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COAL RESOURCE OCCURRENCE AND COAL DEVELOPMENT POTENTIAL MAPS OF THE POINT OF ROCKS QUADRANGLE, SWEETWATER COUNTY, WYOMING

[Report includes 22 plates]

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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 Point of Rocks 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 Published and unpublished public information available through March, 1979, was used as the data base for this study. No new drilling or field mapping was performed, nor was any confidential data used.

Location

The Point of Rocks quadrangle is located in central Sweetwater County, approximately 21 miles (34 km) northeast of the city of Rock Springs and 80 miles (129 km) west of the Rawlins, Wyoming, via Interstate Highway 80. Except for the town of Point of Rocks, located in the east-central part of the quadrangle, the area is unpopulated.

Accessibility

Interstate Highway 80 runs east-west across the center of the quadrangle. An improved light-duty road follows the old Overland Trail south from Interstate Highway 80 at Point of Rocks and crosses the southeastern corner of the quadrangle. A second improved light-duty road follows Deadman Wash across the northeast corner of the quadrangle. Several other unimproved dirt roads and trails provide access to the remainder of the quadrangle.

The main east-west line of the Union Pacific Railroad crosses the west-central part of the quadrangle, then turns south along Bitter Creek through the southeastern corner of the quadrangle. This main line provides service through southern Wyoming connecting Ogden, Utah to the west with Omaha, Nebraska to the east.

Physiography

The Point of Rocks quadrangle lies on the eastern flank of the Rock Springs uplift. The landscape within the quadrangle is characterized by escarpments with long dip slopes, buttes and valleys. Altitudes range from approximately 6,440 feet (1,963 m) on Bitter Creek along the west-central edge of the quadrangle to 7,440 feet (2,268 m) in the southwestern part of the quadrangle.

Bitter Creek flows northerly from the southeastern corner of the quadrangle to the town of Point of Rocks and then flows westerly through the center of the quadrangle. Deadman Wash and Coon Draw, tributaries of Bitter Creek, drain the northern part of the quadrangle. All streams 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). Temperatures during January average 18°F (-8°C), and range 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, rabbitbrush, mountain mahogany, juniper, and grasses (U.S. Bureau of Land Management, 1978).

Land Status

The Point of Rocks quadrangle lies on the western edge of the Rock Springs Known Recoverable Coal Resource Area (KRCRA). Approximately three quarters of the quadrangle lies within the KRCRA boundary and the Federal government owns the coal rights for less than half of this area, as shown on plate 2. No outstanding Federal coal leases occur within the quadrangle.

GENERAL GEOLOGY

Previous Work

Schultz included the Point of Rocks quadrangle in a description of the geology and coal resources of the northern part of the Rock Springs coal field in 1909. Dobbin (1944) mapped and described the Superior coal district located a few miles to the northwest of the quadrangle. In 1950 and 1955 Hale described the stratigraphy and depositional history of the formations cropping out on the flanks of the Rock Springs uplift. 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. Weimer (1960), Smith (1961), Lewis (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 environment of Upper Cretaceous formations exposed on the flanks of the Rock Springs uplift was also described by Weimer (1961) and Douglass and Blazzard (1961). 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. Roehler and others described the geology and coal resources of the Rock Springs uplift in 1977. Roehler (1977a) mapped the geology of the Point of Rocks SE quadrangle to the south and prepared a geologic map of the Rock Springs uplift and adjacent areas (1977b). LaPoint and Pike (1977) prepared lithologic and geophysical logs of coal test holes drilled by the U.S. Geological Survey in the Point of Rocks quadrangle in 1976. Madden mapped the geology and coal outcrops of the Point of Rocks quadrangle (1977a) and of the Bitter Creek NW quadrangle (1977b). In 1978, Roehler correlated coal beds in the Rock Springs Formation using measured sections. Unpublished data from Rocky Mountain Energy Company (RMEC) also provided coal thickness information.

Stratigraphy

The formations cropping out in northwest-trending bands across the Point of Rocks quadrangle are Late Cretaceous in age. The Rock Springs Formation, the Almond Formation, and the Lance Formation contain coal within this quadrangle.

The Baxter Shale of Late Cretaceous age does not crop out in the quadrangle but occurs in the subsurface where it ranges in thickness from approximately 3,800 to 4,300 feet (1,158 to 1,311 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 is non-coal-bearing (Hale, 1950 and 1955; Smith, 1961).

