		
	NW SW	Location			x			Donica, 1978, App. 1, p. 90	
	Section 32	Overburden			x			Bore Hole #35	
19	T 6 N | R 26 E	Coal Thickness			x				
	NE NE	Location			x			Donica, 1978, App. 1, p. 93	Discrepancy in App. 1 table
	Section 5	Overburden		x				Bore Hole #91	- depth to coal was used.
20	T 5 N | R 26 E	Coal Thickness			x				
	SE SW	Location					x	Donica, 1978, App. 1, p.	2500'E and 200'N of SW
	Section 5	Overburden				x		93, 107-108. Bore Hole #94	corner
21	T 5 N | R 26 E	Coal Thickness				x			
	NW SW	Location			x			Donica, 1978, App. 1, p. 93	1 ft. discrepancy in
	Section 5	Overburden		x				Bore Hole #92	Donica's table. Depth to
22	T 5 N | R 26 E	Coal Thickness			x				coal was used.
	SW SW	Location			x			Donica, 1978, App. 1, p. 93	Discrepancy in App. 1 table
	Section 5	Overburden		x				Bore Hole #93	- depth to coal was used.
23	T 5 N | R 26 E	Coal Thickness			x				
	NW NW	Location			x			Donica, 1978, App. 1, p. 93	Donica not sure of UH
	Section 5	Overburden			x			Bore Hole #90	thickness. None was
24	T 5 N | R 26 E	Coal Thickness		x					reported.

DATE POINT #	LOCATION	INCREASING RELIABILITY →	1	2	3	4	5	REFERENCE	NOTES/COMMENTS
	SE SE	Location			x			Donica, 1978, App. 1, p. 93	Discrepancy on App. 1 table
	Section 6	Overburden		x				Bore Hole #104	- depth to coal used
25	T 6 N | R 26 E	Coal Thickness			x				
	SE SE	Location			x			Donica, 1978, App. 1, p. 93	
	Section 6	Overburden			x			Bore Hole #105	
26	T 5 N | R 26 E	Coal Thickness			x				
	SE NE	Location			x			Donica, 1978, App. 1, p. 93	
	Section 6	Overburden			x			Bore Hole #98	
27	T 5 N | R 26 E	Coal Thickness			x				
	SW SE	Location			x			Donica, 1978, App. 1, p. 93	1' discrepancy in App. 1
	Section 6	Overburden		x				Bore Hole #103	table, depth to coal used.
28	T 5 N | R 26 E	Coal Thickness			x				
	SE SW	Location					x	Donica, 1978, App. 1, p. 93	1' discrepancy in App. 1
	Section 6	Overburden				x		Bore Hole #102	table, depth to coal used.
