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FEDERAL COAL RESOURCE OCCURRENCE AND FEDERAL COAL DEVELOPMENT POTENTIAL MAPS OF THE STIGLER WEST QUADRANGLE, MUSKOGEE AND HASKELL COUNTIES, OKLAHOMA

[Report includes 9 plates]

Prepared for

UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

By

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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 Stigler West 7.5-minute quadrangle, Muskogee and Haskell Counties, 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, Inc., Tulsa, Oklahoma, at the request of the United States Geological Survey under contract number 14-08-0001-17989. The resource information gathered for this report is in response to the Federal Coal Leasing Amendments Act of 1976 (Public Law 94-377). Published and unpublished publicly available information was used as the data base for this study. No new drilling or field mapping was done to supplement this study, nor was any confidential or proprietary data used.

Location

The Stigler West 7.5-minute quadrangle is located to the north of the Howe-Wilburton mining district and to the east of the Quinton-Scipio mining district of the southeastern Oklahoma coal field. The southeastern part of the quadrangle is in Haskell County, and the northwestern part is in Muskogee County. The city of McAlester is 40 miles (64 km) southwest of the quadrangle, and the city of Tulsa is approximately 75 miles (120 km) northeast of the quadrangle.

Accessibility

The town of Stigler, the largest in the quadrangle, is in the extreme southeast corner of the quadrangle. Six miles (9.6 km) west of Stigler on State Route 9 is the smaller town of Whitefield and the junction with State Route 2, which runs north to U.S. Interstate 40 and Muskogee, and south to Wilburton. State Route 9 continues out the southwest corner of the quadrangle and intersects U.S. Route 69.

Many improved and unimproved roads provide good access to almost every section in the quadrangle. The Midland Valley Railroad cuts across the southern half of the quadrangle, passing through Briartown and Stigler. The Canadian River also flows through the entire length of the quadrangle, from southwest to northeast, and joins the Arkansas River Navigation Channel north of the area.

Physiography

The Stigler West quadrangle is in the eastern Oklahoma portion of the Ozark - Ouachita Highland Physiographic Province, in the Arkoma Basin. In general the topography can be characterized as that of erosional valleys interrupted by low, elongate ridges of more resistant rocks. The landscape is for the most part one of gently rolling hills, with intermittent steeper slopes and ridges where these resistant units crop out. Relief across the area is almost 400 feet (122 m). The most prominent series of ridges extends across the northwest quarter of the quadrangle, and reach a maximum elevation of 880 feet (264 m). The lowest spots in the area are found along the Canadian River where elevations of 475 feet (143 m) are common. The river bed cuts a wide swath across the quadrangle, in places covering more than 2 miles (3.2 km). Abandoned meander traces are easily recognizeable on the topographic map for the area.

Major drainage for the quadrangle is provided by the Canadian River, which flows northeast, and many other creeks and intermittent streams which feed it. A number of small lakes and ponds exist within 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. (104 cm), with rains generally abundant in the spring, early summer, fall and winter (Hendricks, 1939).

Southeastern Oklahoma 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

The Stigler West quadrangle includes part of the Morgan Mountain Known Recoverable Coal Resource Area (KRCRA). About 3120 acres (1262 hectares) of the total 4706 acres (1905 hectares) belonging to the KRCRA lie in this quadrangle, or about 66%. The Federal Government holds title to the coal mineral rights for an additional 7480 acres (3027 hectares), or about 27% of the entire quadrangle. As of October 19, 1979, about 360 acres (146 hectares), or 3% of these Federal lands were under lease.

GENERAL GEOLOGY

Previous Work

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

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

The Oklahoma Geological Survey published a bulletin by Snider in 1914 on the geology of east-central Oklahoma, emphasizing the geologic structure and oil and gas possibilities of the area. Further studies on the southern Oklahoma coal lands were carried out by Shannon et al (1926), Moose and Searle (1929), Wilson and Newell (1937), and Hendricks (1939). These, along with later works by Knechtel and Oakes in the 1940's added greatly to the body of knowledge on Oklahoma coals, particularly in terms of their quality, chemical composition and extent.

A number of estimates as to original and remaining coal reserves have been published, among them Trumbull (1957) and Friedman (1974). Non-proprietary results of coal test holes drilled in various years in the Stigler West 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. Karvelot (1972) carried out a study of the Stigler coal in an area of southeastern Oklahoma that included the Stigler West 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).

Most of the rock units cropping out in the Stigler West quadrangle are of Pennsylvanian age, and include the Atoka Formation, as well as the Hartshorne, McAlester, and Savanna 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 quadrangle, and crops out along the prominent ridge in the northwest quarter of the quadrangle (Oakes, 1977). Rocks of the upper part of the Atoka Formation are also exposed in the extreme northeast portion of the quadrangle, in sections 6 and 7 of T10N, R21E (Oakes and Knechtel, (1948). The formation consists mostly of black to dark gray sandy shale interbedded with ridge-forming brown or light gray locally calcareous sandstone units. 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. Information on the thickness of the Atoka Formation is spotty, but in a well log northeast of the quadrangle in Sec 23 of T11N, R21E, the unit measures approximately 1850 feet (555 m) (Oakes and Knechtel, 1948).