The Mesaverde Group of Late Cretaceous age conformably overlies the Baxter Shale, and 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 does not crop out in the quadrangle, but occurs in the subsurface. Oil and gas wells drilled in the quadrangle indicate that it ranges in thickness from approximately 760 to 900 feet (232 to 274 m). The lower part of the formation is composed of a thick series of light-brown to brown, thin-bedded to massive, very fine to medium-grained sandstones overlain by light-brownish-gray silty to sandy shale. The upper part of the formation consists of light-brown sandy shales, siltstones, and thin gray fine- to medium-grained sandstones which grade into the overlying Rock Springs Formation (Hale, 1950 and 1955; Douglass and Blazzard, 1961; Smith, 1961; Keith, 1965).

The Rock Springs Formation, conformably overlying the Blair Formation, crops out in the southwestern third of the quadrangle (Madden, 1977a). It ranges in thickness from approximately 1,500 to 1,780 feet (457 to 543 m) where measured in the oil and gas wells drilled in the quadrangle. It thickens to the south and east. In the northwestern part of the Rock Springs uplift, the Rock Springs Formation consists of a sequence of paludal coals, carbonaceous shales, siltstones, claystones, and sandstones. These paludal sedimentary rocks intertongue to the southeast with white to light-gray, fine- to medium-grained littoral sandstone. These, in turn, change to gray marine shale and associated thin very fine grained sandstone in the southeastern part of the Rock Springs uplift. In the Point of Rocks quadrangle, the littoral and barrier sandstones of the Rock Springs Formation have become thicker and more common while the coal-bearing zone has become thinner and less frequent. Rock Springs Formation coals crop out along the southwestern and western edge of the quadrangle (Hale, 1950 and 1955; Smith, 1961; Keith, 1965; Madden, 1977a).

The Ericson Sandstone crops out in a northwest-trending band through the central part of the quadrangle where it conformably overlies the Rock Springs Formation (Madden, 1977a). It ranges in thickness from approximately 825 to 880 feet (251 to 268 m) where measured in the oil and gas wells drilled in the quadrangle. The upper and lower sections of the Ericson Sandstone consist of light-gray, massive, well-bedded, fine- to medium-grained sandstone with occasional coarse-grained to conglomeratic lenses. These are separated by a middle section of gray shale and rusty-weathering sandstone. This middle section, often referred to as the "rusty zone", is approximately 400 feet (122 m) thick to the south in the Point of Rocks SE quadrangle (T. 18 N., R. 101 W.) but thins to the north (Hale, 1950 and 1955; Smith, 1961).

The Almond Formation conformably overlies the Ericson Sandstone and crops out along the southeastern edge and across the northeastern third of the quadrangle (Madden, 1977a). It is approximately 500 to 1,000 feet (152 to 305 m) thick where measured in oil and gas wells drilled in adjacent quadrangles. The lower section of the forma tion 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).

The Lewis Shale of Late Cretaceous age conformably overlies the Almond Formation and crops out in a northwest-trending band across the northeast corner of the quadrangle (Madden, 1977a). It ranges in thickness from approximately 450 to 700 feet (137 to 213 m) in surrounding quadrangles. Weimer and Land (1975) indicate that the Lewis Shale is approximately 650 feet (198 m) thick where measured north of Interstate Highway 80 near Point of Rocks. The Lewis Shale 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; Land, 1972).

The Fox Hills Sandstone of Late Cretaceous age crops out in a narrow northwest-trending band across the northeast corner of the quadrangle (Madden, 1977a) where it conformably overlies and intertongues with the Lewis Shale. The formation ranges in thickness from approximately 60 to 250 feet (18 to 76 m) thick in surrounding quadrangles. The Fox Hills Sandstone is composed of a lower light-brown, very fine to fine-grained, thin-bedded, silty sandstone overlain by a light-tan to very light-gray fine- to medium-grained, massive cliff-forming sandstone. The two types of sandstone are separated by a marked erosional or scour surface (Land, 1972).

