Text to Accompany:

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

[Report includes 17 plates]

Prepared for

UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

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This report has not been edited
for conformity with U.S. Geological
Survey editorial standards or
stratigraphic nomenclature.

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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 Superior 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 resource 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 Published and unpublished public information available through April, 1978, was used as the data base for this study.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 Superior 15-minute quadrangle which is located in central Sweetwater County, approximately 5 miles (8 km) north of the town of Point of Rocks and 5 miles (8 km) east of the town of South Superior, Wyoming. The area is unpopulated.

Accessibility

An improved light-duty road crosses the quadrangle from north to south and joins a second light-duty road crossing easterly through the southern third of the quadrangle. The road then extends southward to Interstate Highway 80, approximately 5 miles (8 km) south of the quadrangle boundary. Several unimproved dirt roads and trails provide access for the remainder of the quadrangle.

The main east-west line of the Union Pacific Railroad passes approximately 4 miles (6 km) south of the quadrangle boundary. This line provides railway service across southern Wyoming connecting Ogden, Utah to the west with Omaha, Nebraska to the east.

Physiography

The southeast quarter of the Superior 15-minute quadrangle lies between the northeastern flank of the Rock Springs uplift and the southwestern rim of the Great Divide Basin. The landscape is characterized by low rolling hills, gently sloping ridges, and isolated buttes. The Continental Divide crosses east-west through the northern third of the quadrangle. Altitudes range from approximately 6,640 feet (2,024 m) on Deadman Wash in the southeastern part of the quadrangle to 7,400 feet (2,256 m) on Spring Butte in the northern part of the quadrangle.

The northern third of the quadrangle north of the Continental Divide is drained by streams flowing northeasterly into the Great Divide Basin. Deadman Wash and its tributaries, Potash Wash and Ninemile Wash, drain the area south of the Continental Divide. A large playa is located in the northeastern part of the quadrangle and two smaller playas are located along the southern edge of the quadrangle. All of the streams in the quadrangle flow intermittently 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. The 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, and 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 and grasses (U.S. Bureau of Land Management, 1978).

Land Status

The southeast quarter of the Superior 15-minute quadrangle lies in the northeastern part of the Rock Springs Known Recoverable Coal Resource Area (KRCRA). The entire quadrangle lies within the KRCRA boundary. The Federal government owns 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. Sears investigated the geology and structure of the Baxter Basin gas field and adjacent areas in 1926. The Superior coal district to the west of the quadrangle was mapped and described by Dobbin in 1944. 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 published analyses for Rock Springs area coals. Carey reviewed the geology of the Leucite Hills area including the quadrangle in 1955. Weimer (1960), Smith (1961), Weichman (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 Douglas and Blazzard (1961). Lawson and Crowson (1961) described the stratigraphy of the Wasatch and Fort Union Formations on the eastern flank of the Rock Springs uplift. Roehler described the Late Cretaceous-Tertiary unconformity (1961) and Early Tertiary depositional environments (1965) present in the Rock Springs area. Bradley discussed the stratigraphy of the Wasatch and Green River

Formations in the Rock Springs uplift in 1964. Gosar and Hopkins (1969) summarized the structure and stratigraphy of Upper Cretaceous and Tertiary rocks in the southwestern part of the Rock Springs uplift. Land mapped the Fox Hills Sandstone and associated formations on the eastern flank of the Rock Springs uplift in 1972 and described their stratigraphy and depositional history. Coal analyses and measured sections of coals in the Rocks Springs coal field were reported by Glass in 1975. Roehler, Swanson, and Sanchez described the geology and coal resources of the Rock Springs uplift in 1977. Roehler also prepared a geologic map of the Rock Springs uplift and adjacent areas in 1977. LaPoint mapped part of the quadrangle in 1977 and LaPoint and Pike (1977) prepared lithologic and geophysical logs of coal test holes drilled in the quadrangle by the U.S. Geological Survey in 1976.

Stratigraphy

The formations exposed in the southeast quarter of the Superior 15-minute quadrangle range in age from Late Cretaceous to Tertiary. The Rock Springs, Almond and Lance Formations of Late Cretaceous age, and the Fort Union Formation of Paleocene age contain coal.

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

In this quadrangle, the Blair Formation is present in the subsurface at depths exceeding 3,000 feet (914 m).

