Text to Accompany:

Open-File Report 79-126

1979

COAL RESOURCE OCCURRENCE AND COAL DEVELOPMENT POTENTIAL MAPS OF THE SOUTHEAST QUARTER OF THE BOARS TUSK 15-MINUTE QUADRANGLE, SWEETWATER COUNTY, WYOMING

[Report includes 36 plates]

Prepared for

UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

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INTRODUCTION

Purpose

This text is to be used in conjunction with Coal Resource Occurrence (CRO) and Coal Development Potential (CDP) Maps of the southeast quarter of the Boars Tusk 15-minute quadrangle, Sweetwater County, Wyoming. This report was compiled to support the land planning work of the Bureau of Land Management (BLM) to provide a systematic coal resource inventory of Federal coal lands in Known Recoverable Coal Resource Areas (KRCRA's) in the western United States. This investigation was undertaken by Dames & Moore, Denver, Colorado, at the request of the U.S. Geological Survey under contract number 14-08-0001-17104. The information gathered for this report is in response to the Federal Coal Leasing Amendments Act of 1976 (P.L. 94-377). Published and unpublished public information available through June, 1978, was used as the data base for this study. No new drilling or field mapping was performed, nor was any confidential data used.

Location

In this report, the term "quadrangle" refers only to the southeast quarter of the Boars Tusk 15-minute quadrangle which is located in central Sweetwater County, approximately 13 miles (21 km) northeast of the city of Rock Springs and 2 miles (3.2 km) west of the town of South Superior, Wyoming. The area is unpopulated.

Accessibility

The Winton Cutoff, an improved light-duty road, runs along the southern edge of the quadrangle connecting the town of South Superior, Wyoming, with U.S. Highway 187 approximately 17 miles (27 km) to the west. The remainder of the quadrangle is served by several unimproved dirt roads and trails. Wyoming Highway 371 extends from Interstate Highway 80, approximately 8 miles (13 km) southeast of the quadrangle, to South Superior approximately 2 miles (3.2 km) east of the quadrangle boundary.

The main east-west line of the Union Pacific Railroad passes approximately 8 miles (13 km) south of the quadrangle. This line provides

railway service across southern Wyoming connecting Odgen, Utah to the west with Omaha, Nebraska to the east. A spur from the main line extends north from Thayer Junction and terminates approximately 1 mile (1.6 km) east of the quadrangle near the town of Superior. Another spur extends north from the main line at Rock Springs. North of the Winton Cutoff this spur is privately owned by the U.S. Steel Corporation and passes approximately 3 miles (4.8 km) west of the quadrangle boundary.

Physiography

The southeast quarter of the Boars Tusk 15-minute quadrangle lies in the northern part of the Rock Springs uplift and forms part of the Leucite Hills. The landscape is characterized by a generally rugged terrain of buttes and badland topography. The Continental Divide crosses the northeastern corner of the quadrangle. Altitudes in the quadrangle range from approximately 6,560 feet (1,999 m) in the North Baxter Basin in the southwestern corner of the quadrangle, to 7,891 feet (2,405 m) on Cross Mesa in the northeastern part of the quadrangle.

Streams in Cedar Canyon, Long Canyon, and Crooked Canyon flow westerly into the Green River Basin, providing drainage for the northern two thirds of the quadrangle. The southern third of the quadrangle is drained by several streams which flow into the North Baxter Basin. All of the streams in the quadrangle are intermittent and flow mainly in response to snowmelt in the spring.

Climate and Vegetation

The climate of southwestern Wyoming is semiarid and is characterized by low precipitation, rapid evaporation, and large daily temperature changes. Summers are usually dry and mild, and winters are cold. Annual precipitation averages 9 inches (23 cm), with approximately two thirds falling during the spring and early summer months.

The average annual temperature is 42°F (6°C). The temperature during January averages 18°F (-8°C), with temperatures ranging from 8°F (-13°C) to 28°F (-2°C). During July temperatures range from 54°F (12°C)

to 84°F (29°C), with an average of 69°F (21°C) (U.S. Bureau of Land Management, 1978; Wyoming Natural Resources Board, 1966).

Winds are usually from the west-southwest and southwest with an average velocity of 11 miles per hour (18 km per hr) (U.S. Bureau of Land Management, 1978).

Principal types of vegetation in the area include sagebrush, saltbush, greasewood, rabbitbrush, mountain mahogany, juniper, and grasses (U.S. Bureau of Land Management, 1978).

Land Status

The southeast quarter of the Boars Tusk 15-minute quadrangle lies in the north-central part of the Rock Springs Known Recoverable Coal Resource Area (KRCRA). Approximately 80 percent of the quadrangle's total area lies within the KRCRA boundary with the Federal government owning the coal rights for approximately half of this area. Two active coal leases are present within the KRCRA boundary, as shown on plate 2.