The Lance Formation of Late Cretaceous age conformably overlies and intertongues with the Fox Hills Sandstone. It crops out in the northeastern corner of the Point of Rocks quadrangle (Madden, 1977a). This formation is approximately 600 to 900 feet (183 to 274 m) thick where measured in surrounding quadrangles and consists of thin, silty fine-grained sandstone interbedded with carbonaceous shale and coal (Hale, 1950 and 1955; Land, 1972; Roehler and others, 1977).

Recent deposits of alluvium cover the stream valleys of Bitter Creek, Deadman Wash and Coon Draw.

Formations of Cretaceous age in the Point of Rocks 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 and 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; Douglass and Blazzard, 1961).

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

Sediments 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).

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).

As the Cretaceous sea regressed eastward, the lower finer-grained sandstone of the Fox Hill Sandstone was deposited in littoral and near-shore marine environments while the upper coarser-grained sandstone was deposited in estuarine or tidal river channel environments (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; Roehler and others, 1977).

Structure

The Point of Rocks quadrangle lies on the eastern flank of the Rock Springs uplift adjacent to the Great Divide structural basin. The Rock Springs uplift is a doubly plunging asymmetric anticline with the 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 the beds dipping 4° to 7° to the northeast. In the southern half of the quadrangle, several normal faults perpendicular to the strike of the beds have formed down-dipped blocks (Madden, 1977a). Horizonal displacement of these faults can be as great as 3 miles (4.8 km) with vertical displacement of several hundred feet (Yourston, 1955). One of these faults cuts out part of the Blair Formation in the True Oil No. 11-12 Brown-Federal well in sec. 12, T. 19 N., R. 101 W.

COAL GEOLOGY

Coal beds have been identified in three formations in the Point of Rocks quadrangle (plate 1). A few thin deltaic coal beds of the Rock Springs Formation crop out in the southwestern part of the quadrangle and several thin Rock Springs coal beds were also encountered in the oil and gas wells drilled in the quadrangle. The coal-bearing Almond Formation lies approximately 850 feet (259 m) stratigraphically above the top of the Rock Springs Formation and its coal beds crop out in a northwest trending band across the entire quadrangle. In addition, several coal beds of the Lance Formation crop out in the extreme northeastern corner of the quadrangle. The Lance Formation overlies and is separated from the Almond Formation by approximately 785 feet (239 m) of the marine Lewis Shale and the Fox Hills Sandstone.

Chemical analyses of coal.--Analyses of the coals in this area, and the sampled locations, are listed in table 1. In general, chemical analyses indicate that the coals in the Almond Formation range in rank from subbituminous B to subbituminous A; coals in the Lance Formation rank as subbituminous B; and the coal in the Rock Springs Formation ranks as high-volatile bituminous C. These coals were ranked on a moist, mineral-matter-free basis according to ASTM Standard Specification D 388-77 (American Society for Testing and Materials, 1977).

Chemical analyses were not available in this quadrangle for coals in the Lance and Rock Springs Formations. However, it is believed that these coals are similar to the Lance and Rock Springs coals mined, respectively, at the Rock Springs-Gibralter mine in the adjacent Black Buttes quadrangle to the southeast and the Superior D mine in the southest quarter of the Superior 15-minute quadrangle to the northwest.

Coal Beds of the Rock Springs Formation

The thicker coal beds in 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), which is in contrast with the Point of Rocks area where the formation is predominantly deltaic in nature. Numerous thin coal beds in the Rock Springs Formation have been penetrated by drill holes and identified in outcrops in this quadrangle, but only one of these beds, the RS[1], is greater than Reserve Base thickness (5.0 feet or 1.5 meters) and has been treated as an isolated data point (see Isolated Data Points section of this report).

Coal Beds of the Almond Formation

Five Almond Formation coal beds of Reserve Base thickness were mapped within the quadrangle. These coal beds are not formally named and have been given bracketed numbers for identification purposes in this quadrangle only. Many of the Almond coal beds in the southeastern part of the Rock Springs uplift have been named by Roehler and others (1977). Madden (oral communication, 1979) has also tentatively named two of the thicker coal beds in this area. Because of the lagoonal nature of the coal beds, correlations over wide areas are difficult.