The Rock Springs Formation, present in the subsurface and conformably overlying the Blair Formation, ranges from in thickness from approximately 1,320 to 1,360 feet (402 to 415 m) where measured in the oil and gas wells drilled in the quadrangle. The Rock Springs Formation consists of a sequence of interbedded coal, carbonaceous shale, siltstone, sandstone, and claystone. These paludal sediments intertongue with a massive white to light-gray fine-to medium-grained littoral sandstone. These in turn change to gray marine shale and thin beds of very fine grained sandstone southeast of the quadrangle (Hale, 1950, 1955, Weichman, 1961, Keith, 1965, and Roehler and others, 1977).

The Ericson Sandstone unconformably overlies the Rock Springs Formation in the subsurface in this quadrangle (Roehler and others, 1977). The formation ranges in thickness from approximately 780 to 880 feet (238 to 268 m) where measured in the oil and gas wells drilled in the quadrangle. The Ericson Sandstone consists of light-gray massive fine- to coarse-grained sandstone and conglomerate containing chert pebbles (Hale, 1950, 1955, and Smith, 1961).

The Almond Formation, conformably overlying the Ericson Sandstone, crops out in the southwestern corner of the quadrangle (Roehler, 1977). In this quadrangle the Almond Formation ranges in thickness from approximately 640 to 680 feet (195 to 207 m) thick in the oil and gas wells drilled in the quadrangle. 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 buff-colored to light-gray, thick-bedded to massive fossiliferous sandstone (Hale, 1950 and 1955).

The Lewis Shale of Late Cretaceous age conformably overlies the Almond Formation and crops out in a northwest-trending band across the southern half of the quadrangle (Roehler, 1977). Oil and gas wells drilled in the quadrangle indicate that the Lewis Shale ranges from approximately 440 to 660 feet (134 to 201 m) in thickness. This formation consists of dark-bluish-gray gypsiferous silty shale, with occasional thin interbeds of sandy limestone and siltstone and a number of thin, widespread bentonite beds. Zones of calcareous concretions are found near the middle of the section with thin ripple-marked sandstones common near the base and top (Hale, 1950 and 1955, and Land, 1972).

The Fox Hills Sandstone of Late Cretaceous age conformably overlies and intertongues with the Lewis Shale. The formation crops out as a narrow northwest-trending band in the southern half of the quadrangle

(Roehler, 1977) and is composed of a lower light-brown, very fine to fine-grained, thin-bedded, cross-bedded silty sandstone overlain by a light-tan to very light gray, fine- to medium-grained massive sandstone (Land, 1972). The Fox Hills Sandstone ranges in thickness from approximately 100 to 150 feet (30 to 46 m) where measured in the oil and gas wells drilled in the quadrangle.

The Lance Formation of Late Cretaceous age also crops out in a northwest-trending band across the southern half of the quadrangle, and conformably overlies the Fox Hills Sandstone (Roehler, 1977). This formation ranges from approximately 660 to 830 feet (201 to 253 m) thick where measured in oil and gas wells drilled in the quadrangle. The Lance Formation consists of thin beds of silty fine-grained sandstone interbedded with carbonaceous shale and coal (Hale, 1950, 1955, Land, 1972, and Roehler and others, 1977).

The Fort Union Formation of Paleocene age, unconformably overlying the Lance Formation, crops out in the northeastern half of the quadrangle (Roehler, 1977) and ranges in thickness from approximately 1,000 to 1,500 feet (305 to 457 m) (Roehler and others, 1977). The formation consists of light-gray shale, sandy shale and siltstone, thick beds of gray-white to white coarse-grained unconsolidated sandstone, and coal. The occurrence of coal and carbonaceous material is more pronounced in the lower half of the formation (Lawson and Crowson, 1961, and Roehler and others, 1977).

The main body of the Wasatch Formation of Eocene age crops out in the northeastern corner of the quadrangle and conformably overlies the Fort Union Formation (Roehler, 1977). This formation is approximately 1,000 feet (305 m) thick on the eastern flank of the uplift (Pipiringos, 1961), but it is estimated that only approximately 300 feet (91 m) may possibly be present in the northwest corner of the quadrangle. It consists of gray sandstone and siltstone with interbedded gray, green and red mudstone, gray and brown, partly carbonaceous shale, coal, and sparce thin beds of gray limestone (Bradley, 1964, and Roehler and others, 1977).

