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FEDERAL COAL RESOURCE OCCURRENCE AND FEDERAL COAL DEVELOPMENT POTENTIAL MAPS OF THE WILBURTON QUADRANGLE, LATIMER COUNTY, OKLAHOMA

[Report includes 22 plates]

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INTRODUCTION

Purpose

These maps and accompanying text were compiled to support the land-planning work of the Bureau of Land Management (BLM). The work was undertaken by Geological Services of Tulsa, Inc., Tulsa, Oklahoma, at the request of the U.S. Geological Survey (USGS) under contract number 14-08-0001-17989. The resource information was gathered in response to the Federal Coal Leasing Amendments Act of 1976 (Public Law 94-377). Published and unpublished publicly available information was used. No new drilling or field mapping was done to supplement this study, nor were any confidential or proprietary data used.

Location

The Wilburton 7.5-minute quadrangle is located on the west side of the Howe-Wilburton mining district in the southern part of the southeastern Oklahoma coal field. The quadrangle is entirely in Latimer County; the town of Wilburton is the county seat. The city of McAlester is 29 miles (47 km) west of the quadrangle, and the city of Tulsa is approximately 90 miles (145 km) northwest of the quadrangle.

Accessibility

The town of Wilburton lies in the south-central part of the quadrangle. Oklahoma Highway 2 runs northward from Wilburton approximately 35 miles (56 km) to U.S. Interstate 40. U.S. Route 270 runs west from Wilburton to McAlester where it joins U.S. Route 69, and east to Poteau where it joins U.S. Highway 59.

Many improved and unimproved roads and jeep trails provide access to hilly and mountainous areas for local ranchers and gas well operators.

The Chicago, Rock Island, and Pacific Railroad maintains a railroad line which crosses the southern half of the quadrangle.

Physiography

The Wilburton quadrangle is in the Arkoma basin on the northern edge of the Ouchita Mountains in the Arkansas Valley physiographic province (Hendricks, 1939). The Choctaw fault, at the southern edge of the basin, cuts across the southern part of the quadrangle.

Topographically, the northern half of the Wilburton quadrangle is dominated by the Sans Bois Mountains, which reach a height of 1,460 feet (445 m), and rise fairly abruptly out of the surrounding land. The southern half of the quadrangle is dominated by east-trending ridges and valleys. The ridges range in altitude from 800 to 900 feet (244 to 274 m), and the valley floors are about 600 to 650 feet (183 to 198 m) above sea level. A fairly broad valley cuts across the southern third of the quadrangle, ranging in width from about 1.5 miles (2.4 km) in the east to at least 3 miles (4.8 km) in the west.

The coal beds of the area crop out to the south of the Sans Bois Mountains in sweeping arcs in the valleys of the area. Virtually all the coal bed outcrops occur between the altitudes of 600 and 700 feet (183-214 m).

A number of manmade lakes and smaller ponds exist within the quadrangle, and the area is drained by several small creeks and streams.

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); the average daily temperature ranges from about 41°F (5°C) in January to about 82°F (28°C) in July, occasional periods of even hotter days are not unusual (Hendricks, 1939). Annual precipitation in the area averages approximately 41 inches (104 cm) spread throughout the year 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 Wilburton 7.5-minute quadrangle. The Federal Government holds title to the coal mineral rights for approximately 10,630 acres (27 percent) of the quadrangle. As of October 19, 1979, none of this land was leased.

GENERAL GEOLOGY

Previous work

Much work has been done on the southern Oklahoma coal field. The first geologic study of the Howe-Wilburton district, of which the Wilburton 7.5-minute quadrangle is a part, was published by Chance (1890) and included a map showing the outcrops of the area's most important coal beds. In 1897, Drake published 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 several investigations carried out for the U.S. Geological Survey on the extent and general character of local stratigraphy, including coal beds. Much of Taff's 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 in a 1914 bulletin on the geology of east-central Oklahoma emphasized 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, and Houseknecht and Iannacchione (1982), added greatly to the knowledge of 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 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 was obtained from USGS files.

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 beds occurring 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-trending anticlinal and synclinal folds (see section on Structure below).

Most of the rock units cropping out in the Wilburton 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. South of the Choctaw fault are noncoal-bearing older rocks associated with the Ouachita Province. They lie south of the Oklahoma coal field and will not be discussed in detail here.

The Atoka Formation was named by Taff and Adams in 1900. It is the oldest exposed formation north of the Choctaw fault in the quadrangle, and crops out across the central and west-central section of it (Hendricks 1939). The formation consists mostly of black to gray sandy shale interbedded with ridge-forming brown or light-gray sandstone. The sandstone is highly variable in character, both from bed to bed and within a single bed. In most exposures it is fine grained, silty and irregularly bedded; however, locally it may be coarse grained, clean, and massive to thick bedded. The Atoka Formation thickens somewhat across the quadrangle, from about 5,000 feet (1,524 m) in the northwest to 6,500 feet (1,981 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 single band trending east across the center 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; Branson, 1962). The contact between the Hartshorne Formation and the overlying McAlester Formation is conformable (Hendricks, 1939).

The boundaries of the Hartshorene 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 lower and upper Hartshorne coals in northern LeFlore and eastern Haskell Counties, and redefined the formation to include both coals. The Hartshorne coals, undivided to the north, split into lower and upper Hartshorne coals along a northeast-trending line. This split line cuts across the northern part of the Wilburton quadrangle (plate 15). The current 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 lower and upper members where applicable (on the basis of the coal split line).
The Hartshorne Formation is highly variable in character and thickness throughout the Howe-Wilburton district. In general it contains interbedded sandstone and shale which tend to become discontinuous as the upper and lower coals merge. The sandstone is mainly fine grained, white to brown, silty and micaceous; and the shale is gray and sandy. Plant fossils are abundant in the shales. The Hartshorne is roughly 250 feet (76 m) thick in the Wilburton quadrangle.

Conformably overlying the Hartshorne is the McAlester Formation, which has an average thickness of about 2,000 to 2,100 feet (610 to 640 m) in the Wilburton quadrangle. The McAlester crops out in a band running northwest to east across the area. The McAlester Formation consists mainly of various unnamed shale units, but also includes one named shale member and several sandstone members. In ascending order, the named members are the McCurtain Shale Member, and the Warner, Lequire, Cameron, Tamaha, and Keota Sandstone Members. Between successive sandstones, and above the Keota Sandstone Member, is an unnamed shale unit. The thickness of each individual member or unit was estimated from well logs in the area.

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 Member contains a few thin sandstone units, including a locally persistent thin sandstone with an associated unnamed local coal, found approximately 350 feet (107 m) above the base of the member.

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. The Warner directly overlies the McCurtain Shale Member. It is highly variable in thickness (Oakes and Knechtel, 1948), and has a locally persistent coal associated with it. Above the Warner Member is an unnamed shale unit which is dark gray silty, and fissile, and in the Wilburton area has an average thickness of 200 feet (61 m) (Russell, 1960). Siderite concretions are common, and a few thin sandstones can be found within it.