The Hartshorne Formation forms the basal unit of the Desmoinesian Series. It is probably most conformable with the underlying Atoka Formation (Dane, et al, 1938; Hendricks, 1937; Knechtel, 1948). However, a sharp and irregular contact between the Hartshorne and Atoka formations in areas east of the McAlester mining district has lead some observers to conclude that a minor unconformity separates them, at least locally (Hendricks, 1939; Dane, et al, 1938; Branson, 1962). The contact between the Hartshorne Formation and the overlying McAlester Formation is conformable (Hendricks, 1937, 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" snadstone, the formation was renamed the Hartshorne sandstone by Taff in 1899. Early workers limited the formation to the massive sandstones and the Hartshorne (Lower Hartshorne) coal; the Upper Hartshorne coal and underlying shale were included in the overlying McAlester Formation. However, Oakes and Knechtel (1948) recognized a convergence of the Upper and Lower Hartshorne coals in northern LeFlore and eastern Haskell counties, and redefined the Hartshorne formation to include both coals. The Hartshorne coal, undivided to the north, splits into Upper and lower Hartshorne coals along a northeast-southwest trending line. This split line is located quite a bit south of the Stigler West quadrangle. The presently-used definition of the Hartshorne Formation is one proposed by McDaniel (1961), which supports the boundaries suggested by Oakes and Knechtel (1948), but formally divides the formation into Upper and Lower members where applicable (based on the above mentioned coal "split line").

The Hartshorne Formation is highly variable in character and thickness in the Stigler West area, and may be anywhere from 50 to 100 feet (15 to 30m) or more thick. Its most prominent outcrop in the quadrangle, extends northeasterly throughly T10N, R20E, roghly paralleling the Canadian River (Oakes, 1977). Here it is a greenish-gray, fine- to medium-grained sandstone, with small scale cross-bedding (Oakes, 1977). The only other outcrop of the

Hartshorne Formation in the Stigler West quadrangle is on Turkey Knob east of Briartown. The Hartshorne coal is found at the top of the formation, but is not present anywhere at the surface here.

The McAlester Formation consists primarily of clayey shale and silty shale, with prominent sandstone beds at widely spaced intervals that give rise to conspicuous escarpments (Oakes, 1977). In the Stigler area the McAlester Formation varies in thickness from 400 to 800 feet (120 to 240m), thinning northward. It crops out quite extensively across the area (Oakes, 1977 and Oakes and Knechtel, 1948), and lies conformably on the Hartshorne Formation. The McAlester Formation includes various unnamed shale members, as well as several sandstone members and local coals. In ascending order, the McAlester Formation includes the McCurtain shale member and the Warner, Lequire, Cameron, Tamaha and Keota Sandstone members. Between each of these sandstones, and above the Keota Sandstone Member, is an unnamed shale unit. The thickness given below of each individual member has been estimated from well logs in the area.

The lowermost unit of the McAlester Formation is the McCurtain Shale Member. The lower half of this shale is dark gray to black, slabby and silty, with numerous siderite concretions and plant material. The upper half is more argillaceous, buff to greenish, and concretions are generally less abundant (Wilson and Newell, 1937).

The most persistent sandstone of the McAlester Formation is the Warner Sandstone Member, a buff, calcareous, fine-grained, massive to thin bedded argillaceous unit which forms the first prominent escarpment stratigraphically above the Hartshorne Formation (Wilson and Newell, 1937). 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. The Warner thins southward through Muskogee County, and in Secs. 17-20, T10N, R20E it virtually pinches out (Oakes, 1977). Above the Warner is an unnamed shale unit which is dark to greenish gray, silty and fissile, and varies from almost nothing up to 60 feet (18m) thick (Oakes, 1977). Where this shale thins dramatically the Warner and overlying Lequire Sandstone are mapped as one unit (Oakes, 1977 and Oakes and Knechtel, 1948). Two thin, lenticular sandstones can be found within this shale, and siderite concretions are common (Oakes, 1977).

The Lequire Sandstone Member includes variable sandstone lenses interbedded with siltstones and shales, and can include a thin local coal. Because of its proximity to the Cameron Sandstone, and considering the Cameron's discontinuous nature in this area, Oakes (1977) has mapped the Cameron-Lequire as a single unit in Muskogee County. They are mapped as separate units in Haskell County by Oakes and Knechtel (1948).

The shale units separating the above mentioned sandstone members are in general greenish to blue-gray, silty and fissile.

Above the Cameron, or Cameron-Lequire, Sandstone is the Stigler coal, the only coal to crop out in the Stigler West quadrangle. The Stigler coal is entirely within a shale sequence that thins northward across the area, and normally has a well-developed underclay between 1 and 2 feet (0.3 to 0.6 m) thick (Karvelot, 1972).

The Tamaha Sandstone Member is the next sandstone above the Stigler coal. It is absent over much of Haskell and Muskogee counties and has its best developement northeast of the study area, where it is 25 feet (8 m) thick. Where it occurs, the Tamaha is micaceous, fine-grained and well-sorted (Karvelot, 1972). A gray shale separates the Tamaha from the Keota Sandstone.

In the Stigler West area, the Keota Sandstone Member is a sequence of sandstone lenses in sandy shale. These lenses thin to the north, and become fewer in number and finer grained (Oakes, 1977). The Keota varies quite a bit in thickness, but averages about 30 feet (9 m) thick in the Stigler West quadrangle. A sandy shale occurs above the uppermost Keota Sandstone lens, and continues up to the basal member of the overlying Savanna Formation.