Extrusive leucite-rich igneous flows of Quaternary or Tertiary age crop out on Spring Butte and Black Rock (Carey, 1955, and Roehler, 1977).

Recent deposits of alluvium cover the stream valleys of Deadman Wash, Potash Wash, and Ninemile Wash.

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

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, and 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, and Gosar and Hopkins, 1969).

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

The Lewis Shale is composed of neritic shale and siltstone deposited in water depths ranging from a few tens of feet to several hundred feet (Land, 1972).

The Fox Hills Sandstone was deposited in estuary, littoral, and shallow neritic environments as the Cretaceous sea regressed eastward (Land, 1972).

The Lance Formation, consisting of swamp, lagoonal, floodplain and channel sand deposits, was deposited on the landward side of the Cretaceous sea shoreline as the sea retreated to the east (Gosar and Hopkins, 1969, and Roehler and others, 1977).

After the final withdrawal of the Cretaceous sea, Fort Union Formation was deposited mainly in a paludal or fresh-water swamp environment across the Rock Springs uplift (Roehler, 1961).

The main body of the Wasatch Formation was deposited in an intermontane basin in fluvial and fresh-water swamp environments (Bradley, 1964, Roehler, 1965, and Roehler and others, 1977).

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

Structure

The southeast quarter of the Superior 15-minute quadrangle lies on the northeastern flank of the Rock Springs uplift which separates the Great Divide and Green River structural basins. The Rock Springs uplift is a doubly plunging asymmetric anticline with west limb having the steeper dips (5° to 30° to the west). Dips along the east limb are from 5° to 8° to the east (Roehler and others, 1977).

The strike of the beds in the quadrangle is generally northwest, with dips of 4° to 6° to the northeast. Four faults are known to offset coal beds in the Almond and Lance Formations near the western edge of the quadrangle. Horizontal displacement of the Tertiary-age faults can be as great as 3 miles (4.8 km) with vertical movement of several hundred feet (Schultz, 1909, and Yourston, 1955).

COAL GEOLOGY

In this quadrangle, four formations contain coal: the Rock Springs, the Almond, the Lance, and the Fort Union. The Rock Springs coal zone is stratigraphically the lowest of the four coal zones and is encountered in only two deep oil and gas wells drilled in the quadrangle. The lowest coal bed of the Almond coal zone is found approximately 1,250 feet (381 m) stratigraphically above the Rock Springs coal zone. The Almond coal zone is approximately 150 feet (46 m) thick. The Lance coal zone is 1,150 feet (351 m) above the Almond coal zone and is approximately 300 feet (91 m) thick. Drill hole data indicate that the Fort Union coal zone is located in a range from less than 20 feet (6.1 m) to approximately 850 feet (18 to 259 m) above the Lance coal zone and ranges from 100 feet (30 m) thick to over 200 feet (61 m) thick in this quadrangle.

Chemical analyses of coal.--An analysis of a sample taken from the Deadman coal bed of the Fort Union coal zone in this quadrangle is given in table 1. Representative analyses of the other coal zones were obtained from the Black Buttes, Point of Rocks, and the southwest quarter of the Superior 15-minute quadrangles, and are included in table 1.

In general, coals from the Rock Springs Formation rank as high-volatile C bituminous, coals from the Almond and Lance Formations rank as subbituminous B, and the Deadman coal bed of the Fort Union Formation ranks as subbituminous B. The coals from these coal zones are ranked on a moist, mineral-matter-free basis according to ASTM Standard Specification D 388-77 (ASTM, 1977).

Rock Springs Coal Zone

Two coal beds of the Rock Springs coal zone were penetrated by an oil and gas well drilled in sec. 4, T. 21 N., R. 101 W. These beds are greater than Reserve Base thickness (5 feet or 1.5 meters) and have been included in the Isolated Data Points section of this report.

Almond Coal Zone

Several thin coal beds of the Almond Formation were penetrated in drill holes in the quadrangle. Individual coal beds average approximately 3 feet (0.9 m) in thickness. One coal bed in the Almond coal zone, the Almond [3] coal bed, is mapped in the southwestern corner of the quadrangle. Because of the local nature of this coal bed, a bracketed number is used for identification purposes in this quadrangle and in the Point of Rocks quadrangle to the south.