Overlying the unnamed shale unit is the Lequire Sandstone Member of the McAlester Formation. The Lequire contains lenticular sandstone beds interbedded with siltstone and shale, and locally a thin 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 Member in the Wilburton area is a thick (± 80 ft, 24 m), massive to thin-bedded, fine-grained sandstone. The overlying shale includes the economically important lower and upper McAlester coals. The Tamaha Sandstone Member includes a complex of sandstone lenses rather than being a single bed (Oakes and Knechtel, 1948) and averages only about 20 feet (6 m) in thickness. The Keota Sandstone Member, separated from the Tamaha by a fairly thick (200 feet, 61 m) unnamed dark-gray shale unit, is the uppermost sandstone member of the McAlester Formation. It is generally a silty, buff, fine-grained sandstone, 30 to 70 feet (9 to 21 m) in thickness. Both the Tamaha and Keota Sandtones tend to be erratic and discontinuous (Russell, 1969). 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 alternating shale and sandstone bands across the north-central part of the Wilburton quadrangle (Hendricks, 1939). In some places the contact with the underlying McAlester Formation appears to be gradational, whereas in others it is highly irregular. The sandstones of the Savanna Formation form prominent ridges, as evidenced by the southern edge of the Sans Bois Mountains. These sandstone beds are generally brown, dense, fine grained, and miaceous, and the interbedded shales are brown to grayish green.

The Boggy Formation is the upper unit of the Krebs Group in the Desmoinesian Series. It lies conformably on the Savanna Formation, and is the youngest consolidated unit exposed in the area. In the Wilburton quadrangle, it crops out to the northeast in the Sans Bois Mountains, where it is about 850 feet (259 m) thick (Russell, 1960). The Boggy consists of alternating shale and sandstone units and its lower boundary is defined as the base of the Bluejacket Sandstone Member (Russell, 1960).

The Secor coal, part of the Boggy Formation, crops out in the extreme northeast corner of the Wilburton quadrangle (Russell, 1960). No information on its thickness or quality was available.

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

Structure

The Wilburton quadrangle lies within a zone of folded Pennsylvanian rocks characterized by broad, shallow synclines and narrow anticlines (Russell, 1960). The axes of these structures are commonly en echelon, and in general run parallel to the frontal margin of the adjacent Ouachita salient, marked by the Choctaw fault. The principal surface structures in the Wilburton quadrangle are shown on plate 1. One of the more dominant features in the area is the Sans Bois syncline, the axis of which passes through the northern quarter of the Wilburton quadrangle. The form of the syncline is altered somewhat by a structural high on the axis in T. 6 N., R. 19 E., where the structure is undulating and irregular and not easily recognized as synclinal (Russell, 1960). The dip of beds along the axis of the syncline ranges from 3° to 7°. Dips on the flanks of the syncline are 10° to 14°.

The eastern tip of the Adamson anticline extends into the quadrangle in sec. 35, T. 6 N., R. 18 E. This structure has very steep dips on the northwest side (40° to 70°) and gentler dips on the southeast side (17° to 40°).

The Wilburton anticline is a poorly defined fold that begins in sec. 13, T. 5 N., R. 18 E., and extends southwestward out of the quadrangle for about 5 miles (8 km), where it passes beneath the Choctaw fault (Hendricks, 1939). Roughly paralleling that anticline is the Hartshorne syncline, which also extends southwestward out of the quadrangle. No strike and dip information is associated with these folds was available.

The only major fault in the quadrangle is the Choctaw fault, which marks the northern edge of the Ouachita thrust zone.

COAL GEOLOGY

Several major coal beds have been identified and mapped in the Wilburton quadrangle. They include, in ascending order, the Hartshorne coal bed and its lower and upper splits, an unnamed local coal bed, the lower McAlester (Stigler) coal bed, and the upper McAlester (Stigler Rider) coal bed. In addition to these are the Secor coal bed, which has been mapped in the northeast corner of the quadrangle by Russell (1960), but for which no data were available, and several other minor local coals. In the Wilburton quadrangle, there are measurements of four local coals which exceed the Reserve Base thickness of 1 foot (0.3 m) used in this area and are treated as isolated data points. These include local coals measured in data points 10, 11, 12, 67, and 71 (see plate 1 for locations and plate 3 for correlations).

Hartshorne coal bed and lower and upper splits

The Hartshorne coals occur at or near the top of the Hartshorne Formation. The split line for the Hartshorne coal bed crosses the north half of the quadrangle. The split line is defined in this report as the 1-foot (0.3-m) interburden isopach line (plate 17). North of this line only one coal seam is present; south of it the bed is split into lower and upper Hartshorne coals. The structure on these coals is presented on plate 16, and the thickness of the interburden between the splits is shown on plate 17. The interburden ranges in thickness from 1 foot (0.3 m) at the split line to at least 60 feet (18 m).

Only the upper and lower splits of the Hartshorne coal crop out in this quadrangle. They crop out in a band trending east-west across the center part of the quadrangle and dip north-northeast. Data available from USGS files (see table 4) on recent coring in the west-central part of the quadrangle in sec. 1, T. 5 N., R. 18 E., indicate that the lower Hartshorne coal crop line was incorrectly located in previous work done in the area. The crop line has been adjusted in this report (plate 1) to conform to the more recent data.

The Hartshorne coal is, in general, thicker than either the upper or lower split, and measurements of it (estimated from gas well logs) range from 5 feet (1.5 m) in the northeast to 10 feet (3.0 m) in the northwest. Measurements of the upper Hartshorne coal split range from 2 feet (0.6 m) to 5 feet (1.5 m). The isopach map (plate 15) indicates that this coal thins to 1 foot (0.3 m) or less in the east-central part of the quadrangle. The lower Hartshorne coal split is generally slightly thicker than its upper counterpart, measuring as much as 6 feet (1.8 m) in several bore holes. Isopach measurements of both the lower and upper Hartshorne coals in the west-central part of the quadrangle have been corrected for the steep dip (greater than 25°) there.

Both the lower and upper Hartshorne coals have been mined extensively (see plate 1).

Unnamed local coal bed

An unnamed local coal bed in the McAlester Formation has been correlated in several well logs in the quadrangle. It occurs approximately 800 feet (244 m) above the underlying Hartshorne Formation and 750 feet (229 m) below the lower McAlester coal. Its occurrence was documented only through well logs, and was interpreted as a coal because of its log response. The subcrop of this coal (plate 12) was determined by geometric triangulation, using regional dip and depth to coal. This bed attains a thickness of about 4 feet (1.2 m) at depth to the north, but toward the south in the shallow subsurface it appears to be less than 1 foot (0.3 m) thick.

Upper and lower McAlester coal beds

The lower and upper McAlester coal beds crop out north of the lower and upper Hartshorne coals, as much as 0.5 mile (0.8 km) south of the front edge of the Sans Bois Mountains. A small normal fault interrupts the lower McAlester crop line in sec. 31, T. 6 N., R. 19 E., and the coal beds dip north to northeast. The structure of these two coals is shown on plate 6. From about 30 feet to at least 60 feet (9 to 18 m) of interburden separates them (see plate 7).

Isopach measurements for both the lower and upper McAlester coals have come mostly from well logs; a few more exact measurements came from bore holes and measured sections. The upper McAlester coal is about 1 to 4 feet (0.3 to 1.2 m) in thickness. The lower McAlester coal is 1 to 3 feet (0.3 to 0.9 m) in thickness; the upper McAlester coal has been strip-mined in sec. 32, T. 6 N., R. 19 E., and secs. 3 and 4, T. 5 N., R. 19 E.

Chemical analyses of coal

Chemical analyses were available only for the lower and upper Hartshorne coal beds in this quadrangle, and not for the upper McAlester, lower McAlester, or

Table 1. Average chemical composition of coal beds in the Wilburton quadrangle, Latimer County Oklahoma. Data shown are from Shannon and others (1926) and Hendricks (1939).