GENERAL GEOLOGY

Previous Work

Schultz described the geology and coal resources of the northern part of the Rock Springs coal field in 1909 and the geology and structure of the Baxter Basin and surrounding area in 1920. The Superior coal district, including part of this quadrangle and the southwest quarter of the Superior 15-minute quadrangle to the east, was mapped and described by Dobbin in 1944. Lindeman also mapped the northern part of the Rock Springs coal field in 1947. Hale described the stratigraphy and depositional history of the formations cropping out on the flanks of the Rock Springs uplift in 1950 and 1955. Yourston (1955) described the structure and stratigraphy of the coal-bearing formations in the Rock Springs coal field and reported chemical analyses for Rock Springs area coals. Carey reviewed the geology of the Leucite Hills area including the quadrangle in 1955. Weimer (1960), Smith (1961), Burger (1965), and Keith (1965) described the stratigraphy and discussed the depositional environment of

Upper Cretaceous formations in the Rock Springs area. The depositional history of the Upper Cretaceous formations exposed on the flanks of the Rock Springs uplift was also described by Weimer (1961) and Douglass and Blazzard (1961). Gosar and Hopkins (1969) summarized the structure and stratigraphy of Upper Cretaceous and Tertiary formations in the southwestern part of the Rock Springs uplift. Roehler and others described the geology and coal resources of the Rock Springs coal field in 1977. Roehler prepared a geologic map of the Rock Springs uplift and adjacent areas in 1977.

Stratigraphy

The formations exposed in the southeast quarter of the Boars Tusk 15-minute quadrangle range in age from Late Cretaceous to Tertiary and crop out across the quadrangle in northwest to west and southwest-trending arcs. The coal-bearing units in the quadrangle include the Blair, Rock Springs, and Almond Formations.

The Baxter Shale of Late Cretaceous age crops out in the southwestern corner of the quadrangle (Roehler, 1977) where it ranges in thickness from approximately 3,350 to 3,600 feet (1,021 to 1,097 m). This formation consists of soft dark-gray, gypsiferous, slightly sandy shale with thin beds of ripple-marked sandstone containing concretionary beds of impure limestone. The Baxter Shale is generally divided into upper and lower shale units by a prominent middle sandy member. The marine Baxter Shale forms the floor of Baxter Basin and is non-coal-bearing (Hale, 1950 and 1955; Smith, 1961).

The Mesaverde Group of Late Cretaceous age conformably overlies and laterally intertongues with the Baxter Shale. The Mesaverde Group is subdivided into four formations which are, in ascending order, the Blair Formation, the Rock Springs Formation, the Ericson Sandstone, and the Almond Formation.

The Blair Formation crops out in the southern half of the quadrangle (Roehler, 1977) and ranges in thickness from approximately 1,000 to 1,250

feet (305 to 381 m) where measured in the oil and gas wells drilled in the quadrangle. The lower section of the formation is composed of a thick series of light-brown, thin-bedded, fine- to medium-grained sandstones. This is overlain by light-brownish-gray arenaceous siltstone, and brownish-gray silty to sandy shale. The upper section of the formation consists of light-brown sandy shale, occasional thin coal beds and thin brown sandstone which grades upward into the sandstone of the Rock Springs Formation (Hale, 1950 and 1955; Smith, 1961; Keith, 1965).

The Rock Springs Formation, conformably overlying the Blair Formation is approximately 1,350 feet (411 m) thick in the Superior coal district (Dobbin, 1944). Cropping out across the northern two thirds of the quadrangle (Roehler, 1977), the Rock Springs Formation consists of a sequence of interbedded coal, carbonaceous shale, siltstone, claystone, and sandstone (Hale, 1950 and 1955; Smith, 1961; Keith, 1965).

In this quadrangle, the Ericson Sandstone is separated from the underlying Rock Springs Formation by a local unconformity (Roehler and others, 1977). The Ericson Sandstone is approximately 500 feet (152 m) thick in the Superior district (Dobbin, 1944) and crops out in the northern third of the quadrangle (Roehler, 1977). The formation consists of light-gray, massive, cliff-forming, cross-bedded, fine- to coarse-grained sandstone containing ferruginous concretions (Hale, 1950 and 1955; Smith, 1961).

The Almond Formation, conformably overlying the Ericson Sandstone, crops out in the northeastern corner of the quadrangle (Roehler, 1977). The formation ranges in thickness from 300 feet (91 m) where measured by Dobbin (1944) in the Superior coal district to approximately 650 feet (198 m) where measured in the oil and gas wells drilled in the adjacent southwest quarter of the Superior 15-minute quadrangle to the east. The lower section of the formation consists of carbonaceous shale, siltstone, mudstone and sandstone alternating with coal beds of variable thickness and quality. The upper section of the formation is predominately a buff-colored to light-gray, thick-bedded to massive, fossiliferous sandstone (Hale, 1950 and 1955).