29	T 5 N | R 26 E	Coal Thickness				x			
	SE SW	Location			x			Donica, 1978, App. 1, p. 93	
	Section 6	Overburden			x			Bore Hole #101	
30	T 5 N | R 26 E	Coal Thickness			x				
	SE SW	Location			x			Donica, 1978, App. 1, p. 93	
	Section 6	Overburden			x			Bore Hole #100	
31	T 5 N | R 26 E	Coal Thickness			x				
	NE SW	Location			x			Donica, 1978, App. 1, p. 93	
	Section 6	Overburden		x				Bore Hole #99	
32	T 5 N | R 26 E	Coal Thickness		x					
	SE NW	Location			x			Donica, 1978, App. 1, p. 93	Discrepancy in Donica's
	Section 6	Overburden	x					Bore hole #97	table, App. 1. Numbers
33	T 5 N | R 26 E	Coal Thickness		x					possibly transposed?
	NW SW	Location			x			Donica, 1978, App. 1, p. 93	Donica not sure of UH
	Section 6	Overburden			x			Bore Hole #96	thickness and did not
34	T 5 N | R 26 E	Coal Thickness		x					report it.
	NW NW	Location			x			Donica, 1978, App. 1, p. 93	
	Section 6	Overburden			x			Pl. 9, Bore Hole #95	
35	T 5 N | R 26 E	Coal Thickness			x				
	SE NE	Location			x			Donica, 1978, App. 1, p. 90	Discrepancy in App. 1 table
	Section 1	Overburden		x				Pl. 8, Bore Hole #43	overburden 1' off
36	T 5 N | R 25 E	Coal Thickness			x				
	SE NE	Location			x			Donica, 1978, App. 1, p. 90	Discrepancy in App. 1 table
	Section 1	Overburden		x				Bore Hole #42	- 1' off, depth to coal
37	T 5 N | R 25 E	Coal Thickness			x				used.

DATA POINT #	LOCATION	INCREASING RELIABILITY →	1	2	3	4	5	REFERENCE	NOTES/COMMENTS
	SE SE	Location			x			Donica, 1978, App. 1, p. 91	
	Section 1	Overburden			x			Bore Hole #45	
38	T 5 N | R 25 E	Coal Thickness			x				
	SW SE	Location			x			Donica, 1978, App. 1, p. 91	
	Section 1	Overburden			x			Bore Hole #44	
39	T 5 N | R 25 E	Coal Thickness			x				
	NE NW	Location			x			Donica, 1978, App. 1, p. 90	
	Section 1	Overburden			x			Pl. 9, Bore Hole #37	
40	T 5 N | R 25 E	Coal Thickness			x				
	NE NW	Location			x			Donica, 1978, App. 1, p. 90	Discrepancy in App. 1
	Section 1	Overburden		x				Bore Hole #38	table, depth to coal was
41	T 5 N | R 25 E	Coal Thickness			x				used
	NW NW	Location			x			Donica, 1978, App. 1, p. 90	
	Section 1	Overburden			x			Bore Hole #39	
42	T 5 N | R 25 E	Coal Thickness			x				
	NW NE	Location			x			Donica, 1978, App. 1, p. 91	
	Section 12	Overburden			x			Bore Hole #46	
43	T 5 N | R 25 E	Coal Thickness			x				
	NW NE	Location			x			Donica, 1978, App. 1, p. 91	
	Section 12	Overburden			x			Bore Hole #47	
44	T 5 N | R 25 E	Coal Thickness			x				
	NE NE	Location			x			Donica, 1978, App. 1, p. 91	
	Section 12	Overburden			x			Bore Hole #50	
45	T 5 N | R 25 E	Coal Thickness			x				
	SE NE	Location			x			Donica, 1978, App. 1, p. 91	
	Section 12	Overburden			x			Bore Hole #51	
46	T 5 N | R 25 E	Coal Thickness			x				
	SE NE	Location			x			Donica, 1978, App. 1, p. 91	
	Section 12	Overburden			x			Bore Hole #53	
47	T 5 N | R 25 E	Coal Thickness			x				
	SE NE	Location			x			Donica, 1978, App. 1, p. 91	
	Section 12	Overburden		x				Bore Hole #54	
48	T 5 N | R 25 E	Coal Thickness			x				
	NE SE	Location			x			Donica, 1978, App. 1, p. 91	
	Section 12	Overburden			x			Bore Hole #56	
49	T 5 N | R 25 E	Coal Thickness			x				
	NE NE	Location			x			Donica, 1978, App. 1, p. 91	
	Section 12	Overburden			x			Bore Hole #48	
50	T 5 N | R 25 E	Coal Thickness			x				

DATA POINT #	LOCATION	INCREASING RELIABILITY	1	2	3	4	5	REFERENCE	NOTES/COMMENTS
	NE NE	Location			x			Donica, 1978, App. 1, p. 91	Donica's est. elev. of 530
	Section 12	Overburden		x				Bore Hole #49	not used
51	T 5 N | R 25 E	Coal Thickness			x				
	SE NE	Location			x			Donica, 1978, App. 1, p. 91	Unresolved data annomaly in
	Section 12	Overburden	x					Bore Hole #52	Donica's thesis involving
52	T 5 N | R 25 E	Coal Thickness			x				LH
	SE NE	Location			x			Donica, 1978, App. 1, p. 91	
	Section 12	Overburden			x			Bore Hole #55	
53	T 5 N | R 25 E	Coal Thickness			x				
	SW NW	Location			x			Donica, 1978, App. 1, p. 93	
	Section 7	Overburden			x			Bore Hole #110	
54	T 5 N | R 26 E	Coal Thickness			x				
	NW NW	Location			x			Donica, 1978, App. 1, p. 93	Discrepancy in App. 1,
	Section 7	Overburden	x					Bore Hole #106	depth to coal used
55	T 5 N | R 26 E	Coal Thickness			x				
	NW NW	Location			x			Donica, 1978, App. 1, p. 93	
	Section 7	Overburden			x			Bore Hole #107	
56	T 5 N | R 26 E	Coal Thickness			x				
	SW NW	Location			x			Donica, 1978, App. 1, p. 94	
	Section 7	Overburden			x			Bore Hole #114	
57	T 5 N | R 26 E	Coal Thickness			x				
	NE NW	Location			x			Donica, 1978, App. 1, p. 93	
	Section 7	Overburden			x			Bore Hole #111	
58	T 5 N | R 26 E	Coal Thickness			x				
	SE NW	Location			x			Donica, 1978, App. 1, p. 94	Discrep. in App. 1 (1 ft.)