ANALYSIS (%)	UPPER HARTSHORNE COAL BED				LOWER HARTSHORNE COAL BED		
	FORM OF ANALYSIS	# OF SAMPLES	AVERAGE	RANGE	# OF SAMPLES	AVERAGE	RANGE
PROXIMATE							
Moisture	A	11	3.4	2.8-3.9	7	2.0	1.0-2.3
	A	11	37.1	36.0-38.0	7	38.5	37.8-39.6
Volatile Matter	C	7	38.2	37.1-39.4	1	39.2	---
	A	11	54.1	52.7-55.9	7	52.0	48.5-54.6
Fixed Carbon	C	7	56.1	54.7-57.6	1	55.2	---
	A	11	5.4	4.5-6.4	7	6.1	5.0-8.5
Ash	C	7	5.7	4.8-6.7	1	5.6	---
ULTIMATE							
	A	11	1.0	0.8-1.2	7	1.6	0.8-2.6
Sulfur	C	7	1.0	0.9-1.2	1	1.9	---
	-	-	-	---	-	-	---
Hydrogen	-	-	-	---	-	-	---
	-	-	-	---	-	-	---
Carbon	-	-	-	---	-	-	---
	-	-	-	---	-	-	---
Nitrogen	-	-	-	---	-	-	---
	-	-	-	---	-	-	---
Oxygen	-	-	-	---	-	-	---
Heating Value							
	A	10	7,582	7,383-7,650	-	-	---
Calories	C	6	7,771	7,678-7,849	-	-	---
	A	10	13,594	13,290-13,770	6	13,701	
Btu/lb	C	6	13,988	13,820-14,130	-	-	13,053-14,141

Form of analysis: A, as-received; C, moisture-free. NOTE: To convert Btu/lb to kJ/kg, multiply by 2.326.

the unnamed local coal bed. Available analyses are summarized in table 1. Average analyses are shown, as well as the range for all samples used to calculate each average value.

The coals are listed according to Btu/lb, as determined on a moisture-free and mineral-matter-free (mmf) basis. The as-received Btu/lb values shown on table 1 were converted to moisture-mmf Btu/lb figures according to the following formula (American Society for Testing and Materials, 1980):

$$\text{Moisture-mmf Btu/lb} = \frac{\text{as rec'd Btu/lb} - 50\ S}{[100 - (1.08\ A + 0.55\ S)]} \quad X\ 100$$

where S = sulfur, A = ash

Based on the average Btu/lb shown on table 1, both the lower and upper Hartshorne coals are classified as high-volatile A bituminous coals; the lower Hartshorne has an average of 14,446 Btu/lb on a moisture mmf basis, and the upper Hartshorne has an average of 14,302 Btu/lb on a moisture mmf basis.

Isolated data points

In instances where single or isolated measurements of coal beds thicker than 1.0 foot (0.3 m) are encountered, the standard criteria for construction of isopach, structure-contour, mining-ratio, and overburden isopach maps are not available. The lack of data concerning these beds limits the extent to which beds 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 illustrations/maps are not included in this report, but are kept on file at the USGS office in Denver. However, coal reserves from these isolated data points are included in tables 2 and 3, and in the Reserve Base tonnages shown on plate 2.

All isolated data points in the Wilburton quadrangle are measurements of unnamed local coals.

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 Wilburton quadrangle. The source of each indexed data point shown on plate 1 is identified in table 4 .

A system for classifying coal resources has been devised by the U.S. Bureau of Mines and the USGS, 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; Undiscovered Resources are bodies of coal which are thought to exist on the basis of 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. Listed 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.

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 lower and upper McAlester coal beds, an unnamed local coal bed, and the Hartshorne coal bed and its lower and upper splits were calculated using data obtained from their coal isopach maps (plates 4, 5, 11, and 15, 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, and Undiscovered Resources in the hypothetical category, for unleased Federal coal land. All coal beds thicker than 1 foot (0.3 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 244 feet (75 m) from the nearest mine are considered to have no reserves and included within mined-out areas. Mine boundaries are only approximately located (as stated in the explanation on plate 1), and therefore these narrow areas may not actually exist. For this reason, they are considered to have no reserves, and have not been planimetered.

Reserve Base and Reserve tonnages are shown on plates 9, 10, 14, 19, and 20, 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 feet (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 subsurface-minable coal. No recovery factor is applicable for in-situ coal gasification methods.

The total tonnage per section for Reserve Base coal, including surface, subsurface-minable, and in-situ gasification coal are shown in the northwest corner of the Federal coal lands in each section on plate 2. All values shown on plate 2 are rounded to the nearest 10,000 short tons, and total approximately 110.27 million short tons (100.04 million metric tons) for the entire quadrangle, including tonnages in the isolated data points. Reserve Base tonnages from the various development-potential categories for surface and subsurface mining and in-situ coal gasification methods are shown in tables 2 and 3.

Geological Services of Tulsa has 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 Bureau of Land Management, approximately 40-acre (16-hectare) parcels have been used to show to limits of the high-, moderate-, or low-development potentials. A constraint imposed by the BLM specifies that the highest development potential affecting any part of a 40-acre (16-hectare) lot, tract, or parcel be applied to that entire lot, tract, or parcel. For example, if 5 acres (2 hectares) within a parcel meet the criteria for a high-development potential; 25 acres (10 hectares), a moderate-development potential; and 10 acres (4 hectares), a low-development potential; then the entire 40 acres (16 hectares) are assigned a high-development potential. 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-ratio values (cubic yards of overburden per ton of recoverable coal). The formula used to calculate mining-ratio values for surface mining of coal is as follows:

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

where MR = mining-ratio value

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 USGS.

Areas where the coal data are absent or extremely limited between the 150-foot (946-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 approximately 0.07 million short ton of coal available for surface mining.

The coal-development potential for surface-mining methods is shown on plate 21. 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, 13 percent is rated high, 2 percent is rated moderate, and 10 percent is rated low. The remaining Federal land (75 percent) is 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 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 of, respectively 150-1,000 feet (46-305 m), 1,000-2,000 feet (305-610 m), and 2,000-3,000 feet (610-914 m).

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, and to those areas influenced by isolated data points. The areas influenced by isolated data points in this quadrangle contain approximately 3.42 million short tons (3.10 million metric tons) of coal available for conventional subsurface mining.

The coal development potential for conventional subsurface-mining methods is shown on plate 22. A summary of all tonnage values is presented in table 3. Of the Federal land having a known development potential for either conventional subsurface-mining or in-situ gasification methods, 44 percent is rated high, 23 percent is rated moderate, and 3 percent is rated low. Of the remaining Federal land in the quadrangle, 18 percent is classified as having unknown or no development potential for conventional subsurface-mining methods.

Based on criteria provided by the USGS, coal beds of Reserve Base thickness dipping 15° to 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 short 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 coverage and containment in the insitu process.

In the Wilburton quadrangle, 21 percent of the Federal coal land has a low-development potential for in-situ coal gasification. However, much of this land (43 percent) also has development potential for subsurface mining (see plate 22). No Federal coal land in the quadrangle is rated as having a moderate-development potential for in-situ coal gasification.