Extrusive leucite-bearing igneous flows of Tertiary age are exposed on Cabin Butte, Cross Mesa and Twin Rocks (Carey, 1955; Roehler, 1977).

Recent deposits of alluvium cover the stream valleys of Cedar Canyon, Long Canyon, and Crooked Canyon.

The Upper Cretaceous formations in the southeast quarter of the Boars Tusk 15-minute quadrangle indicate the transgressions and regressions of a broad, shallow, north-south-trending seaway that extended across central North America. They accumulated near the western edge of the Cretaceous sea and reflect the location of the shoreline (Weimer, 1960; 1961).

Deposition of the Baxter Shale marked a westward or landward movement of the sea with shale, sandstone, and limestone deposited in an offshore marine environment (Hale, 1950; Douglas and Blazzard, 1961).

The Blair Formation, composed of intertonguing nearshore sandstones and offshore marine shales, was deposited in a shallow-water marine sequence as the Cretaceous sea regressed eastward (Douglass and Blazzard, 1961, and Gosar and Hopkins, 1969).

Both marine and continental deposits are contained in the Rock Springs Formation. Northwest of a strand line extending from approximately the southeastern corner of T. 16 N., R. 106 W., northeastward through T. 22 N., R. 100 W., the Rock Springs Formation consists of sediments deposited in swamp, deltaic and fluvial environments. Southeast of the strand line the Rock Springs Formation consists mainly of shallow-water marine deposits (Burger, 1965; Douglass and Blazzard, 1961; Gosar and Hopkins, 1969).

Sandstones of the Ericson Sandstone were deposited in stream and floodplain environments with a source area to the northwest (Douglass and Blazzard, 1961; Gosar and Hopkins, 1969).

The Almond Formation reflects deposition in fresh-water coastal swamps, brackish-water lagoons and shallow-water marine environments (Hale, 1950).

Volcanic activity resulted in leucite-rich surface lava flows which covered Late Cretaceous-age deposits (Carey, 1955).

Structure

The southeast quarter of the Boars Tusk 15-minute quadrangle lies on the northern end of the Rock Springs uplift which separates the Great Divide and Green River structural basins. The axial trace of the Rock Springs uplift, a doubly plunging asymmetric anticline, crosses the western edge of the quadrangle. Beds on the west side of axial trace strike northeasterly and dip 5° to 40° to the northwest. On the east side of the axial trace, the beds strike northwesterly and dip 5° to 8° to the northeast (Roehler and others, 1977). Dips in the southeast quarter of the Boars Tusk 15-minute quadrangle range from 3° to 6° to the northeast, north, and northwest.

Two parallel normal faults cross the northern third of the quadrangle. The area between the faults has dropped down in relation to the areas north and south of the faults. Several other similar fault systems run northeast across the southeastern corner of the quadrangle. The strike of the faults is nearly at right angles to the strike of the beds, or across the limbs of the anticline (Schultz, 1909; Dobbin, 1944).

COAL GEOLOGY

For the most part, this quadrangle contains only coal beds of the Rock Springs Formation. A few thin coal beds encountered near the contact between the Blair and Rock Springs Formations have been identified as Blair Formation coal beds (plate 1), although the contact is transitional and these coal beds may belong in the Rock Springs Formation (Dobbin, 1944).

The coal-bearing Almond Formation occurs in the northeastern corner of the quadrangle. A few drill holes to the north of the quadrangle have revealed thin Almond Formation coal beds in the subsurface.

Chemical analyses of coal.--Analyses of representative samples of coal from the Rock Springs Formation in the Rock Springs area are shown in table 1 (U.S. Bureau of Mines, 1931). All of the samples analyzed rank as high-volatile C bituminous according to ASTM Standard Specification D-388-77 (American Society for Testing and Materials, 1977).

Coal Beds of the Rock Springs Formation

Coal beds of the Rock Springs Formation are restricted to areas of coastal swamp deposition in the northwestern part of the Rock Springs uplift (Roehler and others, 1977). A number system adopted by the Union Pacific Railroad is most commonly used (Schultz, 1909) to name coal beds in the Rock Springs Formation. The beds worked in the coal field are, in descending order, the 5, 3, 1, 7 1/2, 7, 8, 9, 10, 11 (13, 15, 17), and 19. The same nomenclature is used across the field, although recent stratigraphic investiations suggest that the coal beds were commonly miscorrelated (Roehler and others, 1977). Dobbin (1944) has given a local name (Superior) to the coal beds in this area.