The Savanna Formation is the youngest unit exposed in the Stigler West area. It crops out on some of the higher hills on the south/east side of the Canadian River (Oakes and Knechtel, 1948), and consists mostly of sandstones and shales. The sandstones are quite variable in both character and thickness from place to place and bed to bed (Oakes, 1977), but in general are gray, hard and fine-grained. The Savanna Formation in the Arkoma Basin contains a few thin disconnected limestone beds and several thin coal seams, including the Rowe, or lower Boggy (Oakes, 1977). As with other Pennsylvanian formations mentioned here, the Savanna Formation thins northward (Oakes, 1977).

Deposits of Quaternary alluvium and terrace deposits cover a wide band through the quadrangle from southwest to northeast, primarily in the Canadian River Valley.

Structure

The Stigler West 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 Stigler West quadrangle are shown on Plate 1. These include the Mudlark fault, the Stigler syncline and the Lone Star anticline.

The Mudlark fault runs from northeast to southwest across the Stigler West quadrangle, passing beneath the alluvium of the Canadian River (Oakes and Knechtel, 1948). Roughly paralleling this structure is the Lone Star anticline. This is an asymmetrical structure, with its steeper limb on the southeast side (Oakes and Knechtel, 1948). The Lone Star anticline probably extends westward into Muskogee County, but is hidden by alluvium starting in Sec. 27 of T10N, R20E (Oakes and Knechtel, 1948).

The axis of the Stigler syncline is known to extend northeast from Sec. 4, T9N, R20E beyond the eastern edge of the Stigler West quadrangle. It is a long asymmetrical structure, with steep dips on the northwest limb, and a broad southeast limb formed of strata dipping gently northwestward (Oakes and Knechtel, 1948).

COAL GEOLOGY

The Stigler (Lower McAlester) coal is the only major coal seam to be considered in this report, as it is the only major coal seam encountered in the Stigler West quadrangle for which information as to thickness and extent was available. A few measurements were also available for the Upper McAlester (Stigler rider) coal and some unnamed locals, but these did not exceed the Reserve Base thickness of 1 foot (0.3 m), and so will not be discussed at length here.

Stigler (Lower McAlester) Coal Bed

The Stigler coal is the only coal found at the surface in the Stigler West quadrangle. Crop lines are found along the southern edge and in the northwest corner of the quadrangle, and roughly paralleling the Lone Star anticline Plate 1). The structure of the Stigler coal is shown on Plate 5, and reflects the influence of the Stigler syncline, with beds dipping gently toward the axis of the syncline.

Data on the Stigler coal is for the most part sparse, particularly away from the cropline. Most of the information on the coal used in this report comes from non-proprietary information in USGS files, with additional information from Karvelot (1972) and Oakes and Knechtel (1948). Appendix I gives a complete listing of all sources of data. In general, the data available indicates that the Stigler coal varies from just under 1 foot (0.3 m) to slightly more than 2 feet (0.6 m) toward the northeast of the quadrangle.

The Stigler coal has been strip mined in the quadrangle, but not very extensively (Plate 1).

Chemical Analyses of Coal

A summary of the chemical analyses available for the Stigler coal are presented on Table 1. Average analyses are given, as is the range for all samples used to calculate each average value.

The coal was classified according to Fixed Carbon (FC) as determined on a dry, mineral-matter-free (mmf) basis. The "as received" fixed carbon values shown on Table 1 were converted to dry mmf FC according to the following formula:

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

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

Based on the average FC, shown on Table 1, the Stigler coal is classified as medium volatile bituminous coal, with an average 74% dry, mmf fixed carbon.

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 Stigler West quadrangle (see below). The source of each indexed data point shown on Plate 1 is listed in Appendix I at the end of this report.

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

Identified Resources may be subdivided into three categories of reliability of occurrence, according to their distance from a known point of coal-bed measurement. In order of decreasing reliability, these categories are: measured, indicated and inferred. Measured coal is that which is located within 0.25 mile (0.4 km) from a measurement point, indicated coal extends

Table 1. Average chemical analyses of coal in the Stilger West quadrangle, Muskogee and Haskell Counties, Oklahoma

STIGLER COAL BED (Lower McAlester)				
ANALYSES %	FORM OF ANALYSIS	# OF SAMPLES	AVERAGE	RANGE
PROXIMATE				
Moisture	A	2	1.4	1.2-1.7
Volatile Matter	A	2	25.0	23.0-26.9
	C	15	28.9	25.1-32.2
Fixed Carbon	A	2	70.1	67.7-72.5
	C	15	65.8	60.1-70.8
Ash	A	2	3.5	1.9-5.0
	C	15	5.4	2.4-9.5
ULTIMATE				
Sulfur	A	2	0.8	0.7-0.9
	C	15	1.1	0.6-1.7
Hydrogen	A	-	---	---
	C	-	---	---
Carbon	A	-	---	---
	C	-	---	---
Nitrogen	A	-	---	---
	C	-	---	---
Oxygen	A	-	---	---
	C	-	---	---
HEATING VALUE				
Calories	A	-	---	---
	C	-	---	---
Btu/lb	A	1	14,690	---
	C	1	14,864	---

Form of Analyses: A = as received, C = moisture-free.

To convert Btu/lb to kj/kg, multiply by 2.324

Data on this table is from Shannon et al (1926) and from non-prietary information in USGS files.