Table 2. Coal Reserve Base data for surface-mining methods for Federal coal lands (in short tons) in the Wilburton quadrangle, Latimer County, Oklahoma

Coal Bed or Coal Zone	High Development Potential	Moderate Development Potential	Low Development Potential	Unknown Development Potential	TOTAL
Upper McAlester	30,000	10,000	1,150,000	---------	1,190,000
Lower McAlester	210,000	110,000	1,360,000	---------	1,680,000
Unnamed Local	---------	---------	---------	---------	---------
Upper Hartshorne	30,000	10,000	70,000	---------	110,000
Hartshorne	---------	---------	---------	---------	---------
Lower Hartshorne	670,000	180,000	480,000	---------	1,330,000
Isolated Data Points	---------	---------	---------	70,000	70,000
Totals	940,000	310,000	3,060,000	70,000	4,380,000

Table 3. Coal Reserve Base data for subsurface mining and in-situ gasification methods for Federal coal lands (in short tons) in the Wilburton quadrangle, Latimer 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 McAlester	6,130,000	1,660,000	-------	470,000	-------	8,260,000
Lower McAlester	4,920,000	1,270,000	-------	740,000	-------	6,930,000
Unnamed Local	--------	1,050,000	350,000	-------	-------	1,400,000
Upper Hartshorne	8,700,000	16,580,000	10,200,000	7,160,000	-------	42,640,000
Hartshorne	--------	-------	-------	40,000	-------	40,000
Lower Hartshorne	6,890,000	15,650,000	13,160,000	7,670,000	-------	43,370,000
Isolated Data Points	-------	-------	-------	-------	3,250,000	3,250,000
Totals	26,640,000	36,210,000	23,710,000	16,080,000	3,250,000	105,890,000

TABLE 4. SOURCE AND RELIABILITY OF DATA USED ON PLATE 1.

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

DATA POINT #	LOCATION	INCREASING RELIABILITY →	1	2	3	4	5	REFERENCE	NOTES/COMMENTS
	SW NE	Location					x	Mobil Oil Company,	Hartshorne missing in sec.
	Section 14	Overburden			x			T. Johnson #1, 1970	between 3950 & 4350 on log.
1	T 6 N | R 19 E	Coal Thickness		x					KB 18.5' above GL.2.5"E log
	SW NE	Location					x	Mobil Oil Company,	KB is 18' above GL.
	Section 15	Overburden			x			H. Johnson #1, 1969	2 1/2" E log.
2	T 6 N | R 19 E	Coal Thickness		x					
	SW NE	Location					x	Mobil Oil Company,	KB 20' above GL.
	Section 17	Overburden			x			D. Weaver D-1, 1967	2 1/2" E & D logs.
3	T 6 N | R 19 E	Coal Thickness		x					
	C NE	Location					x	Snee & Eberly, Scruggs 1-	KB 17' above GL.
	Section 14	Overburden			x			14, 1977	2 1/2" E & D logs.
4	T 6 N | R 18 E	Coal Thickness		x					U & L Harts benches.
	SW NE	Location					x	Monsanto Company, Wildlife	KB 17' above GL.
	Section 24	Overburden			x			#1, 1969	2 1/2" E log.
5	T 6 N | R 18 E	Coal Thickness		x					
	SE SW	Location					x	Monsanto Company, Cave #1,	KB 18' above GL.
	Section 19	Overburden			x			1966	2 1/2 large scale E log.
6	T 6 N | R 19 E	Coal Thickness		x					
	NW SE	Location					x	Mobil Oil Company,	KB 18' above GL.
	Section 20	Overburden			x			D. Weaver B-1, 1966	2.5" E & D logs.
7	T 6 N | R 19 E	Coal Thickness		x					U & L Hartshorne benches.
	NE SW	Location					x	Mobil Oil Company,	2.5" E & D logs.
	Section 21	Overburden			x			D. Weaver B-1, 1967	
8	T 6 N | R 19 E	Coal Thickness		x					
	SE SW	Location					x	Austral Oil Company,	KB 20' above GL.
	Section 27	Overburden			x			Young Ranch 1-27, 1966	2.5" E & D logs.
9	T 6 N | R 19 E	Coal Thickness		x					GL 833 (from topo sheet).
	NW SW	Location					x	Austral Oil Company,	KB 20' above GL.
	Section 28	Overburden			x			Young Ranch 1-28, 1966	2.5" E & D logs.
10	T 6 N | R 19 E	Coal Thickness		x					
	NW SE	Location					x	Shell Oil Company,	KB 17.5' above GL.
	Section 29	Overburden			x			Kilpatrick 1-29, 1965	2.5" E log.
11	T 6 N | R 19 E	Coal Thickness		x					

DATE POINT #	LOCATION	INCREASING RELIABILITY →	1	2	3	4	5	REFERENCE	NOTES/COMMENTS
	NW SE	Location					x	Mobil Oil Company,	KB 17.5' above GL.
	Section 30	Overburden			x			Hackney #1, 1966	2.5" E & D logs.
12	T 6 N | R 19 E	Coal Thickness		x					
	SE SE	Location					x	Senate Document 390, 1910,	
	Section 25	Overburden					x	p. 63, Bore Hole #18	
13	T 6 N | R 18 E	Coal Thickness					x		
	SE SE	Location					x	Pan American Petroleum Co.	KB 18.6' above GL.
	Section 25	Overburden			x			USA Anderson-Pritchard #1,	2.5" E log.
14	T 6 N | R 18 E	Coal Thickness		x				1968	
	NW SE	Location					x	Senate Document 390, 1910,	No coal.
	Section 25	Overburden					x	p. 63, Bore Hole #17.	
15	T 6 N | R 18 E	Coal Thickness					x		
	NW SE	Location					x	Pan American Petroleum Co.	KB 18.7' above GL.
	Section 26	Overburden			x			Doremus #1, 1963	1" Sonic log.
16	T 6 N | R 18 E	Coal Thickness		x					2" Electric log.
		Location		x				Russell,D.T., 1960, p. 46,	
	Section 35 & 26	Overburden	-	-	-	-	-	Measured Section #8	
17	T 6 N | R 18 E	Coal Thickness					x		
	SE NE	Location					x	USGS Files, 1953,	Hit old mine at 19 ft.
	Section 35	Overburden				x		Bore Hole #42	
18	T 6 N | R 18 E	Coal Thickness			x				
	SE NE	Location					x	USGS Files, 1953,	Mixed coal & smut.
	Section 35	Overburden				x		Bore Hole #43	
19	T 6 N | R 18 E	Coal Thickness			x				
	SE NE	Location					x	USGS Files, 1953,	
	Section 35	Overburden				x		Bore Hole # 44	
20	T 6 N | R 18 E	Coal Thickness			x				
	SE NE	Location					x	USGS Files, 1953,	Hit old mine, U & L splits
	Section 35	Overburden				x		Bore Hole #45	are together here. Lower
21	T 6 N | R 18 E	Coal Thickness			x				split worked by Old #19 Mine
	NE SE	Location		x				Hendricks, T., 1939,	4 sample average from
	Section 35	Overburden	-	-	-	-	-	Plates 27,34, Measured	M K & T Mine #19. Location
22	T 6 N | R 18 E	Coal Thickness			x			Sections # 2, 3, 5, 6	within mine not known.
	SW SW	Location		x				Hendricks, T., 1939,	M K & T #18 Mine
	Section 36	Overburden	-	-	-	-	-	Plates 27, 34, Measured	
23	T 6 N | R 18 E	Coal Thickness			x			Section #48	
	SE NE	Location					x	Moose & Searle, 1929, p.46	M K & T Mine #19. Located
	Section 35	Overburden	-	-	-	-	-	Measured Section A	with USGS Mine Map.
24	T 6 N | R 18 E	Coal Thickness					x		