Almond [1] Coal Bed

The Almond [1] coal bed is, stratigraphically, the lowest isopached coal bed (plate 4) in the quadrangle and has been tentatively named the Wyoming bed (Madden, oral communication, 1979). The coal bed attains a maximum thickness in sec. 27, T. 20 N., R. 101 W., where it is 9 feet (2.7 m) thick. Roehler and others (1977) reported that the Wyoming bed is 5.7 feet (1.7 m) thick where mined in sec. 27. This coal bed has not been correlated with any other Almond coal beds in surrounding quadrangles.

Almond [2] Coal Bed

The Almond [2] coal bed lies approximately 25 feet (7.6 m) above the Almond [1] coal bed. As shown on plate 6, the Almond [2] coal bed thickens locally to 8.5 feet (2.6 m) in sec. 35, T. 20 N., R. 101 W.

Almond [3] Coal Bed

The Almond [3] coal bed, lying approximately 25 feet (7.6 m) stratigraphically above the Almond [2] coal bed, has been isopached on plate

10. Like most of the Almond coal beds, it is lenticular and thickens irregularly. It attains a maximum measured thickness of 7.5 feet (2.3 m) in the southeastern corner of the quadrangle. This coal bed has been traced into the Bitter Creek NW quadrangle to the east, where it is less than Reserve Base thickness (Madden, 1977b).

Almond [4] Coal Bed

The Almond [4] coal bed has been tentatively correlated with the Lebar coal bed in the Black Buttes quadrangle to the south. The Lebar coal bed, named by the Black Butte Coal Company, is 7.7 to 8.7 feet (2.3 to 2.7 m) thick in T. 18-19 N., R. 100-101 W. (Roehler and others, 1977). In the Point of Rocks quadrangle, this coal bed attains a thickness of 11.8 feet (3.6 m) in sec. 8, T. 20 N., R. 101 W. The Lebar coal bed has been mapped in the Bitter Creek NW quadrangle (Madden, 1977b) where it attains a maximum reported thickness of 8 feet (2.4 m). It also extends into the southeast quarter of the Superior 15-minute quadrangle, where it is named the Almond [3] coal bed. A maximum measured thickness of 7.5 feet (2.3 m) was recorded in that quadrangle.

Almond [5] Coal Bed

The Almond [5] coal bed, uppermost of the isopached Almond coal beds, lies stratigraphically above the Almond [4] bed. The Almond [5] coal bed may possibly correlated with the Lebar Rider coal bed, named by the Black Butte Coal Company (Roehler and others, 1977), which lies 15 to 20 feet (4.6 to 6.1 m) above the Lebar coal bed in the Black Buttes quadrangle. In this quadrangle, the Almond [5] coal bed is generally less than Reserve Base thickness, although it thickens to 7.9 feet (2.4 m), including an unknown thickness of rock partings, in sec. 8, T. 20 N., R. 101 W.

Coal Beds of the Lance Formation

Several coal beds of the Lance Formation crop out in the northeastern corner of the quadrangle. The coal is commonly interbedded with sandstone and shale that contains oyster shells and other brackish-water mollusks, suggesting deposition in swampy lagoons that formed behind barrier bars of sand (Roehler and others, 1977).

Because the coal beds are lenticular, frequently split or channeled out, they are difficult to correlate and have been assigned bracketed numbers for identification purposes in this report.

Lance [1] Coal Bed

The Lance [1] coal bed exceeds Reserve Base thickness only in a small area, as shown on plate 10, but the coal bed thickens to the east in the Bitter Creek NW quadrangle where coal thicknesses in excess of 10 feet (3.0 m) have been reported (Madden, 1977b). Since the Lance [1] coal bed is, stratigraphically, the lowest coal bed in the formation, it may correlate with the Hall coal bed mapped near the base of the formation in the Black Buttes quadrangle (Roehler and others, 1977).

Lance [2] Coal Bed

The isopach map of the Lance [2] coal bed is shown on plate 6. The coal bed lies approximately 90 feet (27 m) above the base of the formation and attains a maximum measured thickness of 7.5 feet (2.3 m) in sec. 2, T. 20 N., R. 101 W. This coal bed extends into the Bitter Creek NW quadrangle to the east, where a coal measurement of 9.5 feet (2.9 m) was recorded in sec. 1, T. 20 N., R. 101 W.