The Rock Springs Formation coal beds crop out in a broad northwest-trending band across the quadrangle. Both Schultz (1909) and Dobbin (1944) have mapped coal outcrop traces in this area. For the most part, Dobbin's map shows better correlation between coal outcrop traces and recent drill-hole data. Therefore, Dobbin's map has been used as a base for this report.

Rock Springs No. 19 Coal Bed

In this quadrangle, the Rock Springs No. 19 coal bed is, stratigraphically, the lowest isopached coal bed in the Rock Springs Formation. This coal bed reaches a maximum thickness of 6 feet (1.8 m) near the center of the quadrangle as shown on plate 4, but is generally less

than Reserve Base thickness (5 feet or 1.5 meters) where it can be traced elsewhere in the quadrangle.

Rock Springs No. 17 Coal Bed

The Rock Springs No. 17 coal bed thickens locally (plate 6) to a maximum of 10 feet (3.0 m) in the northwestern part of this quadrangle and in the quadrangle to the west. As do all the Rock Springs Formation coal beds, the Rock Springs No. 17 coal bed thins gradually southward as the formation becomes more marine in nature.

Rock Springs No. 15 Coal Bed

The isopach map of the Rock Springs No. 15 coal bed, one of the thicker Rock Springs Formation coal beds, is shown on plate 8. The coal bed reaches a maximum thickness of 13.3 feet (4.1 m) in this quadrangle, thinning to the southeast. To the west, in the adjacent southwest quarter of the Boars Tusk 15-minute quadrangle, the Rock Springs No. 15 coal bed is commonly split by considerable amounts of rock partings and has been mapped as a coal zone instead of a coal bed.

Rock Springs No. 13 Coal Bed

The Rock Springs No. 13 coal bed was encountered in several coal test holes in and around sec. 5, T. 21 N., R.103 W., where the coal bed ranges from 3.0 to 13 feet (0.9 to 4.0 m) in thickness (plate 12). This coal bed is not known to exceed Reserve Base thickness outside of this quadrangle.

Rock Springs No. 9 Coal Bed

This coal bed averages approximately 6 feet (1.8 m) in thickness, ranging from 1 to 9 feet (0.3 to 2.7 m) in this quadrangle (plate 15). The coal bed becomes slightly thinner in the southwest quarter of the Superior 15-minute quadrangle where the average thickness is 5 feet (1.5 m) with a maximum measured thickness of 8.6 feet (2.6 m). To the west in the southwest quarter of the Boars Tusk 15-minute quadrangle, the No. 9 coal bed thickens locally to 9.0 and 12.5 feet (2.7 and 3.8 m) but is usually less than Reserve Base thickness. In the adjacent Reliance

quadrangle to the southwest, this coal bed is 12 feet (3.7 m) thick, thinning gradually to the south.

Rock Springs No. 8 Coal Bed

Subsurface data has indicated local thickenings of the Rock Springs No. 8 coal bed (plate 19). The coal bed has a maximum measured thickness of 8 feet (2.4 m) in sec. 12, T. 21 N., R. 103 W., of this quadrangle and attains a maximum thickness of 13 feet (4.0 m) in the adjacent quadrangle to the west.

Rock Springs No. 7 Coal Bed

The Rock Springs No. 7 coal bed has been mapped over much of the quadrangle (plate 21) where it averages approximately 7 feet (2.1 m) in thickness. The coal bed thins rapidly to the southeast but generally exceeds Reserve Base thickness where mapped in the Reliance quadrangle and in the southwest quarter of the Boars Tusk 15-minute quadrangle to the west.

The coal bed is commonly split in this quadrangle, and in some areas, becomes very trashy. In these areas only the thickest split has been used for isopach purposes, effectively limiting the amount of rock partings contained within the mapped coal bed. The maximum amount of rock partings contained within the Rock Springs No. 7 coal bed, as isopached, totals 3.9 feet (1.2 m).

Rock Springs No. 7 1/2 Coal Bed

The Rock Springs No. 7 1/2 coal bed is isopached on plate 25 with reported thicknesses ranging from 2 to 10 feet (0.6 to 3.0 m), occasionally containing minor rock partings. Recent drill hole data in the southern part of the quadrangle indicate that Dobbin's (1944) trace of the Rock Springs No. 7 1/2 coal bed outcrop was incorrect and a second (projected) outcrop trace has been included on plates 25, 26, and 27.

The Rock Springs No. 7 1/2 coal bed thickens locally to 8 feet (2.4 m) in the quadrangle to the west. In the Reliance quadrangle, the coal

bed is commonly split but attains a maximum thickness of 13 feet (4.0 m) in a single coal bed located in sec. 7, T. 20 N., R. 104 W.