DATE POINT #	LOCATION	INCREASING RELIABILITY →	1	2	3	4	5	REFERENCE	NOTES/COMMENTS
	SW NW	Location					x	USGS Files, M K & T Mine	1450' S 300' E of NWC of
	Section 36	Overburden	-	-	-	-	-	#19	Section 36.
25	T 6 N | R 18 E	Coal Thickness			x				
	SE NW	Location					x	Fieldner, et al, 1922,	M K & T #19 Mine. Located
	Section 36	Overburden	-	-	-	-	-	p. 218, Measured Section A	with USGS Mine Map.
26	T 6 N | R 18 E	Coal Thickness					x		
	SW NW	Location					x	Fieldner, et al, 1922,	M K & T #19 Mine. Located
	Section 36	Overburden	-	-	-	-	-	p. 218, Measured Section B	with USGS Mine Map.
27	T 6 N | R 18 E	Coal Thickness					x		
	SW NW	Location					x	Fieldner, et al, 1922,	M K & T #19 Mine. Located
	Section 36	Overburden	-	-	-	-	-	p. 218, Measured Section C	with USGS Mine Map.
28	T 6 N | R 18 E	Coal Thickness					x		
	SE NW	Location					x	Fieldner, et al, 1922,	M K & T #19 Mine. Located
	Section 36	Overburden	-	-	-	-	-	p. 218, Measured Section D	with USGS Mine Map.
29	T 6 N | R 18 E	Coal Thickness					x		
	SW NW	Location					x	Fieldner, et al, 1922,	M K & T #19 Mine. Located
	Section 36	Overburden	-	-	-	-	-	p. 218, Measured Section E	with USGS Mine Map.
30	T 6 N | R 18 E	Coal Thickness					x		
	NW SW	Location			x			Shannon, et al, 1926,	Approximately located in
	Section 36	Overburden	-	-	-	-	-	p. 46, Measured Section	M K & T #19 Mine using USGS
31	T 6 N | R 18 E	Coal Thickness			x			#17	Mine Map.
	SW SW	Location		x				Russell, 1960, p. 45,	Line Measured Section which
	Section 36	Overburden	-	-	-	-	-	Measured Section #7	measured coal thickness in
32	T 6 N | R 18 E	Coal Thickness				x			strip pit.
	NW SE	Location				x		USGS Files, M K & T	250' E, 150's of Center,
	Section 36	Overburden	-	-	-	-	-	Mine #19	Section 36.
33	T 6 N | R 18 E	Coal Thickness			x				
	CE/2 NW	Location			x			Russell, 1960, p. 45-50,	LM is faulted out. Russell
	Section 31	Overburden	-	-	-	-	-	Measured Section #10	Hackney, 1960, p.18
34	T 6 N | R 19 E	Coal Thickness				x			#1 log (data point #12).
	SW NE	Location					x	USGS Files, 1957,	
	Section 31	Overburden				x		Bore Hole #17	
35	T 6 N | R 19 E	Coal Thickness	-	-	-	-	-		
	SW NE	Location					x	USGS Files, 1957,	
	Section 31	Overburden				x		Bore Hole #16	
36	T 6 N R 19 E	Coal Thickness	-	-	-	-	-		
	SW SE	Location					x	USGS Files, 1957,	
	Section 31	Overburden				x		Bore Hole #15	
37	T 6 N | R 19 E	Coal Thickness	-	-	-	-	-		

DATA POINT #	LOCATION	INCREASING RELIABILITY	1	2	3	4	5	REFERENCE	NOTES/COMMENTS
	SE NE	Location					x	USGS Files, 1957,	
	Section 31	Overburden				x		Bore Hole #11	
38	T 6 N R 19 E	Coal Thickness	-	-	-	-	-		
	SE NE	Location					x	USGS Files, 1957,	
	Section 31	Overburden				x		Bore Hole #12	
39	T 6 N R 19 E	Coal Thickness	-	-	-	-	-		
	SE NE	Location					x	USGS Files, 1957,	
	Section 31	Overburden				x		Bore Hole #13	
40	T 6 N R 19 E	Coal Thickness	-	-	-	-	-		
	CNE	Location					x	USGS Files, 1957,	
	Section 31	Overburden				x		Bore Hole #14	
41	T 6 N R 19 E	Coal Thickness	-	-	-	-	-		
	SE NE	Location					x	USGS Files, 1957,	
	Section 31	Overburden				x		Bore Hole #7	
42	T 6 N R 19 E	Coal Thickness	-	-	-	-	-		
	SE NE	Location					x	USGS Files, 1957,	
	Section 31	Overburden				x		Bore Hole #6	
43	T 6 N R 19 E	Coal Thickness	-	-	-	-	-		
	SE NE	Location					x	USGS Files, 1957,	
	Section 31	Overburden				x		Bore Hole #5	
44	T 6 N R 19 E	Coal Thickness	-	-	-	-	-		
	SE NE	Location					x	USGS Files, 1957,	
	Section 31	Overburden				x		Bore Hole #4	
45	T 6 N R 19 E	Coal Thickness	-	-	-	-	-		
	SE NE	Location					x	USGS Files, 1957,	
	Section 31	Overburden				x		Bore Hole #3	
46	T 6 N R 19 E	Coal Thickness	-	-	-	-	-		
	SE NE	Location					x	USGS Files, 1957,	
	Section 31	Overburden				x		Bore Hole #2	
47	T 6 N R 19 E	Coal Thickness	-	-	-	-	-		
	SE NE	Location					x	USGS Files, 1957,	
	Section 31	Overburden				x		Bore Hole #1	
48	T 6 N R 19 E	Coal Thickness	-	-	-	-	-		
	NE SE	Location					x	USGS Files, 1957,	No coal reached.
	Section 31	Overburden				x		Bore Hole #10	
49	T 6 N R 19 E	Coal Thickness	-	-	-	-	-		
	NE SE	Location					x	USGS Files, 1957,	No coal reached.
	Section 31	Overburden				x		Bore Hole #9	
50	T 6 N R 19 E	Coal Thickness	-	-	-	-	-		