Lance [3] Coal Bed

The Lance [3] coal bed is, stratigraphically, the uppermost of the isopached coal beds within the quadrangle. It lies approximately 115 feet (35 m) above the base of the formation and exceeds 7 feet (2.1 m) in thickness, where mapped in secs. 1 and 2, T. 20 N., R. 101 W. The coal bed has been traced into the Bitter Creek NW quadrangle where thicknesses up to 10 feet (3.0 m) have been measured (Madden, 1977b).

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 coal beds. Therefore, where coal beds of Reserve Base thickness are encountered at only one location, they are treated as isolated data points and 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.

Source	Location	Coal Bed	Thickness
LaPoint, 1977	sec. 34, T. 21 N., R. 101 W.	A1	7 feet (2.1 m)
Prenalta Corp.	Sec. 34, T. 21 N., R. 101 W.	RS	6 feet (1.8 m)

COAL RESOURCES

Information from oil and gas wells, and from coal test holes drilled by RMEC and the U.S. Geological Survey, as well as measured sections by Madden (1977a), 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 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, 14, and 18). 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 the isopached coal bed. Coal beds thicker than 5 feet (1.5 m) 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 both bituminous and subbituminous coal.

Reserve Base and Reserve tonnages for the isopached beds are shown on plates 9, 13, 17, and 20, 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 10.12 million short tons (9.18 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.

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 as follows:

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

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 5.0 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, 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 the isolated data points in this quadrangle contain approximately 0.67 million short tons (0.61 million metric tons) of coal available for surface mining.

The coal development potential for surface mining methods is shown on plate 21. Of the Federal land areas having a known development potential for surface mining methods, 95 percent are rated high and 5 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 include those areas where 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 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 the isolated data points in this quadrangle contain approximately 1.24 million short tons (1.12 million metric tons) of coal available for conventional subsurface mining.

The coal development potential for subsurface mining methods is shown on plate 22.

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 Point of Rocks 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
SW¼, sec. 16, T. 18 N., R. 100 W., (Yourston, 1955) (Rock Springs-Gilbraltar Mine)	Lance Formation	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., (Dobbin, 1944) (Point of Rocks Mine)	Upper bed, Almond Formation	A	17.9	29.5	49.3	3.3	0.5	-	-	-	-	-	10,220
		C	0.0	36.0	60.0	4.0	0.6	-	-	-	-	-	12,450
SW¼, sec. 26, T. 20 N., R. 101 W., (Dobbin, 1944) (Point of Rocks Mine)	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., (Bureau of Mines, 1931) (Superior D Mine)	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
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 Point of Rocks quadrangle, Sweetwater County, Wyoming.

Coal Bed or Zone	High Development Potential	Moderate Development Potential	Low Development Potential	Unknown Development Potential	Total
La {3}	30,000	20,000	80,000	-0-	130,000
La {2}	130,000	80,000	350,000	-0-	560,000
La {1}	10,000	-0-	-0-	-0-	10,000
Al {5}	1,930,000	-0-	-0-	-0-	1,930,000
Al {4}	2,710,000	1,060,000	840,000	-0-	4,610,000
Al {3}	350,000	370,000	160,000	-0-	880,000
Al {1}	-0-	-0-	10,000	-0-	10,000
Isolated Data Points	-0-	-0-	-0-	670,000	670,000
Totals	5,160,000	1,530,000	1,440,000	670,000	8,800,000

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 Point of Rocks quadrangle, Sweetwater County, Wyoming.

Coal Bed or Zone	High Development Potential	Moderate Development Potential	Low Development Potential	Unknown Development Potential	Total
La {2}	70,000	-0-	-0-	-0-	70,000
Al {1}	10,000	-0-	-0-	-0-	10,000
Isolated Data Points	-0-	-0-	-0-	1,240,000	1,240,000
Totals	80,000	-0-	-0-	1,240,000	1,320,000

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	Madden, 1977a, U.S. Geological Survey, unpublished data	Measured Section No. 17
2	True Oil Co.	Oil/gas well No. 11-2 Texaco-Federal
3	Madden, 1977a, U.S. Geological Survey, unpublished data	Measured Section No. 18
3	↓	Measured Section No. 19
5	Kenneth D. Luff, Inc.	Oil/gas well No. 3-3 Amoco-Champlin
6	Forest Oil Co.	Oil/gas well No. 4-1 Shiprock-Federal
7	Madden, 1977a, U.S. Geological Survey, unpublished data	Measured Section No. 21
8	↓	Measured Section No. 22
9	↓	Measured Section No. 23
10	True Oil Co.	Oil/gas well No. 11-12 Brown-Federal
11	Madden, 1977a, U.S. Geological Survey, unpublished data	Measured Section No. 24
12	Chandler and Simpson, Inc.	Oil/gas well No. 1 Simpson-Gov't.
13	Rocky Mountain Energy Co., (no date), unpublished data	Drill hole No. 4, line A
14	↓	Drill hole No. 1, line A