Rock Springs No. 1 Coal Bed

The Rock Springs No. 1 coal bed is generally one of the thicker, if not the thickest, coal beds in the Rock Springs Formation (plate 29). It attains a maximum thickness of 15 feet (4.6 m) in the northwestern part of the quadrangle, thinning to the southeast. The Rock Springs No. 1 coal bed has been mined at the abandoned D.O. Clark Mine in sec. 18, T. 21 N., R. 102 W., where it is between 5 and 7 feet (1.5 and 2.1 m) thick.

The Rock Springs No. 1 coal bed reaches a maximum thickness of 10 feet (3.0 m) in the southwest quarter of the Superior 15-minute quadrangle, 13.5 feet (4.1 m) in the southwest quarter of the Boars Tusk 15-minute quadrangle, and 18 feet (5.5 m) in the Reliance quadrangle.

Rock Springs No. 3

The Rock Springs No. 3 coal bed thickens to 6 feet (1.8 m) or greater in two areas, as shown on plate 33. In the quadrangle to the west, the maximum recorded thickness for the this coal bed is 6.4 feet (2.0 m), where measured in sec. 15, T. 18 N., R. 105 W. The Rock Springs No. 3 coal bed averages 5 feet (1.5 m) thick in the Reliance quadrangle.

Isolated Data Points

In instances where isolated measurements of coal beds thicker than 5 feet (1.5 m) are encountered, the standard criteria for construction of isopach, structure contour, mining ratio, and overburden isopach maps are not available. The lack of data concerning these beds limits the extent to which they can be reasonably projected in any direction and usually precludes correlations with other, better known beds. For this reason, isolated data points are included on a separate sheet (in U.S. Geological Survey files) for non-isopached coal beds. The isolated

data point used in this quadrangle is thought to be an isolated thickening of the Rock Springs No. 8 coal bed. It is located in sec. 23, T. 21 N., R. 103 W., and measures 5.5 feet (1.7 m) thick.

COAL RESOURCES

Data from coal test holes drilled by Rocky Mountain Energy Company (RMEC) and the Union Pacific Coal Company, as well as oil and gas well information, surface mapping by Schultz (1909) and Dobbin (1944), and inactive coal lease information from the U.S. Geological Survey (1937) were used to construct outcrop, isopach, and structure contour maps of the coal beds in this quadrangle. At the request of RMEC, coal-rock data for some of their drill holes have not been shown on plate 1 or on the derivative maps. However, data from these drill holes have been used to construct the derivative maps. These data may be obtained by contacting RMEC. The source of each indexed data point shown on plate 1 is listed in table 4.

Coal resources were calculated using data obtained from the coal isopach maps (plates 4, 6, 10, 13, 15, 19, 21, 25, 29, and 33). The coal bed acreage (measured by planimeter) multiplied by the average isopached 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 for each isopached coal bed. Reserve Base and Reserve tonnages for the isopached beds are shown on plates 9, 18, 24, 28, and 32, and are rounded to the nearest 10,000 short tons (9,072 metric tons). Coal beds of Reserve Base thickness (5 feet or 1.5 meters) or greater that lie less than 3,000 feet (914 m) below the ground surface are included. These criteria differ somewhat from that used in calculating Reserve Base and Reserve tonnages as 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. Only Reserve Base tonnages (designated as inferred resources) are calculated for areas influenced by the isolated data point in this quadrangle.

Coal Reserve Base tonnages per Federal section are shown on plate 2 and total approximately 31.54 million short tons (28.61 million metric tons) for the entire quadrangle, including tonnages from the isolated data point. Reserve Base tonnages in the various development potential categories for surface and subsurface mining methods are shown in tables 2 and 3.

Dames & Moore 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 so as 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-ha) parcels have been used to show the limits of the high, moderate, or low development potentials. A constraint imposed by the BLM specifies that the highest development potential affecting any part of a 40-acre (16-ha) lot, tract, or parcel be applied to that entire lot, tract, or parcel. For example, if 5 acres (2 ha) within a parcel meet criteria for a high development potential, 25 acres (10 ha) a moderate development potential, and 10 acres (4 ha) a low development potential, then the entire 40 acres (16 ha) are assigned a high development potential.

Development Potential for Surface Mining Methods

Areas where the coal beds of Reserve Base thickness are overlain by 200 feet (61 m) or less of overburden are considered to have potential for surface mining and were assigned a high, moderate, or low development potential based on the mining ratio (cubic yards of overburden per ton of recoverable coal). The formula used to calculate mining ratios for surface mining of coal is shown on the next page:

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

where MR = mining ratio

t_o = thickness of overburden in feet

t_c = thickness of coal in feet

rf = recovery factor (85 percent for this quadrangle)

cf = conversion factor to yield MR value in terms of cubic yards of overburden per short tons of recoverable coal:
0.911 for subbituminous 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 200-foot (61-m) overburden line and the outcrop are assigned unknown development potentials for surface mining methods. This applies to the areas where no known coal beds more than 5 feet (1.5 m) occur and to the area influenced by the isolated data point. Limited knowledge pertaining to the areal distribution, thickness, depth, and attitude of the coal beds prevents accurate evaluation of the development potential in the high, moderate, or low categories. The area influenced by the isolated data point in this quadrangle contains approximately 0.19 million short tons (0.17 million metric tons) of coal available for surface mining.