DATA POINT #	LOCATION	INCREASING RELIABILITY →	1	2	3	4	5	REFERENCE	NOTES/COMMENTS
	NE SE	Location					x	USGS Files, 1957,	No coal reached.
	Section 31	Overburden				x		Bore Hole #8	
51	T 6 N R 19 E	Coal Thickness	-	-	-	-	-		
	NW SW	Location					x	USGS Files, 1957,	
	Section 32	Overburden				x		Bore Hole #18	
52	T 6 N R 19 E	Coal Thickness	-	-	-	-	-		
	SW NW	Location					x	USGS Files, 1957,	
	Section 32	Overburden				x		Bore Hole #19	
53	T 6 N R 19 E	Coal Thickness	-	-	-	-	-		
	NE SW	Location					x	USGS Files, 1957,	
	Section 32	Overburden				x		Bore Hole #25	
54	T 6 N R 19 E	Coal Thickness	-	-	-	-	-		
	NW SE	Location					x	USGS Files, 1957,	
	Section 32	Overburden				x		Bore Hole #24	
55	T 6 N R 19 E	Coal Thickness	-	-	-	-	-		
	NE SW	Location					x	USGS Files, 1957,	No coal reached.
	Section 32	Overburden				x		Bore Hole #23	
56	T 6 N R 19 E	Coal Thickness	-	-	-	-	-		
	NE SW	Location					x	USGS Files, 1957,	No coal reached.
	Section 32	Overburden				x		Bore Hole #22	
57	T 6 N R 19 E	Coal Thickness	-	-	-	-	-		
	NE SW	Location					x	USGS Files, 1957,	No coal reached.
	Section 32	Overburden				x		Bore Hole #21	
58	T 6 N R 19 E	Coal Thickness	-	-	-	-	-		
	SE SW	Location					x	USGS Files, 1957,	No coal reached.
	Section 32	Overburden				x		Bore Hole #20	
59	T 6 N R 19 E	Coal Thickness	-	-	-	-	-		
	NW SE	Location					x	USGS Files, 1958, Mine Map	2400' FEL. 1250' FSL.
	Section 32	Overburden				x		CW Allen Strip pit	
60	T 6 N R 19 E	Coal Thickness			x				
	C SE	Location					x	USGS Files, 1958, Mine Map	350' FEL. 450' FSL.
	Section 32	Overburden				x		CW Allen Strip pit	
61	T 6 N R 19 E	Coal Thickness			x				
	SE SE	Location					x	USGS Files, 1957, Mine Map	
	Section 32	Overburden				x		CW Allen Strip pit, Bore	
62	T 6 N R 19 E	Coal Thickness	-	-	-	-	-	Hole #26	
	SE SE	Location					x	USGS Files, 1957, Mine Map	
	Section 32	Overburden				x		CW Allen Strip pit, Bore	
63	T 6 N R 19 E	Coal Thickness	-	-	-	-	-	Hole #27	

DATA POINT #	LOCATION	INCREASING RELIABILITY →	1	2	3	4	5	REFERENCE	NOTES/COMMENTS
	CSW						x	Wilshire-Camerina,	Top of Harts coal can only
	Section 34				x			Young Unit #1, 1965	be estimated, thickness
64	T 6 N R 19 E	Coal Thickness		x					can't. KB 18' above GL.
	NW SE	Location					x	USGS Files, 1958, Mine Map	2100' FEL. 1780' FSL.
	Section 3	Overburden				x		CW Allen Strip pit	
65	T 5 N R 19 E	Coal Thickness			x				
	C NW	Location					x	Pan American Petroleum	KB 15.77' above GL.
	Section 3	Overburden			x			Corporation, Reusch #1,	2.5" E & S logs.
66	T 5 N R 19 E	Coal Thickness		x				1964	
	NE NW	Location					x	Pan American Petroleum	KB 20.7' above GL.
	Section 4	Overburden			x			Corporation, Choctaw Tribe	1" E log.
67	T 5 N R 19 E	Coal Thickness		x				T-3, 1965	
	NW NW	Location					x	USGS Files, 1958, Mine Map	1200' FWL, 550' FNL.
	Section 4	Overburden				x		CW Allen Strip pit	
68	T 5 N R 19 E	Coal Thickness			x				
	SE SW	Location					x	Fieldner, et al, 1922,	Degnan-McConnell #5 Mine.
	Section 5	Overburden	-	-	-	-	-	p. 221, Measured Section D	Located with USGS Mine Map.
69	T 5 N R 19 E	Coal Thickness					x		
	SW SW	Location					x	Fieldner, et al, 1922,	Degnan-McConnell #5 Mine.
	Section 5	Overburden	-	-	-	-	-	p. 221, Measured Section A	Located with USGS Mine Map.
70	T 5 N R 19 E	Coal Thickness					x		
	SE NW	Location					x	Pan American Petroleum	KB 20.8' above GL.
	Section 6	Overburden			x			Corporation, McTierman #1,	2.5" E log & Sonic (large
71	T 5 N R 19 E	Coal Thickness		x				1965	scale)
	SW SW	Location					x	USGS Files, 1953,	
	Section 6	Overburden				x		Bore Hole #14	
72	T 5 N R 19 E	Coal Thickness			x				
	SW SW	Location					x	USGS Files, 1953,	
	Section 6	Overburden				x		Bore Hole #17	
73	T 5 N R 19 E	Coal Thickness			x				
	SW SW	Location					x	USGS Files, 1953,	
	Section 6	Overburden				x		Bore Hole #16	
74	T 5 N R 19 E	Coal Thickness			x				
	SW SW	Location					x	USGS Files, 1953,	
	Section 6	Overburden				x		Bore Hole #15	
75	T 5 N R 19 E	Coal Thickness			x				
	SW SW	Location					x	USGS Files, 1953,	
	Section 6	Overburden				x		Bore Hole #12	
76	T 5 N R 19 E	Coal Thickness			x				

DATA POINT #	LOCATION	INCREASING RELIABILITY →	1	2	3	4	5	REFERENCE	NOTES/COMMENTS
	SW SW	Location					x	USGS Files, 1953,	
	Section 6	Overburden				x		Bore Hole #13	
77	T 5 N | R 19 E	Coal Thickness			x				
	NW SE	Location		x				Hendricks, T., 1939,	Missouri, Kansas & Texas
	Section 1	Overburden	-	-	-	-	-	Plates 27 & 34, Measured	Coal Company #15 Mine.
78	T 5 N | R 18 E	Coal Thickness			x			Section #49	
	NW NE	Location					x	USGS Files, M K & T	3600' S, 400' E of center
	Section 1	Overburden	-	-	-	-	-	Mine #19	of section.
79	T 5 N | R 18 E	Coal Thickness			x				
	NE SW	Location					x	USGS Files, 1953,	
	Section 1	Overburden				x		Bore Hole #27	
80	T 5 N | R 18 E	Coal Thickness			x				
	NE SW	Location					x	USGS Files, 1953,	
	Section 1	Overburden				x		Bore Hole #28	
81	T 5 N | R 18 E	Coal Thickness			x				
	NE SW	Location					x	USGS Files, 1953,	
	Section 1	Overburden				x		Bore Hole #29	
82	T 5 N R 18 E	Coal Thickness			x				
	NE SW	Location					x	USGS Files, 1953,	
	Section 1	Overburden				x		Bore Hole #30	
83	T 5 N | R 18 E	Coal Thickness			x				
	SE NW	Location					x	USGS Files, 1953	
	Section 1	Overburden				x		Bore Hole #31	
84	T 5 N | R 18 E	Coal Thickness			x				
	SE NW	Location					x	USGS Files, 1953,	
	Section 1	Overburden				x		Bore Hole #32	
85	T 5 N R 18 E	Coal Thickness			x				
	SE NW	Location					x	USGS Files, 1953,	
	Section L	Overburden				x		Bore Hole #33	
86	T 5 N | R 18 E	Coal Thickness			x				
	SE NW	Location					x	USGS Files, 1953,	
	Section 1	Overburden				x		Bore Hole #34	
87	T 5 N | R 18 E	Coal Thickness			x				
	SE NW	Location					x	USGS Files, 1953,	
	Section 1	Overburden				x		Bore Hole #35	
88	T 5 N | R 18 E	Coal Thickness			x				
	NE NW	Location					x	USGS Files, 1953,	Hit old mine at 18 ft.
	Section 1	Overburden				x		Bore Hole #36	
89	T 5 N | R 18 E	Coal Thickness			x				