	Section 7	Overburden		x				Bore Hole #113	Depth to coal used.Donica's
59	T 5 N | R 26 E	Coal Thickness			x				est. elev. of 550 not used.
	SW NW	Location			x			Donica, 1978, App. 1, p. 93	
	Section 7	Overburden			x			Bore Hole #112	
60	T 5 N | R 26 E	Coal Thickness			x				
	NE SW	Location			x			Donica, 1978, App. 1, p. 94	1' discrepancy App. 1
	Section 7	Overburden		x				Bore Hole #118	table, depth to coal used.
61	T 5 N | R 26 E	Coal Thickness			x				
	SE NW	Location			x			Donica, 1978, App. 1, p. 94	3' discrepancy in App. 1
	Section 7	Overburden		x				Bore Hole #115	table, depth to coal used.
62	T 5 N | R 26 E	Coal Thickness			x				
	NW SE	Location			x			Donica, 1978, App. 1, p. 94	1' discrepancy in App. 1,
	Section 7	Overburden		x				Bore Hole #117	depth to coal used.
63	T 5 N | R 26 E	Coal Thickness			x				

DATA POINT #	LOCATION	INCREASING RELIABILITY →	1	2	3	4	5	REFERENCE	NOTES/COMMENTS
	NE SE	Location			x			Donica, 1978, App. 1, p. 94	1' discrepancy in App. 1
	Section 7	Overburden		x				Bore Hole #117	table, depth to coal used.
64	T 5 N | R 26 E	Coal Thickness			x				
	NE NE	Location			x			Donica, 1978, App. 1, p. 93	1' discrepancy in App. 1
	Section 7	Overburden	x					Bore Hole #109	table, depth to coal used.
65	T 5 N | R 26 E	Coal Thickness			x				
	NE NE	Location			x			Donica, 1978, App. 1, p. 93	See App. 1 table, #108,
	Section 7	Overburden		x				Bore Hole #108	discrepancy of 1 ft. depth
66	T 5 N | R 26 E	Coal Thickness			x				to coal used
	NW NW	Location					x	Donica, 1978, App. 1, p.	1550'S and 250'E of NW
	Section 8	Overburden					x	94, 109, Bore Hole #119	corner
67	T 5 N | R 6 E	Coal Thickness					x		
	SE NW	Location		x				Moose & Searle, 1929, p. 53	Average of net coal from 2
	Section 18	Overburden			x			Heavener Smokeless Coal No.	CMS, Hendricks, 1939, meas.
68	T 5 N | R 26 E	Coal Thickness			x			1 Mine	sec. 42 & 43
	NW NW	Location		x				Moose & Searle, 1929, p. 53	Average of net coal from 2
	Section 18	Overburden			x			Standard Coal Mining Co.	CMS, Hendricks, 1939, meas.
69	T 5 N | R 26 E	Coal Thickness			x				sec. 40 & 41
	SE SW	Location			x			Donica, 1978, App. 1, p. 99	
	Section 24	Overburden			x			Bore Hole #122	
70	T 5 N | R 26 E	Coal Thickness			x				
	SE SW	Location			x			Donica, 1978, App. 1, p. 94	
	Section 24	Overburden			x			Bore Hole #120	
71	T 5 N | R 26 E	Coal Thickness			x				
	SW SE	Location		x				Donica, 1978, App. 1, p. 94	UH absent, Donica's est.