The average thickness of the Almond [3] coal bed in this quadrangle is 5 feet (1.5 m) with a maximum thickness of 7.5 feet (2.3 m) recorded in sec. 33, T. 21 N., R. 101 W. In the Point of Rocks quadrangle to the south, the coal bed is identified as the Almond [4] and averages 7 feet (2.1 m) thick with a maximum recorded thickness of 11.8 feet (3.6 m). The coal bed dip, derived from plate 7, is approximately 5° to the northeast.

Lance Coal Zone

The Lance coal zone crops out in a northwest-trending band across the southern half of the quadrangle. Numerous coal beds are present in the zone, but only three coal beds exhibit sufficient thickness and lateral extent to warrant preparation of derivative maps. None of the coal beds possess formal names and are therefore given bracketed numbers for identification purposes in this quadrangle. The coal beds dip to the northeast at approximately 5° as measured by LaPoint (1977). Overburden thicknesses increase in the same direction.

Lance [1] Coal Bed

The Lance [1] coal bed is stratigraphically the lowest isopached coal bed in the Lance coal zone. The average thickness of the coal bed is 5 feet (1.5 m), with a maximum recorded thickness of 10 feet (3.0 m) in sec. 5, T. 21 N., R. 101 W. The dip of the coal bed, as derived from plate 4, is 5° to the northeast.

Lance [2] Coal Bed

The Lance [2] coal bed is located 50 feet (15.2 m) stratigraphically above the Lance [1] coal bed. The maximum recorded thickness of the coal bed is 7.5 feet (2.3 m) in sec. 15, T. 21 N., R. 101 W., and the average thickness is 6 feet (1.8 m). The Lance [2] coal bed is only found in secs. 10, 14, and 15, T. 21 N., R. 101 W. The dip of the coal bed, calculated from plate 13, is 5° to the northeast.

Lance [3] Coal Bed

The Lance [3] coal bed is the most extensive and continuous of the Lance Formation coal beds in this quadrangle. It is located 20 feet (6.1 m) stratigraphically above the Lance [2] coal bed. The Lance [3] coal bed reaches a maximum thickness of 8.5 feet (2.6 m), in sec. 5, T. 21 N., R. 101 W., and averages 6 feet (1.8 m) thick in this quadrangle. This coal bed is offset by a horst and graben structure perpendicular to the strike of the bed which extends to the west into the southwest quarter of the Superior 15-minute quadrangle. The dip of the bed, calculated from plate 7, is approximately 5° to the northeast.

Fort Union Coal Zone

The Fort Union coal zone contains one major coal bed in this quadrangle, the Deadman coal bed. Stratigraphically, the Deadman coal bed lies in the lower 100 feet (30 m) of the Fort Union Formation (Roehler and others, 1977). This coal bed is presently mined at the Jim Bridger strip mine, which extends into the southestern part of the quadrangle, and is the major source of coal for the nearby Jim Bridger power plant. The coal bed dips to the northeast at approximately 5° as measured by LaPoint (1977).

Deadman Coal Bed

The Deadman coal bed (Roehler and others, 1977) is named for Deadman Wash which crosses this quadrangle. The coal bed is commonly split into the Upper and Lower Deadman coal beds. Where it occurs as a single bed in this quadrangle, the coal bed averages 15 feet (4.6 m) thick, with a maximum recorded thickness of 30 feet (9.1 m) in sec. 17, T. 21 N., R. 100 W. In the northwestern part of this quadrangle, the coal bed splits with the interburden reaching a thickness of over 70 feet (21.3 m). The Lower Deadman coal bed is the thickest of the two splits, averaging 10 feet (3.0 m) thick in this quadrangle with a maximum recorded thickness of 14 feet (4.3 m) in sec. 1, T. 21 N., R. 101 W. The Upper Deadman coal bed has an average thickness of 4 feet (1.2 m), reaching a maximum recorded thickness of 6.1 feet (1.9 m) in sec. 11, T. 21 N., R. 101 W. The Deadman coal bed dips 2° to the northeast, as derived from plates 11 and 13.