0.5 mile (0.8 km) beyond measured coal to a distance of 0.75 mile (1.2 km) from the measurement point, and inferred coal extends 2.25 (3.6 km) miles beyond indicated coal, or a maximum distance of 3 miles (4.8 km) from the measurement point.

Undiscovered Resources may be either hypothetical or speculative. Hypothetical resources are those undiscovered coal resources that may reasonably be expected to exist in known coal fields under known geologic conditions. They are located beyond the outer boundary of inferred resources (see above) in areas where the coal-bed continuity is assumed, based on geologic evidence. Hypothetical resouces are those more than 3 miles (4.8 km) from the nearest measurement point. 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 Stigler (Lower McAlester) coal were calculated using data obtained from the coal isopach maps (Plate 4). The coal-bed acreage (measured by planimeter and calculated using the trapezoidal method [modified from Hollo and Fifadara, 1980]) multiplied by the average thickness of the coal bed, and by a conversion factor of 1800 short tons of coal per acre-foot (13,238 metric tons per hectare-meter) for bituminous coal yields the coal resources in short tons. Coal resource tonnages were calculated for Identified Resources in measured, indicated, and inferred categories, and Undiscovered Resources in the hypothetical category, for unleased Federal coal lands. All coal beds thicker than 1 foot (0.305 m) that lie less than 3000 feet (914 m) below the ground surface are included in these calculations. These criteria differ from those stated in U.S. Geological Survey Bulletin

1450-B, which calls for a minimum thickness of 28 inches (70 cm) and a maximum depth of 1000 feet (305 m) for bituminous coal. Narrow strips between mines where undisturbed coal is less than 75 meters from the nearest mine are considered to have no reserves and are included within mined-out areas. Mine boundaries are only approximately located (as stated in the legend of 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 Plate 7, and have been rounded to the nearest 10,000 short tons (9,072 metric tons). In this report, Reserve Base coal is the gross amount of Identified Resources that occurs in beds 1 foot (0.3 m) or more thick and under less than 3,000 feet (914 m) of overburden. Reserves are the recoverable part of the Reserve Base coal. In the southeastern Oklahoma coal field, a recovery factor of 80 percent is applied toward surface-minable coal, and a recovery factor of 50 percent is applied toward subsurface minable coal. No recovery factor is applciable 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 lands 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 27.68 million short tons (25.11 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.

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 BLM, approximate 40-acre (16-hectare) parcels have been used to show to limits of the high, moderate, or low development potentials. A constraint imposed by the BLM specifies that the highest development potential affecting any part of a 40-acre (16-hectare) lot, tract, or parcel be applied to that entire lot, tract, or parcel. For example, if 5 acres (2 hectares) within a parcel meet the criteria for a high development potential; 25 acres (10 hectares), a moderate development potential; and 10 acres (4 hectares), a low development potential; then the entire 40 acres (16 hectares) are assigned a high development potential. For purposes of this report, any lot or tract assigned a coal development potential contains coal in beds with a nominal minimum areal extent of 1 acre (0.4 hectare).

Development Potential for Surface Mining Methods

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

$$MR = \frac{t_o \, (cf)}{t_c \, (rf)}$$ where MR = mining ration

t_o = thickness of overburden in feet

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

0.896 for bituminous coal

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

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

Areas where the coal data is 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 areas with an unknown development potential in this quadrangle.

The coal development potential for surface mining methods is shown on Plate 8. A summary of all tonnage values is presented in Table 2. Of Federal coal land not subject to currently outstanding coal lease, permit, license of preference right lease application having a known development potential for surface mining, 5 percent is rated high, 2 percent is rated moderate, and 14 percent is rated low. The remaining Federal land (79 percent) is classified as having unknown and/or no development potential for surface mining methods.

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

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

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

Areas where the coal data is absent or extremely limited between 150 and 3,000 feeet (46 to 914 m) below the ground surface are assigned unknown development potentials. This applies to areas where coal beds of Reserve Base thickness are not known, but may occur. There are no such areas in the Stigler West quadrangle.

The coal development potential for conventional subsurface mining and in-situ gasification methods is shown on Plate 9. A summary of all tonnage values is presented in Table 3. Of Federal coal land areas having a known development potential for these mining methods, 79 percent is rated high, none is rated moderate, and none is rated low. The remaining Federal land in the quadrangle (21 percent) is classified as having no development potential for either conventional subsurface mining or in-situ gasification methods.

Based on criteria provided by the U.S. Geological Survey coal beds of Reserve Base thickness dipping between 15° and 35°, regardless of tonnage, have a low development potential for in-situ coal gasification methods. Beds dipping from 35° to 90°, with a minimum of 50 million tons of coal in a single unfaulted bed or multiple, closely spaced, approximately parallel beds have a moderate development potential for in-situ coal gasification methods. Coal lying between the 150-foot (46 m) overburden isopach and the outcrop is not included in total coal tonnages available because it is needed for cover and containment in the in-situ process. No Federal coal land in the Stigler West quadrangle has any development potential for in-situ gasification.

Table 2. Coal Reserve Base data for surface mining methods for Federal coal land (in short tons) in the Stigler West quadrangle, Muskogee and Haskell Counties, Oklahoma.