	Section 25	Overburden		x				Bore Hole #123	elev. of 717 not used.
72	T 5 N | R 26 E	Coal Thickness			x				
	SW SE	Location			x			Donica, 1978, App. 1, p. 94	
	Section 24	Overburden			x			Bore Hole #121	
73	T 5 N | R 26 E	Coal Thickness			x				
	NW SW	Location			x			Donica, 1978, App. 1, p. 94	UH thickness not known by
	Section 19	Overburden		x				Bore Hole #134	Donica
74	T 5 N | R 27 E	Coal Thickness		x					
	NW SW	Location			x			Donica, 1978, App. 1, p. 94	UH thickness not known by
	Section 19	Overburden		x				Bore Hole #135	Donica
75	T 5 N | R 27 E	Coal Thickness		x					
	NW SW	Location			x			Donica, 1978, App. 1, p. 95	UH absent
	Section 19	Overburden			x			Bore Hole #136	
76	T 5 N | R 27 E	Coal Thickness			x				

DATA POINT #	LOCATION		INCREASING RELIABILITY →	1	2	3	4	5	REFERENCE	NOTES/COMMENTS
	NW SW		Location			x			Donica, 1978, App. 1, p. 95	
	Section 19		Overburden			x			Bore Hole #137	
77	T 5 N	R 27 E	Coal Thickness			x				
	NW SW		Location			x			Donica, 1978, App. 1, p. 95	
	Section 19		Overburden			x			Bore Hole #138	
78	T 5 N	R 27 E	Coal Thickness			x				
	NW NW		Location			x			Donica, 1978, App. 1, p. 94	
	Section 25		Overburden			x			Bore Hole #125	
79	T 5 N	R 26 E	Coal Thickness			x				
	NW NW		Location			x			Donica, 1978, App. 1, p. 94	UH absent
	Section 25		Overburden			x			Bore Hole #124	
80	T 5 N	R 26 E	Coal Thickness			x				
	NW NW		Location			x			Donica, 1978, App. 1, p. 94	
	Section 30		Overburden			x			Bore Hole #126	
81	T 5 N	R 26 E	Coal Thickness			x				
	NE NE		Location			x			Donica, 1978, App. 1, p. 91	
	Section 25		Overburden			x			Bore Hole #57	
82	T 5 N	R 25 E	Coal Thickness			x				
	NE NE		Location			x			Donica, 1978, App. 1, p. 91	
	Section 25		Overburden			x			Bore Hole #58	
83	T 5 N	R 25 E	Coal Thickness			x				
	SE NW		Location			x			Donica, 1978, App. 1, p. 91	
	Section 25		Overburden			x			Bore Hole #60	
84	T 5 N	R 25 E	Coal Thickness			x				
	SE NW		Location			x			Donica, 1978, App. 1, p. 91	Donica's est. elev. of 670
	Section 25		Overburden		x				Bore Hole #59	not used
85	T 5 N	R 25 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 and depth	Scout card coal	Harts. Drill	Harts. Scout	Top Log Int. Gamma / Elec.	Top Log Int. Dens. / Sonic	T.D. (ft)	Year
11-5-26	SW SW SW							2341	
14-6-26	Dyco/#1-14 Blaylock 1390 FSL 1464 FWL of NW/4		NR		NR			6820	1978
15-6-26	Dyco/#1 Reed 1320 FSL 2340 FWL	NR	NR	NR	NR			6650	1976
20-6-26	Dyco/#1 Turner CSE	NR	NR	NR	NR			6600	1976
21-6-26	Dyco/#1 Hull CNE SW	NR	NR	NR	NR			9978	1976
28-6-26	Dyco/#1-28 Faulkenberry 2530 FSL 1750 FWL	NR	NR	990	990			6900	1978
29-6-26	Mobil/#1 A. Lyons CNE SW	NR	NR	980	980			10254	1966
33-6-26	Dyco Pet., Le Flore G&E NW/4							6600	1968
19-6-27	Am. Ind. O&G/Winterfeat No. 6 NW NW SW	NR		NR				2910	1924