To the east in the southwest quarter of the Twelvemile Well 15-minute quadrangle, the Deadman coal bed is split with an interburden thickness averaging 32 feet (9.8 m), and both splits averaging 10 feet (3.0 m) in thickness.

To the west in the southwest quarter of the Superior 15-minute quadrangle the Upper and Lower Deadman coal beds both average 6 feet (1.8 m) thick with interburden thicknesses averaging 17 feet (5.2 m).

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 coal 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 points used in this quadrangle are listed below. The coal beds identified by bracketed numbers are not formally named, but are numbered for identification purposes in this quadrangle only.

Source	Location	Coal Bed or Zone	Thickness
True Oil Co.	sec. 4, T. 21 N., R. 101 W.	RS[1]	6 feet (1.8 m)
True Oil Co.	sec. 4, T. 21 N., R. 101 W.	RS[2]	8 feet (2.4 m)
RMEC	sec. 29, T. 21 N., R. 100 W.	La	9 feet (2.7 m)

COAL RESOURCES

Information from an oil and gas well, and coal test holes drilled by the Pacific Power & Light Company (PP&L) and by the Rocky Mountain Energy Company (RMEC), as well as surface mapping by Schultz (1909) and LaPoint (1977), 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 are not shown on plate 1 or on the derivative maps. However, data from these holes have been used to construct the derivative maps. These data may be obtained by contacting RMEC.

Coal resources were calculated using data obtained from the coal isopach maps (plates 4, 7, 10, and 13). The coal bed acreage (measured by planimeter) multiplied by the average isopached thickness of the coal bed, and by a conversion factor of 1,770 short tons of coal per acre-foot (13,018 metric tons per hectare-meter) for subbituminous coal, or 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. 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) for bituminous coal and a maximum depth of 1,000 feet (305 m) for bituminous and subbituminous coal.

Reserve Base and Reserve tonnages for the Lance [1], Lance [2], Lance [3], Lower Deadman, Upper Deadman, and Deadman beds are shown on plates 6, 9, and 15, and are rounded to the nearest 10,000 short tons (9,072 metric tons). Coal Reserve Base tonnages per Federal section are shown on plate 2 and total approximately 88.85 million short tons (80.60 million metric tons) for the entire quadrangle, including tonnages from the isolated data points. Reserve Base tonnages in the various development potential categories for surface and subsurface mining methods are shown in tables 2 and 3. The source of each indexed data point shown on plate 1 as listed in table 4.

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 of 5 feet (1.5 m) or more thick 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 the development potential in the high, moderate, or low categories. The areas influenced by isolated data points in this quadrangle contain approximately 670,000 short tons (608,000 metric tons) of coal available for surface mining.

The coal development potential for surface mining methods is shown on plate 16. Of the Federal land areas having a known development potential for surface mining methods, 52 percent are rated high, 11 percent are rated moderate, and 37 percent are rated low. The remaining Federal lands within the KRCRA boundary are classified as having unknown development potential for surface mining methods.

Development Potential for Subsurface and In-Situ Mining 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 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 development potential for in-situ mining methods.

Areas of high, moderate, and low development potential for conventional subsurface mining are defined as areas underlain by coal beds of Reserve Base thickness at depths ranging from 200 to 1,000 feet (61 to 305 m), 1,000 feet to 2,000 feet (305 to 610 m), and 2,000 to 3,000 feet (610 to 914 m), below the ground surface, 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 those areas influenced by isolated data points and to the areas where no known coal beds of Reserve Base thickness occur. The areas influenced by isolated data points in this quadrangle contain approximately 5,350,000 short tons (4,854,000 metric tons) of coal available for subsurface mining.

The coal development potential for conventional subsurface mining methods is shown on plate 17. All of the Federal land areas classified as having known development potential for conventional subsurface mining methods are rated high. The remaining Federal land is classified as having unknown development potential for conventional subsurface mining methods.