Coal Bed	High Development Potential	Moderate Development Potential	Low Development Potential	Total
Stigler	340,000	170,000	3,580,000	4,090,000

Table 3. Coal Reserve Base data for subsurface mining and in-situ gasification for Federal coal land (in short tons) in the Stigler West quadrangle, Muskogee and Haskell Counties, Oklahoma.

Coal Bed	High Subsurface Development Potential	Moderate Subsurface Development Potential	Low Subsurface Development Potential	Low In-situ Development Potential	Total
Stigler	23,590,000	-	-	-	23,590,000

REFERENCES

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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 SE	Location			x			Karvelot, 1968, p. 93	Unpublished measurement by
	Section 1	Overburden	-	-	-	-	-	Bore Hole #1	Sierra Coal Corporation,
1	T 10 N | R 19 E	Coal Thickness			x				overburden not recorded.
	C of Section	Location			x			Karvelot, 1968, p. 93	See data point #1
	Section 12	Overburden	-	-	-	-	-	Bore Hole #4	
2	T 10 N | R 19 E	Coal Thickness			x				
	Center E line	Location			x			Karvelot, 1968, p. 93	See data point #1
	Section 12	Overburden	-	-	-	-	-	Bore Hole #3	
3	T 10 N | R 19 E	Coal Thickness			x				
	NE NW	Location				x		USGS files, Bore Hole HR-1	
	Section 18	Overburden				x		1954	
4	T 10 N | R 21 E	Coal Thickness				x			
	NE SE	Location				x		USGS files, Bore Hole	
	Section 13	Overburden			x			NAR-1, 1969	
5	T 10 N | R 20 E	Coal Thickness			x				
	SE NE	Location					x	USGS files, Bore Hole	Location from KRCRA map.
	Section 13	Overburden				x		Hn 1-2, 1954	
6	T 10 N | R 20 E	Coal Thickness				x			
	C E/2 E/2	Location					x	Oakes & Knechtel, 1948,	Prospect
	Section 13	Overburden	x					p. 99, measured section #2	
7	T 10 N | R 20 E	Coal Thickness		x					
	SE SE	Location					x	BLM Emria Project, 1979,	IEL, D-GR, and caliper logs
	Section 13	Overburden	-	-	-	-	-	Bore Hole DH-AB-7	
8	T 10 N | R 20 E	Coal Thickness	-	-	-	-	-		
	NW SE	Location				x		USGS files, Bore Hole #P-1	
	Section 13	Overburden				x		1954	
9	T 10 N | R 20 E	Coal Thickness				x			
	NW NW	Location					x	Oakes & Knechtel, 1948,	Prospect. Local coal in
	Section 13	Overburden	-	-	-	-	-	p. 99, measured section #1	Warner Sd.
10	T 10 N | R 20 E	Coal Thickness		x					
	SW NE	Location			x			Karvelot, 1968, p. 93	See data point #1
	Section 13	Overburden	-	-	-	-	-	Bore Hole #5	
11	T 10 N | R 19 E	Coal Thickness			x				

DATE POINT #	LOCATION	INCREASING RELIABILITY	1	2	3	4	5	REFERENCE	NOTES/COMMENTS
	C S/2 SE	Location				x		USGS files, Bore Hole	
	Section 23	Overburden				x		#Sn-2, 1954	
12	T 10 N | R 20 E	Coal Thickness				x			
	NE SE	Location					x	USGS files, Bore Hole #1,	
	Section 23	Overburden				x		1953	
13	T 10 N | R 20 E	Coal Thickness				x			
	NW NW	Location					x	Oakes & Knechtel, 1948,	Prospect
	Section 24	Overburden	x					p. 99, prospect, Measured	
14	T 10 N | R 20 E	Coal Thickness		x				Section #3	
	SW NW	Location				x		USGS files, Bore Hole #K-1	
	Section 24	Overburden				x		1954	
15	T 10 N | R 20 E	Coal Thickness				x			
	NW NW	Location				x		USGS files, Bore Hole	
	Section 24	Overburden				x		#RS-1, 1954	
16	T 10 N | R 20 E	Coal Thickness				x			
	SW NW	Location					x	Oakes & Knechtel, 1948,	Rowe Coal Prospect.
	Section 19	Overburden	x					p. 100, Measured Section	
17	T 10 N | R 21 E	Coal Thickness			x			#8	
	SW SW	Location				x		USGS file, Bore Hole #9,	
	Section 19	Overburden				x		1968	
18	T 10 N | R 21 E	Coal Thickness				x			
	NW SE	Location					x	BLM Emria Project, 1979,	IEL, D-GR, and caliper logs
	Section 26	Overburden	-	-	-	-	-	Bore Hole DH-AB-6	
19	T 10 N | R 20 E	Coal Thickness	-	-	-	-	-		
	NW SE	Location					x	BLM Emria Project, 1979,	IEL, D-GR, and caliper logs
	Section 26	Overburden				x		Bore Hole DH-AB-6A	
20	T 10 N | R 20 E	Coal Thickness				x			
	SE NW	Location				x		USGS files, Bore Hole	
	Section 26	Overburden				x		#Sm-1, 1954	
21	T 10 N | R 20 E	Coal Thickness				x			
	SW NW	Location					x	Oakes & Knechtel, 1948,	Prospect
	Section 26	Overburden	x					p. 99, Measured Section #4	
22	T 10 N | R 20 E	Coal Thickness			x				
	NW SW	Location					x	USGS files, Bore Hole	Location from KRCRA map.
	Section 26	Overburden				x		#Sm-2, 1954	
23	T 10 N | R 20 E	Coal Thickness				x			
	NE SE	Location				x		USGS files, Bore Hole #L-1	
	Section 27	Overburden				x		1954	
24	T 10 N | R 20 E	Coal Thickness				x			