The coal development potential for surface mining methods is shown on plate 35. Of the Federal land areas having a known development potential for surface mining methods, 59 percent are rated high and 41 percent are rated low. The remaining Federal lands within the KRCRA boundary have been previously leased. The development potential for Federal lands outside the KRCRA boundary is unknown.

Development Potential for Subsurface and In-Situ Mining Methods

Areas considered to have a development potential for conventional subsurface mining methods include those areas where the coal beds of Reserve Base thickness are between 200 and 3,000 feet (61 and 914 m) below the ground surface and have dips of 15° or less. Coal beds lying between 200 and 3,000 feet (61 and 914 m) below the ground surface, dipping greater than 15°, are considered to have a development potential for in-situ mining methods.

Areas of high, moderate, and low development potential for subsurface mining methods are defined as areas underlain by coal beds at depths ranging from 200 to 1,000 feet (61 to 305 m), 1,000 to 2,000 feet (305 to 610 m), and 2,000 to 3,000 feet (610 to 914 m), respectively.

Areas where the coal data is absent or extremely limited between 200 and 3,000 feet (61 and 914 m) below the ground surface are assigned unknown development potentials. This applies to the area influenced by the isolated data point and those areas where coal beds of Reserve Base thickness are not known to occur. The area influenced by the isolated data point in this quadrangle contains approximately 0.50 million short tons (0.45 million metric tons) of coal available for conventional subsurface mining.

The coal development potential for subsurface mining methods is shown on plate 36. All of the Federal land areas classified as having known development potential for conventional subsurface mining methods

are rated high. The remaining Federal land within the KRCRA boundary has been previously leased. The development potential for Federal lands lying outside the KRCRA boundary is unknown.

Because the coal beds in this quadrangle have dips less than 15°, all Federal land areas within the KRCRA boundary have been rated as having an unknown development potential for in-situ mining methods.

Table 1.--Chemical analyses of coals in the southeast quarter of the Boars Tusk 15-minute quadrangle, Sweetwater County, Wyoming.

Location	COAL BED NAME	Form of Analysis	Proximate				Ultimate					Heating Value	
			Moisture	Volatile Matter	Fixed Carbon	Ash	Sulfur	Hydrogen	Carbon	Nitrogen	Oxygen	Calories	Btu/Lb
Sec. 3, T. 21 N., R. 103 W., Prospect Pits (U.S. Bureau of Mines, 1931)	Rock Springs, undifferentiated	A	13.8	31.7	49.5	5.0	0.9	-	-	-	-	-	10,790
		C	0.0	36.8	57.4	5.8	1.0	-	-	-	-	-	12,520
NW¼, NW¼, sec. 2, T. 18 N., R. 105 W., Blairtown Mine (U.S. Bureau of Mines, 1931)	Rock Springs No. 3	A	11.5	36.8	50.1	1.6	0.8	-	-	-	-	-	12,220
		C	0.0	41.6	55.6	1.8	0.9	-	-	-	-	-	13,810
SE¼, NW¼, sec. 20, T. 21 N., R. 102 W., Superior D. Mine (U.S. Bureau of Mines, 1931)	Rock Springs No. 1	A	13.8	31.5	50.5	4.2	1.3	-	-	-	-	-	11,430
		C	0.0	36.6	58.5	4.9	1.5	-	-	-	-	-	13,250
NW¼, SE¼, sec. 27, T. 21 N., R. 102 W., Superior A Mine (U.S. Bureau of Mines, 1931)	Rock Springs No. 7	A	12.7	32.8	50.0	4.5	0.8	-	-	-	-	-	11,720
		C	0.0	37.6	57.2	5.2	0.9	-	-	-	-	-	13,430

Form of Analysis: A, as received
B, air dried
C, moisture free

Note: To convert Btu/pound to kilojoules/kilogram, multiply by 2.326

Table 2.--Coal Reserve Base data for surface mining methods for Federal coal lands (in short tons) in the southeast quarter of the Boars Tusk 15-minute quadrangle, Sweetwater County, Wyoming.

Coal Bed or Zone	High Development Potential	Moderate Development Potential	Low Development Potential	Total
Rock Springs No. 1	20,000	--	40,000	60,000
Rock Springs No. 7½	180,000	240,000	770,000	1,190,000
Rock Springs No. 7	750,000	690,000	1,320,000	2,760,000
Upper Rock Springs No. 9	150,000	140,000	90,000	380,000
Rock Springs No. 15	--	--	20,000	20,000
Totals	1,100,000	1,070,000	2,240,000	4,410,000

NOTE: To convert short tons to metric tons, multiply by 0.9072.