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 Superior 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
NW¼ NW¼ sec. 20, T. 21 N., R. 100 W., Jim Bridger Mine (Glass, 1975)	Deadman bed, Fort Union Formation	A	19.5	32.6	42.0	5.9	0.5	--	--	--	--	--	9,270
		C	0.0	40.5	52.1	7.4	0.6	--	--	--	--	--	11,520
SW¼ sec. 16, T. 18 N., R. 100 W., Rock Springs-Gibraltar Mine (Yourston, 1955)	Lance Formation undifferentiated	A	20.8	28.4	47.1	3.7	0.4	--	--	--	--	--	9,910
		C	0.0	35.8	59.5	4.7	0.5	--	--	--	--	--	12,510
SW¼ sec.26, T. 20 N., R. 101 W., Point of Rocks Mine (Dobbin, 1944)	Lower bed, Almond Formation	A	16.6	30.2	44.0	9.2	0.7	--	--	--	--	--	9,410
		C	0.0	36.3	52.7	11.0	0.8	--	--	--	--	--	11,290
SE¼ NW¼ sec. 20, T. 21 N., R. 102 W., Superior D Mine (U.S. Bureau of Mines, 1931)	Rock Springs No. 1 bed, Rock Springs Formation	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

Form of Analysis: A, as received

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 Superior 15-minute quadrangle, Sweetwater County, Wyoming

Coal Bed or Zone	High Development Potential	Moderate Development Potential	Low Development Potential	Total
Upper Deadman	230,000	40,000	0	270,000
Lower Deadman	3,290,000	2,840,000	9,470,000	15,600,000
Lower Lance {3}	1,330,000	570,000	3,540,000	5,440,000
Lower Lance {2}	10,000	30,000	70,000	110,000
Lower Lance {1}	1,000,000	380,000	1,270,000	2,650,000
Total	5,860,000	3,860,000	14,350,000	24,070,000

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 Suprior 15-minute quadrangle, Sweetwater County, Wyoming

Coal Bed or Zone	High Development Potential	Moderate Development Potential	Low Development Potential	Total
Deadman	32,910,000	0	0	32,910,000
Lower Deadman	21,330,000	0	0	21,330,000
Lower Lance {3}	1,570,000	0	0	1,570,000
Lower Lance {1}	2,950,000	0	0	2,950,000
Total	58,760,000			58,760,000

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

Table 4. -- Sources of data used on plate 1 (CRO Map)

Plate 1 Index Number	Source	Data Base
1	Coquina Oil Corp.	Oil/gas well No. 1 Amoco Blue Cheese
2	Rocky Mountain Energy Co., (no date) unpublished data	PP & L Drill hole No. 11
3	LaPoint, 1977, U.S. Geological Survey, unpublished map	Measured Section No. 21
4	Rocky Mountain Energy Co., (no date), unpublished data	Drill hole No. 1, line A
5	↓	Drill hole No. 2, line A
6	Glass, 1975, Wyoming Geological Survey Report of Investigations No. 11	Measured Section No. 74-20
7	Rocky Mountain Energy Co., (no date), unpublished data	Drill hole No. 3, line A
8	↓	Drill hole No. 4, line A
9	LaPoint, 1977, U.S. Geological Survey, unpublished map	Measured Section No. 42
10	↓	Measured Section No. 43
11	↓	Measured Section No. 44
12	↓	Measured Section No. 45
13	↓	Measured Section No. 46
14	Rocky Mountain Energy Co., (no date), unpublished data	PP & L Drill hole No. 110
15	↓	PP & L Drill hole No. 107

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Table 4. -- Continued

Plate 1 Index Number	Source	Data Base
16	Davis Oil Co.	Oil/gas well No. 1 Federal-"B"
17	LaPoint and Pike, 1977, U.S. Geological Survey, Open-File Report 77-117	Drill hole No. RS-6-S
18	True Oil Co.	Oil/gas well No. 14-4 Clark-Federal
19	LaPoint, 1977, U.S. Geological Survey, unpublished map	Measured Section No. 15
20	Rocky Mountain Energy Co., (no date), unpublished data	Drill hole No. 1, line A
21	LaPoint, 1977, U.S. Geological Survey, unpublished map	Measured Section No. 29
22	↓	Measured Section No. 16
23	Rocky Mountain Energy Co., (no date), unpublished data	Drill hole No. 2, line A
24	LaPoint, 1977, U.S. Geological Survey, unpublished map	Measured Section No. 17
25	↓	Measured Section No. 18
26	↓	Measured Section No. 30
27	↓	Measured Section No. 31
28	↓	Measured Section No. 32
29	Rocky Mountain Energy Co., (no date), unpublished data	Drill hole No. 1, line A
30	LaPoint, 1977, U.S. Geological Survey, unpublished map	Measured Section No. 19