DATE POINT #	LOCATION	INCREASING RELIABILITY →	1	2	3	4	5	REFERENCE	NOTES/COMMENTS
	NE NE	Location				x		USGS file, Bore Hole #8,	
	Section 35	Overburden				x		1968	
25	T 10 N | R 20 E	Coal Thickness				x			
	SW NE	Location				x		USGS files, Bore Hole #6,	
	Section 2	Overburden				x		1968	
26	T 9 N | R 20 E	Coal Thickness				x			
	SW SE	Location				x		USGS files, Bore Hole #4,	
	Section 9	Overburden				x		1968	
27	T 9 N | R 20 E	Coal Thickness				x			
	NE SE	Location		x				USGS files, Bore Hole #5,	
	Section 10	Overburden				x		1968	
28	T 9 N | R 20 E	Coal Thickness				x			
	SW NW	Location		x				USGS files, Bore Hole	
	Section 14	Overburden	-	-	-	-	-	#DH-9, 1955	
29	T 9 N | R 20 E	Coal Thickness	-	-	-	-	-		
	SW NW	Location					x	USGS files, Bore Hole	
	Section 14	Overburden				x		#DH-8, 1955	
30	T 9 N | R 20 E	Coal Thickness				x			
	SW NW	Location					x	USGS files, Bore Hole	
	Section 14	Overburden				x		#DH-7, 1955	
31	T 9 N | R 20 E	Coal Thickness				x			
	SW NW	Location					x	USGS files, Bore Hole	
	Section 14	Overburden				x		#DH-6, 1955	
32	T 9 N | R 20 E	Coal Thickness				x			
	SW NW	Location					x	USGS files, Bore Hole #2,	
	Section 14	Overburden					x	1953	
33	T 9 N | R 20 E	Coal Thickness					x		
	SW NW	Location					x	USGS files, Bore Hole	
	Section 14	Overburden				x		#DH-1, 1955	
34	T 9 N | R 20 E	Coal Thickness				x			
	SW NW	Location					x	USGS files, Bore Hole	
	Section 14	Overburden				x		#DH-5, 1955	
35	T 9 N | R 20 E	Coal Thickness				x			
	SW NW	Location					x	USGS files, Bore Hole	
	Section 14	Overburden	-	-	-	-	-	#DH-4, 1955	
36	T 9 N | R 20 E	Coal Thickness	-	-	-	-	-		
	SE NE	Location					x	USGS files, Bore Hole #1,	Core
	Section 15	Overburden	-	-	-	-	-	1953	
37	T 9 N | R 20 E	Coal Thickness	-	-	-	-	-		

DATA POINT #	LOCATION		INCREASING RELIABILITY →	1	2	3	4	5	REFERENCE	NOTES/COMMENTS
	S/2 S/2 NE		Location					x	USGS files, Bore Hole	
	Section 15		Overburden	-	-	-	-	-	#DH-3	
38	T 9 N	R 20 E	Coal Thickness	-	-	-	-	-		
	SE NE		Location					x	USGS files, Bore Hole #3,	Core
	Section 15		Overburden					x	1953	
39	T 9 N	R 20 E	Coal Thickness					x		
	S/2 S/2 NE		Location					x	USGS files, Bore Hole #2	
	Section 15		Overburden				x		1955	
40	T 9 N	R 20 E	Coal Thickness				x			
	SW NE		Location					x	USGS files, Bore Hole #1,	Core
	Section 15		Overburden					x	1953	
41	T 9 N	R 20 E	Coal Thickness					x		
	SW NE		Location					x	USGS files, Bore Hole #2,	Core
	Section 15		Overburden					x	1953	
42	T 9 N	R 20 E	Coal Thickness					x		
	SW NE		Location					x	USGS files, Bore Hole #3,	Core
	Section 15		Overburden					x	1953	
43	T 9 N	R 20 E	Coal Thickness					x		
	SE NW		Location					x	USGS files, Bore Hole #1,	
	Section 15		Overburden				x		1955	
44	T 9 N	R 20 E	Coal Thickness				x			
	SW NW		Location					x	USGS files, Bore Hole #1,	Core
	Section 15		Overburden					x	1953	
45	T 9 N	R 20 E	Coal Thickness					x		
	SW NW		Location					x	USGS files, Bore Hole #1,	Core
	Section 15		Overburden					x	1953	
46	T 9 N	R 20 E	Coal Thickness					x		
	SE NE		Location					x	USGS files, Bore Hole #W-1	
	Section 16		Overburden				x		1955	
47	T 9 N	R 20 E	Coal Thickness				x			
	SE NE		Location					x	USGS files, Bore Hole	Core, questionable data re-
	Section 16		Overburden				x		#C-37, 1955	porting. Same location as
48	T 9 N	R 20 E	Coal Thickness				x			data point 47.
	SE NE		Location					x	USGS files, Bore Hole #1,	
	Section 16		Overburden				x		1955	
49	T 9 N	R 20 E	Coal Thickness				x			
	SE NE		Location				x		USGS files, Bore Hole #19,	Core
	Section 16		Overburden					x	1953	
50	T 9 N	R 20 E	Coal Thickness					x		