Table 3.--Coal Reserve Base data for subsurface mining methods for Federal coal lands (in short tons) in the southeast quarter of the Boars Tusk 15-minute quadrangle, Sweetwater County, Wyoming.

Coal Bed or Zone	High Development Potential	Moderate Development Potential	Low Development Potential	Total
Rock Springs No. 1	730,000	-	-	730,000
Rock Springs No. 7½	3,280,000	-	-	3,280,000
Rock Springs No. 7	10,470,000	-	-	10,470,000
Upper Rock Springs No. 9	4,680,000	-	-	4,680,000
Rock Springs No. 15	7,010,000	2,770,000	-	9,780,000
Totals	26,170,000	2,770,000	-	28,940,000

NOTE: To convert short tons to metric tons, multiply by 0.9072.

Table 4. -- Sources of data used on plate 1

Plate 1 Index Number	Source	Data Base
1	Rocky Mountain Energy Co., (no date), unpublished data	Drill hole No. LC-119-7
2	U.S. Geological Survey, 1937, Inactive Coal Lease Nos. Evanston-07490 and Evanston-07849, Union Pacific Railroad	D. O. Clark Mine Drill hole No. 75
3	Rocky Mountain Energy Co., (no date), unpublished data	Drill hole No. 96
4	U.S. Geological Survey, 1937, Inactive Coal Lease Nos. Evanston-07490 and Evanston-07849, Union Pacific Railroad	D. O. Clark Mine Drill hole No. 58
5	↓	D. O. Clark Mine Drill hole No. 64
6	↓	D. O. Clark Mine Drill hole No. 73
7	↓	D. O. Clark Mine Drill hole No. 67
8	↓	D. O. Clark Mine Drill hole No. 37
9	↓	D. O. Clark Mine Drill hole No. 68
10	Rocky Mountain Energy Co., (no date), unpublished data	Union Pacific Coal Co. Drill hole No. 15-B
11	U.S. Geological Survey, 1937, Inactive Coal Lease Nos. Evanston-07490 and Evanston-07849, Union Pacific Railroad	D. O. Clark Mine Drill hole No. 80
12	↓	D. O. Clark Mine Drill hole No. 79

Table 4. -- Continued

Plate 1 Index Number	Source	Data Base
13	U.S. Geological Survey, 1937, Inactive Coal Lease Nos. Evanston-07490 and Evanston-07849, Union Pacific Railroad	D. O. Clark Mine Drill hole No. 39
14	↓	D. O. Clark Mine Drill hole No. 72
15	↓	D. O. Clark Mine Drill hole No. 38
16	Rocky Mountain Energy Co., (no date), unpublished data	Union Pacific Coal Co. Drill hole No. 62
17	↓	Drill hole No. 31
18	↓	Drill hole No. 32
19	Rocky Mountain Energy Co., (no date), unpublished data	Drill hole No. 30
20	↓	Drill hole No. LC-82
21	↓	Drill hole No. LC-90
22	↓	Drill hole No. 1AS
23	Schultz, 1909, U.S. Geological Survey Bulletin 341-B, p. 262	Measured Section
24	Kenneth D. Luff, Inc.	Oil/gas well No. 1-4 Federal-Leucite Hills
25	Rocky Mountain Energy Co., (no date), unpublished data	Drill No. 4 BD
26	↓	Drill hole No. 1AS
27	↓	Drill hole No. 1-AD

Table 4. -- Continued

Plate 1 Index Number	Source	Data Base
28	Kenneth D. Luff, Inc. and John Kemmerer	Oil/gas well No. 1-5 Champlin
29	↓	Oil/gas well No. 1-5 Amoco-Champlin
30	Rocky Mountain Energy Co., (no date), unpublished data	Drill hole No. 1 BD
31	↓	Drill hole No. 3 AD
32		Drill hole No. 3 AD
33	Schultz, 1909, U.S. Geological Survey Bulletin 341-B, p. 262	Measured Section
34	Kenneth D. Luff, Inc.	Oil/gas well No. 1-8 Leucite
35	Brack Drilling Company	Oil/gas well No. 3 Unit-Twin Rocks
36	Rocky Mountain Energy Co. (no date), unpublished data	Drill hole No. 61
37	Rocky Mountain Energy Co., (no date), unpublished data	Drill hole No. 47
38	↓	Drill hole No. 11
39	Schultz, 1909, U.S. Geological Survey Bulletin 341-B, p. 262	Measured Section
40	Rocky Mountain Energy Co., (no date), unpublished data	Drill hole No. 62
41	↓	Drill hole No. 64
42		Drill hole No. 63