DATA POINT #	LOCATION	INCREASING RELIABILITY →	1	2	3	4	5	REFERENCE	NOTES/COMMENTS
	NE NW	Location					x	USGS Files, 1953,	Hit old mine at 30 ft.
	Section 1	Overburden				x		Bore Hole #37	
90	T 5 N R 18 E	Coal Thickness			x				
	SE NW	Location					x	USGS Files, 1953,	
	Section 1	Overburden				x		Bore Hole #38	
91	T 5 N R 18 E	Coal Thickness			x				
	NW NW	Location					x	USGS Files, 1953,	
	Section 1	Overburden				x		Bore Hole #39	
92	T 5 N R 18 E	Coal Thickness			x				
	NW NW	Location					x	USGS Files, 1953,	
	Section 1	Overburden				x		Bore Hole #40	
93	T 5 N R 18 E	Coal Thickness			x				
	NW NW	Location					x	USGS Files, 1953,	
	Section 1	Overburden				x		Bore Hole #41	
94	T 5 N R 18 E	Coal Thickness			x				
	NE NW	Location		x				Hendricks, 1939, Plates 27	
	Section 7	Overburden	-	-	-	-	-	& 34, Measured Section #50	
95	T 5 N R 19 E	Coal Thickness			x				
	NE NW	Location					x	Fieldner, et al, 1922,	Degnan-McConnell Mine #5.
	Section 8	Overburden	-	-	-	-	-	p. 220, Measured Section C	Located with USGS Mine Map.
96	T 5 N R 19 E	Coal Thickness					x		
	NE NW	Location					x	Fieldner, et al, 1922,	Degnan-McConnell Mine #5.
	Section 8	Overburden	-	-	-	-	-	p. 220, Measured Section E	Located with USGS Mine Map.
97	T 5 N R 19 E	Coal Thickness					x		
	SE NW	Location					x	Fieldner, et al, 1922,	Degnan-McConnell Mine #5.
	Section 8	Overburden	-	-	-	-	-	p. 220, Measured Section A	Located with USGS Mine Map.
98	T 5 N R 19 E	Coal Thickness					x		
	NE NW	Location					x	Fieldner, et al, 1922,	Degnan-McConnell Mine #5.
	Section 8	Overburden	-	-	-	-	-	p. 221, Measured Section C	Located with USGS Mine Map.
99	T 5 N R 19 E	Coal Thickness					x		
	NE NW	Location					x	Fieldner, et al, 1922,	Degnan-McConnell Mine #5.
	Section 8	Overburden	-	-	-	-	-	p. 220, Measured Section D	Located with USGS Mine Map.
100	T 5 N R 19 E	Coal Thickness					x		
	NE NW	Location					x	Fieldner, et al, 1922,	Degnan-McConnell Mine #5.
	Section 8	Overburden	-	-	-	-	-	p. 220, Measured Section B	Located with USGS Mine Map.
101	T 5 N R 19 E	Coal Thickness					x		
	NE NW	Location					x	Fieldner, et al, 1922,	Degnan-McConnell Mine #5.
	Section 8	Overburden	-	-	-	-	-	p. 221, Measured Section B	Located with USGS Mine Map.
102	T 5 N R 19 E	Coal Thickness					x		

DATA POINT #	LOCATION	INCREASING RELIABILITY	1	2	3	4	5	REFERENCE	NOTES/COMMENTS
	SE NE	Location					x	USGS Files, Degnan	Degnan-McConnell Mine #5.
	Section 8	Overburden	-	-	-	-	-	McConnell, Mine #5	1700' S of 300' W of NE
103	T 5 N | R 19 E	Coal Thickness			x				Corner.
	SE SW	Location		x				Hendricks, 1939, plates 27	Great Western Mining Co.
	Section 9	Overburden	-	-	-	-	-	& 34, Measured Section #13	Mine #4.
104	T 5 N | R 19 E	Coal Thickness			x				
	SW SE	Location		x				Hendricks, 1939, plates 27	Great Western Mining Co.
	Section 9	Overburden	-	-	-	-	-	& 34, Measured Section #13	Mine #3.
105	T 5 N | R 19 E	Coal Thickness			x				
	SE SE	Location		x				Hendricks, 1939, plates 27	Great Western Mining Co.
	Section 9	Overburden	-	-	-	-	-	& 34, Measured Section #14	Mine #7.
106	T 5 N | R 19 E	Coal Thickness			x				
	SW SE	Location		x				Hendricks, 1939, plates 27	Great Western Mining Co.
	Section 10	Overburden	-	-	-	-	-	& 34, Measured Section #61	Mine #2.
107	T 5 N | R 19 E	Coal Thickness			x				
	SE SW	Location		x				Hendricks, 1939, plates 27	Great Western Mining Co.
	Section 10	Overburden	-	-	-	-	-	& 34, Measured Section #15	Mine #1.
108	T 5 N R 19 E	Coal Thickness			x				
	NE SE	Location					x	USGS Files, 1905, Great	
	Section 10	Overburden	-	-	-	-	-	Western Coal & Coke #6	
109	T 5 N | R 19 E	Coal Thickness					x		
	SE SE	Location		x				Hendricks, 1939, plates 27	Great Western Mining Co.
	Section 10	Overburden	-	-	-	-	-	& 34, Measured Section #16	Mine #6.
110	T 5 N | R 19 E	Coal Thickness				x			
	Cen EL NE	Location					x	USGS Files, 1907,	
	Section 10	Overburden					x	Bore Hole #2	
111	T 5 N | R 19 E	Coal Thickness					x		
	NE SW	Location		x				Shannon, et al, 1926,	Hailey-Ola Coal Company
	Section 12	Overburden	-	-	-	-	-	p. 46, Measured Section	Mine #4
112	T 5 N | R 19 E	Coal Thickness			x			# 16	
	SW NW	Location					x	USGS Files, 1907,	
	Section 12	Overburden					x	Bore Hole #1	
113	T 5 N | R 19 E	Coal Thickness					x		
	NW SE	Location					x	USGS Files, Hailey-Ola	500' E 20' S of center of
	Section 12	Overburden	-	-	-	-	-	Mine #4	section.
114	T 5 N | R 19 E	Coal Thickness			x				

TABLE 5. 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
1-5-18	Sinclair/USA Anderson #1			NR		2100	11525
	SW SW NE	NR	NR	NR	250		
12-5-18	Ambassador/#1 R. Robinson			NR			12087
	NE SW NW 1300 FSL 2170 FWL	NR	NR	NR	92		
13-5-18	Ambassador/#1 W. Austin			NR		9000	10188
	CSW	NR	NR	NR	1991		
24-5-18	Ambassador/#1 James			NR			8988
	CNW	NR	NR	NR			
24-5-18	Ambassador/#1-A James			NR			10085
	NE SW NW 3960 FSL 1670 FWL	NR	NR	NR	100		
25-5-18	Skelly Oil/G. Vernum #1						10614
	NW NW SE NW		NR	NR			1966
26-5-18	Sinclair/#1 Watts Jones Unit						10407
			NR	NR			1964
2-5-19	Pan Amer./#1 Kier			NR	2498		15380
	SE NW	NR	NR	NR	2498	2498	
3-5-19	Pan Amer. Petro/#1 Reusch			NR	6600	6600	12300
	CNW	NR	NR	1970	100	100	1964
4-5-19	Pan Amer./#1 USA Choctaw T T T 3			NR	0		11470
	SE NE NW	NR	NR	1840		2326	1964
5-5-19	Pan Amer./#1 USA Choctaw T T 14			NR	2009		11485
	1000' SW CNE SW	NR	NR	NR	2009	2009	1965
6-5-19	Pan Amer./#1 USA J. W. McTierman			NR	0		11475
	CSE NW	NR	NR	482		1772	1964
7-5-19	Pan Amer./#1 Quaid			NR	30		12000
	NE SE NW	NR	NR	NR	100*	30	1964