DATA POINT #	LOCATION		INCREASING RELIABILITY →	1	2	3	4	5	REFERENCE	NOTES/COMMENTS
	SE NE		Location					x	USGS files, Bore Hole #2,	
	Section 16		Overburden				x		1955	
51	T 9 N	R 20 E	Coal Thickness				x			
	SE NE		Location					x	USGS files, Bore Hole #14,	Core
	Section 16		Overburden					x	1953	
52	T 9 N	R 20 E	Coal Thickness					x		
	SW NE		Location					x	USGS files, Bore Hole #3,	
	Section 16		Overburden				x		1955	
53	T 9 N	R 20 E	Coal Thickness				x			
	SE NW		Location					x	USGS files, Bore Hole #18,	Core
	Section 16		Overburden					x	1953	
54	T 9 N	R 20 E	Coal Thickness					x		
	SE NW		Location					x	USGS files, Bore Hole #1,	Core
	Section 16		Overburden					x	1953	
55	T 9 N	R 20 E	Coal Thickness					x		
	SW NE		Location					x	USGS files, Bore Hole #15,	Core
	Section 16		Overburden					x	1953	
56	T 9 N	R 20 E	Coal Thickness					x		
	N/2 S/2 N/2		Location					x	USGS files, Bore Hole	Core, questionable data re-
	Section 16		Overburden			x			#C-38, 1955	porting.
57	T 9 N	R 20 E	Coal Thickness			x				
	NE NW		Location					x	USGS files, Bore Hole #W-4	
	Section 16		Overburden				x		1955	
58	T 9 N	R 20 E	Coal Thickness				x			
	SE NW		Location					x	USGS files, Bore Hole	Core, questionable data re-
	Section 16		Overburden				x		#C-32, 1955	porting.
59	T 9 N	R 20 E	Coal Thickness				x			
	SE NW		Location					x	USGS files, Bore Hole #22,	Core
	Section 16		Overburden					x	1953	
60	T 9 N	R 20 E	Coal Thickness					x		
	SE NW		Location				x		USGS files, Bore Hole #20,	Core
	Section 16		Overburden					x	1953	
61	T 9 N	R 20 E	Coal Thickness					x		
	SE NW		Location					x	USGS files, Bore Hole #21,	Core
	Section 16		Overburden					x	1953	
62	T 9 N	R 20 E	Coal Thickness					x		
	SE NW		Location					x	USGS files, Bore Hole #4,	Soft coal.
	Section 16		Overburden				x		1955	
63	T 9 N	R 20 E	Coal Thickness				x			

DATA POINT #	LOCATION	INCREASING RELIABILITY →	1	2	3	4	5	REFERENCE	NOTES/COMMENTS
	SE NW	Location					x	USGS files, Bore Hole #16,	Core
	Section 16	Overburden					x	1953	
64	T 9 N | R 20 E	Coal Thickness					x		
	SW NW	Location		x				USGS files, Bore Hole #W-6	Questionable location. Note:
	Section 16	Overburden				x		1955	2'10" reported in 2' inter-
65	T 9 N | R 20 E	Coal Thickness				x			val between 45'0" & 47'0"
	SW NW	Location					x	USGS files, Bore Hole #W-5	
	Section 16	Overburden				x		1955	
66	T 9 N | R 20 E	Coal Thickness				x			
	NE NW	Location					x	USGS files, Bore Hole #W-7	
	Section 16	Overburden				x		1955	
67	T 9 N | R 20 E	Coal Thickness				x			
	SW NW	Location					x	USGS files, Bore Hole #23,	Core
	Section 16	Overburden					x	1953	
68	T 9 N | R 20 E	Coal Thickness					x		
	SE NE	Location					x	USGS files, Bore Hole #1,	Core
	Section 17	Overburden					x	1953	
69	T 9 N | R 20 E	Coal Thickness					x		
	SW NW	Location					x	USGS files, Bore Hole #17,	Core
	Section 16	Overburden					x	1953	
70	T 9 N | R 20 E	Coal Thickness					x		
	SW NW	Location					x	USGS files, Bore Hole #W-3	
	Section 16	Overburden				x		1955	
71	T 9 N | R 20 E	Coal Thickness				x			
	NW NW	Location					x	USGS files, Bore Hole	Core, questionable data re-
	Section 16	Overburden			x			#C-39B, 1955	porting.
72	T 9 N | R 20 E	Coal Thickness			x				
	NW NW	Location					x	USGS files, Bore Hole	Core. Same location as
	Section 16	Overburden			x			#C-39, 1955	data point 74. Note: 13.5"
73	T 9 N | R 20 E	Coal Thickness			x				coal reported.
	NW NW	Location					x	USGS files, Bore Hole #W-2	Use core C-39. Net coal
	Section 16	Overburden				x		1955	value at this location.
74	T 9 N | R 20 E	Coal Thickness	x						
	NW NW	Location					x	USGS files, Bore Hole	Core
	Section 16	Overburden	-	-	-	-	-	#C-39A, 1955	
75	T 9 N | R 20 E	Coal Thickness	-	-	-	-	-		
	SE NE	Location					x	USGS files, Bore Hole #2,	W. of N-S section line.
	Section 17	Overburden					x	1953	Core drill.
76	T 9 N | R 20 E	Coal Thickness					x		

DATE POINT #	LOCATION	INCREASING RELIABILITY →	1	2	3	4	5	REFERENCE	NOTES/COMMENTS
	SE NE	Location					x	USGS files, Bore Hole #3,	Core drill
	Section 17	Overburden					x	1953	
77	T 9 N | R 20 E	Coal Thickness					x		
	SW NE	Location				x		Oakes & Knechtel, 1948,	Slope mine
	Section 17	Overburden	-	-	-	-	-	p. 98, measured section #1	
78	T 9 N | R 20 E	Coal Thickness				x			

APPENDIX II TABLES OF OIL AND GAS TEST HOLES

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

* Logged interval stratigraphically below Hartshorne Coals.