Table 4. -- Continued

Plate 1 Index Number	Source	Data Base
43	Rocky Mountain Energy Co., (no date), unpublished data	Drill hole No. 39
44		Drill hole No. 59
45		Drill hole No. 24
46		Drill hole No. 70
47		Drill hole No. 34
48		Drill hole No. 71
49		Drill hole No. 35
50		Drill hole No. 36
51		Drill hole No. 27
52		Drill hole No. 8
53		Drill hole No. LC-106
54		Drill hole No. 26
55		Drill hole No. 3
56		Drill hole No. 4
57		Drill hole No. 55
58		Drill hole No. LC-104
59	Schultz, 1909, U.S. Geological Survey Bulletin 341-B, p. 262	Measured Section
60	U.S. Geological Survey, 1937, Inactive Coal Lease Nos. Evanston-07490 and Evanston-07849, Union Pacific Railroad	D. O. Clark Mine Drill hole No. 81

Table 4. -- Continued

Plate 1 Index Number	Source	Data Base
61	U.S. Geological Survey, 1937, Inactive Coal Lease Nos. Evanston-07490 and Evanston-07849, Union Pacific Railroad	D. O. Clark Mine Drill hole No. 74
62	↓	D. O. Clark Mine Drill hole No. 70
63	Rocky Mountain Energy Co., (no date) unpublished data	Drill hole No. 77
64	U.S. Geological Survey, 1937, Inactive Coal Lease Nos. Evanston-07490 and Evanston-07849, Union Pacific Railroad	D.O. Clark Mine Drill hole No. 78
65	Rocky Mountain Energy Co., (no date), unpublished data	Drill hole No. 1AS
66	↓	Drill hole No. 2AS
67	U.S. Geological Survey, 1937, Inactive Coal Lease Nos. Evanston-07849 and Evanston-07849, Union Pacific Railroad	D. O. Clark Mine Drill hole No. 69
68	↓	D. O. CLark Mine Drill hole No. 76
69	Rocky Mountain Energy Co., (no date), unpublished data	Drill hole No. 1AS
70	Sun Oil Co.	Oil/gas well No. 6
71	Rocky Mountain Energy Co., (no date), unpublished data	Drill hole No. 1-D, line A
72	Mountain Fuel Supply Co.	Oil/gas well No. 3 Unit-Leucite Hills

Table 4. -- Continued

Plate 1 Index Number	Source	Data Base
73	Rocky Mountain Energy Co., (no date), unpublished data	Drill hole No. LC-215-20
74	↓	Drill hole No. 1AS
75	Kenneth D. Luff, Inc.	Oil/gas well No. 4 Unit-Leucite Hills
76	Rocky Mountain Energy Co., (no date), unpublished data	Drill hole No. 2AS
77	Kenneth D. Luff, Inc.	Oil/gas well No. 5 Unit-Leucite Hills
78	Rocky Mountain Energy Co., (no date), unpublished data	Drill hole No. LC-191
79	Kenneth D. Luff, Inc.	Oil/gas well No. 1-23 Amoco-Champlin
80	Rocky Mountain Energy Co., (no date), unpublished data	Drill hole No. 2D, line A
81	↓	Drill hole No. 2AS
82	↓	Drill hole No. 1AS
83	↓	Drill hole No. 2, line A
84	↓	Drill hole No. LC-196-28
85	Mountain Fuel Supply Co.	Oil/gas well No. 2 Unit-Leucite Hills
86	Rocky Mountain Energy Co., (no date), unpublished data	Drill hole No. 1AS
87	Mountain Fuel Supply Co.	Oil/gas well No. 1 Unit-Leucite Hills

Table 4. -- Continued

Plate 1 Index Number	Source	Data Base
88	Rocky Mountain Energy Co., (no date), unpublished data	Drill hole No. 2AS
89	↓	Drill hole No. LC-210-30
90	Carter Oil Co.	Oil/gas well No. 1 Unit-Leucite Hills
91	Rocky Mountain Energy Co., (no date), unpublished data	Drill hole No. 1AS
92	↓	Drill hole No. 1, line A
93	Kenneth D. Luff, Inc.	Oil/gas well No. 1-32 Leucite-Federal
94	Rocky Mountain Energy Co., (no date), unpublished data	Drill hole No. LC-62
95	↓	Drill hole No. LC-72
96		Drill hole No. 2AD
97	Kenneth D. Luff, Inc.	Oil/gas well No. 1-34 Federal
98	Rocky Mountain Energy Co., (no date), unpublished data	Drill hole No. LC-69
99	↓	Drill hole No. LC-67
100	Jack Grynberg & Assoc.	Oil/gas well No. 1-12 Reserve-Federal
101	Carter Oil Co.	Oil/gas well No. 1
102	Prenalta Corp.	Oil/gas well No. 14-28-21-103-Gov't

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