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Table 4. -- Continued

Plate 1 Index Number	Source	Data Base
15	Madden, 1977a, U.S. Geological Survey, unpublished data	Measured Section No. 27
16	↓	Measured Section No. 28
17	↓	Measured Section No. 29
18	↓	Measured Section No. 30
19	Amoco Production Co.	Oil/gas well No. 1 Champlin 195-Amoco A-1
20	True Oil Co.	Oil/gas well No. 42-8 YHS-Federal
21	LaPoint and Pike, 1977, U.S. Geological Survey Open-File Report 77-117	Drill hole No. RS-9-S
22	Amoco Production Co.	Oil/gas well No. 172 Champlin 1-A
23	Chandler and Simpson, Inc.	Oil/gas well No. 1 Gov't-Campbell
24	Prenalta Corp.	Oil/gas well No. 14 Gov't. (14-18-20-101)
25	Madden, 1977a, U.S. Geological Survey, unpublished data	Measured Section
26	Signal Explorations, Inc.	Oil/gas well No. 19-2 Masterson

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Table 4. -- Continued

Plate 1 Index Number	Source	Data Base
27	Champlin Oil and Refining Co.	Oil/gas well No. 1 Federal-Ferguson
28	Kenneth D. Luff, Inc.	Oil/gas well No. 21-1 Shiprock
29	Madden, 1977a, U.S. Geological Survey, unpublished data	Measured Section No. 3
30	Forest Oil Co.	Oil/gas well No. 22-1 Shiprock-Federal
31	Fundamental Oil Co.	Oil/gas well No. 1-26 Federal
32	Smokey Oil Co.	Oil/gas well No. 11-26 Coon Draw Unit
33	Madden, 1977a, U.S. Geological Survey, unpublished data	Measured Section No. 10
34	↓	Measured Section No. 11
35	↓	Measured Section No. 4
36	↓	Measured Section No. 5
37	↓	Measured Section No. 6
38	↓	Measured Section No. 8
39	↓	Measured Section No. 9

Table 4. -- Continued

Plate 1 Index Number	Source	Data Base
40	Prenalta Corp.	Oil/gas well No. 21-Gov't (21-30-20-101)
41	Texaco, Inc.	Oil/gas well No. 1-B Vula O'Connel-Gov't
42	↓	Oil/gas well No. 1 L.L. Roberts-Gov't
43	Signal Explorations, Inc.	Oil/gas well No. 34-1 Shiprock (BLM)
44	Madden, 1977a, U.S. Geological Survey, unpublished data	Measured Section No. 12
45		Measured Section No. 13
46		Measured Section No. 14
47		Measured Section No. 15
48		Measured Section No. 16
49	↓	Measured Section
50	Amoco Production Co.	Oil/gas well No. 89-Champlin-1-Amoco

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Table 4. -- Continued

Plate 1 Index Number	Source	Data Base
51	Prenalta Corp.	Oil/gas well No. 43 (43-24-20-102)
52	Rocky Mountain Energy Co., (no date), unpublished data	Drill hole No. 1AS
53	Amoco Production Co.	Oil/gas well No. 115 Champlin-1-Amoco
54	Madden, 1977a, U.S. Geological Survey, unpublished data	Measured Section
55	↓	Measured Section No. 25
56	↓	Measured Section No. 26
57	↓	Measured Section
58	↓	Measured Section
59	Prenalta Corp.	Drill hole No. 14-Gov't (14-34-21-101)
60	U.S. Geological Survey, 1970, Inactive Coal Lease No. Wyoming-20884	Drill hole No. K-2
61	LaPoint and Pike, 1977, U.S. Geological Survey Open-File Report 77-117	Drill hole No. RS-8-S
62	Prenalta Corp.	Oil/gas well No. 12 (12-36-21-101)
63	↓	Oil/gas well No. 44 State

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