Sec-Tn-Rg	Operator/Farm Location	Driller Logs Coal Reported Thickness & Depth	Scout Card Coal	Harts. Drill. Scout	Top Log Int. Gamma Elec.	Dens. Sonic	T.D. Year
3-9-20	Earlsboro Oil/#1-3 Frazier			NR			5809
	E/2 E/2 W/2 SE	NR	NR	NR			1978
4-9-20	No information, location only:						
	SE NE						
6-9-20	Roye Realty/#1 Tyler			400			4490
	CSE SW, 660 FSL 2180 FWL	NR	NR	400			
6-9-20	Service Drilling/Culver #1-6						
	CNW		NR	NR			1978
7-9-20	Service 1-7 Kirk			NR			4876
	SW SE SE	NR	NR	NR			1977
8-9-20	Service Drilling/#2-8 Conklin			NR			4291
	CSW	NR	NR	NR			1977
8-9-20	Service Drilling/#1-8 Conklin			NR			4068
	CSE	NR	NR	NR			1979
9-9-20	Service Drilling/#1-9 Cantrell			NR			4875
	CSW	NR	NR	NR			1977
10-9-20	Service Drilling/#1-10 Norman						4798
	W/2 NE SW SW	5' @ 1025	NR	NR			1979
10-9-20	Service Drilling/#2-10 Norman			NR			4346
	NW SW	NR	NR	NR			1979
11-9-20	Earlsboro O & G/#2 Cates						5140
	CSE		NR	NR			1977
11-9-20	Earlsboro/#1 Cates			NR			5100
	CSE, 1320 FNL 1470 FWL	NR	NR	NR			1977
12-9-20	Earlsboro O & G/#Rose-Beach			NR			4438
	1000 FSL 2505 FWL of SE/4	NR	NR	NR			1975

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
12-9-20	Earlsboro O & G/#1 Fioritta			NR		3900	4410
	100 FSL 1831 FWL of NE/4	NR	NR	NR	790		1976
13-9-20	Earlsboro O & G/#1 Speer-Logan			NR			4296
	CSE	NR	NR	NR			1975
14-9-20	Earlsboro O & G/#1 Scott			NR			4345
	CSE	NR	NR	NR			1977
14-9-20	Texas O & G/#1 Bumpers			NR			5307
	CNW	NR	NR	NR			1979
15-9-20	Samson/#1 College			NR			5200
	CNW NW	NR	NR	NR			1978
16-9-20	Service Drilling/#1-16 Quick			NR			4016
	CNW	NR	NR	NR			1976
16-9-20	Service Drilling/#2-16 Quick			NR			4357
	CNE	NR	NR	NR			1979
17-9-20	Service/#1-17 Johnson						4035
	CNE		NR	NR			1976
17-9-20	Service/#2-17 Johnson			NR			5200
	E/2 E/2 E/2 NW	NR	NR	NR			1979
18-9-20	Service/#2-18 Satterfield			NR			5598
	W/2 E/2 NW	NR	NR	NR			1978
18-9-20	Service '#1-18 Satterfield			NR			4271
	11/0 FSL 970 FWL of NE/4	NR	NR	NR			1977
7-9-21	El Johnson/#1 Conrad			NR			4415
	100 FSL 1320 FWL of NW/4	NR	NR	NR			1976
18-9-21	Earlsboro & Anderson/#1 Scantlin			NR			4496
	CW/2 NE SW SW	NR	NR	NR			1975
3-10-20	Shenandoah/#1 O. Keck			NR		1800*	3169
	CNW SE	NR	NR	NR	315*		1966
11-10-20	Service Drilling/#1-11 Ross			NR			3011
	CSE SE NW	NR	NR	NR			1976
16-10-20	Socony Mobil/#1 J. T. McAlester			NR			3256
	CSW NE	NR	NR	NR	250*	2350*	1962
20-10-20	Hendrick/#1 Calavan						3098
	CSW NE		NR	NR	208*	1700*	1966
21-20-20	Hendrick/#1-21 McAlester			NR			2490
	SE SE NW	NR	NR	NR	184*	1000*	1966

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
23-10-20	Sinclair O & G/#1 McCurtain-Scott			NR			4100
	CSW NE	NR	NR	NR	634		1963
28-10-20	Service Drilling/#1-28 Fudge			NR			3545
	W/2 NE SW SW	NR	NR	NR			1976
18-10-21	John Gill/#1 Harrell			NR			700
	CSW NE NW	NR	NR	NR			1975
29-10-22	Humble/#1 Levi Kates			NR		3325*	4425
	SE NW	NR	NR	NR	568*		1962