Table 4. -- Continued

Plate 1 Index Number	Source	Data Base
31	Rocky Mountain Energy Co., (no date), unpublished data	Drill hole No. 2, line A
32	LaPoint, 1977, U.S. Geological Survey, unpublished map	Measured Section No. 33
33	LaPoint, 1977, U.S. Geological Survey, unpublished map	Measured Section No. 20
34	Rocky Mountain Energy Co., (no date), unpublished data	PP & L Drill hole No. 159
35	↓	PP & L Drill hole No. 160
36	↓	PP & L Drill hole No. 158
37	↓	Drill hole No. 2, line A
38	↓	Drill hole No. 3, line A
39	LaPoint and Pike, 1977, U.S. Geological Survey Open-File Report 77-117	Drill hole No. RS-14-S
40	LaPoint, 1977, U.S. Geological Survey, unpublished map	Measured Section No. 37
41	↓	Measured Section No. 38
42	True Oil Co., Bluewater Oil Co., and Reserve Oil and Gas Co.	Oil/gas well No. 44-14 Federal
43	LaPoint, 1977, U.S. Geological Survey, unpublished map	Measured Section No. 34
44	Rocky Mountain Energy Co., (no date), unpublished data	Drill hole No. 1, line A

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Table 4. -- Continued

Plate 1 Index Number	Source	Data Base
45	LaPoint, 1977, U.S. Geological Survey, unpublished map	Measured Section No. 35
46	Rocky Mountain Energy Co., (no date), unpublished data	Drill hole No. 2, line A
47	LaPoint, 1977, U.S. Geological Survey, unpublished map	Measured Section No. 36
48	↓	Measured Section No. 39
49	Rocky Mountain Energy Co., (no date), unpublished data	Drill hole No. 1, line A
50	LaPoint, 1977, U.S. Geological Survey, unpublished map	Measured Section No. 40
51	Rocky Mountain Energy Co., (no date), unpublished data	Drill hole No. 1, line A
52	LaPoint, 1977, U.S. Geological Survey, unpublished map	Measured Section No. 41
53	Rocky Mountain Energy Co., (no date), unpublished data	Drill hole No. 1, line A
54	↓	Drill hole No. 1, line A
55	↓	Drill hole No. 2, line A
56	LaPoint, 1977, U.S. Geological Survey, unpublished map	Measured Section No. 58
57	↓	Measured Section No. 59
58	↓	Measured Section No. 60
59	Rocky Mountain Energy Co., (no date), unpublished data	Drill hole No. 1, line A

Table 4. -- Continued

Plate 1 Index Number	Source	Data Base
60	Rocky Mountain Energy Co., (no date), unpublished data	Drill hole No. 2, line A
61		Drill hole No. 1 line A
62	Alvin C. Hope	Oil/gas well No. 1-20 Federal
63	William Gruenerwold	Oil/gas well No. 1 Pierce
64	Rocky Mountain Energy Co., (no date), unpublished data	Drill hole No. 1, line A
65		Drill hole No. 2, line A
66		Drill hole No. 2, line A
67		Drill hole No. 1, line A
68		Drill hole No. 1, line A
69		Drill hole No. 2, line A
70		Drill hole No. 1, line A
71		Drill hole No. 3, line A
72		Drill hole No. 2, line A

Table 4. -- Continued

Plate 1 Index Number	Source	Data Base
73	LaPoint, 1977, U.S. Geological Survey, unpublished map	Measured Section No. 14
74	LaPoint and Pike, 1977, U.S. Geological Survey Open-File Report 77-117	Drill hole No. RS-4-S
75	Rocky Mountain Energy Co., (no date), unpublished data	Drill hole No. 1, line A
76	↓	Drill hole No. 3, line A
77		Drill hole No. 2, line A
78	Rocky Mountain Energy Co., (no date), unpublished data	Drill hole No. 1, line A
79	Union Pacific Railroad (E. B. Hall and Co.)	Oil/gas well No. 41-35D U.P.R.R.
80	Rocky Mountain Energy Co., (no date), unpublished data	Drill hole No. 2, line A

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