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
8-5-19	Sinclair/#1 D. J. Bishop			NR		5250*	12550
	C S/2 SE NW	NR	NR	NR	318		1965
8-5-19	Hadson Ohio/E. Okla. State College			NR		4800	11720
	(1-8) CNW NW	NR	NR	NR	2519	30	1978
17-5-19	Akers/#1 J. H. Gray			NR			3925
	C E/2 NE	NR	NR	NR	75		1953
17-5-19	Aker & Wabash/#1 J. U. Gray (Twin)			NR			4406
	C E/2 NE			NR			1953
17-5-19	Humble/#1 J. D. Humphrey			NR	2000		12713
	SE NE NW	NR	NR	NR	2000	4350	1965
17-5-19	Prospective I & T/Poteet 1-17			NR	33*		12601
	CSW			NR	33*		1978
17-5-19	Texas O & G/Poteet 1						
	SW SW NE SW or 1575 FSL 1470 FWL	Abandoned Location					1978
18-5-19	Humble/#1 College			NR		10520	12446
	100' NW of CSW or 1391 FSL, 1549 FWL	NR	NR	NR	243		1962
19-5-19	Humble/#1 C. Sparks			NR	80	2200*	12384
	CNW or 1320 FSL 1320 FWL	NR	NR	NR	80		1963
19-5-19	Samson/#1 Dressen			NR			6720
	N/2 N/2 S/2 SW 1000 FSL 1320 FWL	NR	NR	NR			1978
20-5-19	Humble/#1 J. A. Ray			NR	12200	12200	12400
	CNW	NR	NR	NR	2085		1965
20-5-19	Ferguson/McKeown #1			NR			7558
	S/2 S/2 S/2 SW 50' FSL 1320 FWL	NR	NR	NR			1972
21-5-19	Humble/#1 E. Jewell			NR		3150	13360
	CSE SW NW	NR	NR	NR	30		1965
21-5-19	Ferguson/#1 V. F. W.			NR			8092
	N/2 S/2 SW, 1300 FSL 1320 FWL	NR	NR	NR	100*		1973
22-5-19	Skelly/#1 M. L. Johnson			NR		750	9545
	NW SE 1880 FSL 660 FWL	NR	NR	NR	254		
29-5-19	Superior/#1 Babb			NR			7751
	CSE NW	NR	NR	NR	2350		1968
30-5-19	Austral Oil/#1-30 Diamond			NR	6300	1700	11203
	SE NW NW	NR	NR	NR	274		1966
13-6-18	Mobil/#1 C.L. Peppers			NR			10558
	SW NE NE	NR	NR	3462	459		1964

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
13-6-18	Galaxy/#1 State "A"			NR		4014	10565
	SE NW SE NW, 710 FSL 1930 FWL of NW/4	NR	NR	NR			1970
14-6-18	Snee & Eberly/Scruggs #1			4122	184	1064	10800
	CNE	NR	NR	4122	184		1977
23-6-18	Cleary/#1-23 Carver			NR			9265
	NE NE NW NE, 20 FNL 1300 FWL of NE/4	NR	NR	4268			1975
23-6-18	Cleary/#2-23 Carver			4180			12262
	CE/2	NR	NR	4180			1976
24-6-18	Monsanto/#1 Wildlife			NR		7200	11685
	SE SW SW NE,200 FSL 500 FWL of NE/4	NR	NR	3460	95		1969
25-6-18	Pan Amer./#1 Anderson-Prichard			NR			11750
	NW NW SE SE,1020 FSL 1240 FEL	NR	NR	2174	60		1968
26-6-18	Pan Amer. Doremus			NR	48		13138
	NW SE	NR	NR	3193	48	48	1963
35-6-18	Pan. Amer./#1 C. Wilson			NR		2500	12050
	SE NW SE,100' NW/C	NR	NR	NR	2200		1967
35-6-18	Amoco/#1 C. Wilson			NR			11204
	SW SW NE SE,1391 FSL 1391 FW of SE/4	NR	NR	NR			1966
36-6-18	Texas Pacific/#1 Federal Church			NR			1250
	SE NW SE 1550 FSL 1550 FEL	NR	NR	NR	1145*		1972
14-6-19	Mobil/#1 T. Johnson			NR		2500	11692
	1220 FSL 100 FWL of NE/4	NR	NR	NR	40		1970
14-6-19	Pitco/#1-14 Shaw			NR			11133
	CN/2 SW SW	NR	NR	NR			1979
14-6-19	Cox/#1 Huffman			NR			10400
	CNW	NR					1973
15-6-19	Mobil/#1 H. Johnson			NR		7600	10459
	1190 FSL 1003 FWL of NE/4	NR	NR	3553	40		1969
16-6-19	Sunset Intl./#1 Weaver			3080		7200	10500
	1933 FNL 1933 FEL	NR	NR	NR	3269		1969
16-6-19	Weaver/H. English #1						1542
	NW SE		NR	NR			
17-6-19	Mobil/#1 D. Weaver "D"			2910	46	46	11092
	CSW NE	NR	NR	2910	46		1967
17-6-19	Long et. al./#2-17 Weaver "D"			2907	993		10818
	C E/2 SE	NR	NR	2907	993		1976

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
18-6-19	Coquina/#1 Robbers Cave			3180			10700
	1485 FSL 165 FWL of SE/4	10' @ 3161	3161	3180			1973
19-6-19	Monsanto/#1 Cave			NR		7050	11550
	1420 S of Center, NW SW SE	NR	NR	3074	307		1969
20-6-19	Mobil/#1 D. Weaver			2938		48	11296
	CNW SE	NR	NR	NR	48		1967
21-6-19	Mobil/#1 D. Weaver "F"			NR	53	55	11376
	CNW SE	NR	NR	3240	53		1967
22-6-19	Mobil /#1 C. O. Harrison			NR			11050
	1920 FSL 1980 FWL	NR	NR	3500			1969
23-6-19	An-Son/#1 Jankowsky						11683
	1180 FSL 1460 FWL of NW/4		NR	NR			1972
23-6-19	Cox/#1 Jankowsky			NR			13255
	CSE NE SW	NR	NR	NR			1976
23-6-19	Headington/Jankowsky 1-A			NR			11641
	NW SE NW	NR					1971
27-6-19	Austral/#1-27 Young Ranch			NR		314	11300
	NE SE SW	NR	NR	NR	314		1966
28-6-19	Austral/#1-28 Young Ranch			3068	120	118	11492
	NE NW SW	NR	NR	3068	120	5200	1966
29-6-19	Shell/#1-29 Kilpatrick			NR	305		11783
	SW NW SE	NR	NR	NR	305		1966
30-6-19	Mobil/#1 Hackney			NR		56	11835
	SE NW SE or 1500 FSL 1310 FWL	NR	NR	2728	60		1966
31-9-19	Pan Amer./#1 East Okla. A & M College			NR	1925		11145
	CNW SE	NR	NR	NR	1925	1925	1965
32-6-19	Pan Amer./#1 Quaid "B"			NR			11138
	NW SE	NR	NR	NR	2050	2050	1966
33-6-19	Pan Amer./#1 Adams			NR			11177
	NE SE SW	NR	NR	NR	2386	2386	1965
34-6-19	Wilshire/#1 Young			2622		4500*	11538
	1320 FSL 1320 FWL	NR	NR	2622	63		1965

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