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COAL RESOURCE OCCURRENCE AND COAL DEVELOPMENT POTENTIAL MAPS OF THE SEAVERSON RESERVOIR QUADRANGLE, CARBON COUNTY, WYOMING

[Report includes 31 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 Seaverson Reservoir quadrangle, Carbon 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 Published and unpublished public information was used as the data base for this study.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 Seaverson Reservoir quadrangle is located in south-central Wyoming in the western portion of Carbon County, approximately 23 miles (37 km) southwest of Rawlins and 12 miles (19 km) southeast of Wamsutter, Wyoming. The area is unpopulated.

Accessibility

Wyoming Highway 789 runs north-south just west of the quadrangle boundary and joins Interstate Highway 80 approximately 7 miles (11 km) to the north. The remainder of the quadrangle is accessible by a network of unimproved dirt roads and trails.

The main east-west Union Pacific Railroad line, providing service through southern Wyoming, runs approximately 6 miles (10 km) to the north of the quadrangle. This railway connects Ogden, Utah to the west and Omaha, Nebraska to the east.

Physiography

The Seaverson Reservoir quadrangle is located in the Red Desert region on the southern edge of the Great Divide Basin. The landscape

within the quadrangle is characterized by relatively low terrain, gentle cuestas, and badland topography. The southern branch of the Continental Divide, which encircles the Great Divide Basin, cuts across the southern portion of the quadrangle. Altitudes vary from approximately 6,800 feet (2,073 m) on Holler Draw in the southwestern corner of the quadrangle to 7,400 feet (2,256 m) on the Continental Divide near the southeastern edge of the quadrangle.

Draining the area north of the Continental Divide, Fillmore Creek and its tributaries in the northern two thirds of the quadrangle flow into Separation Creek, northeast of the quadrangle boundary. In the area south of the Continental Divide, Holler Draw and Chicken Springs Wash are tributaries of Muddy Creek, south of the quadrangle boundary. All streams in the area are intermittant, flowing mainly in response to snowmelt in the spring.

Climate and Vegetation

The climate of south-central Wyoming is semiarid, characterized by low precipitation, rapid evaporation, and large daily temperature variations. Summers are usually dry and mild, and winters are cold. The annual precipitation in the area averages 10.4 inches (26.4 cm). Approximately two thirds of the precipitation falls in the spring and summer during a seven-month period from April through October.

The average annual temperature in the area is 43°F (6°C). The temperature during January averages 21°F (-6°C) and ranges from 12°F (-11°C) to 31°F (-0.6°C). During July the average temperature is 68°F (20°C), and the temperature ranges from 51°F (11°C) to 84°F (29°C) (Wyoming Natural Resources Board, 1966).

The winds are usually from the southwest and the west-southwest with an average velocity of 12 miles per hour (19 km per hr) (U.S. Bureau of Land Management, 1978).

The principal types of vegetation in the quadrangle include grasses, sagebrush, greasewood, saltbush, rabbitbrush, and other desert shrubs.

Land Status

The Seaverson Reservoir quadrangle lies within the central portion of the Rawlins Known Recoverable Coal Resource Area. The entire quadrangle lies within the KRCRA boundary. The Federal government owns the coal rights for approximately one half of this area. One active coal lease is present within the KRCRA boundary, as shown on plate 2.

GENERAL GEOLOGY

Previous Work

Ball (1909) described the coal-bearing Fort Union Formation present in the Seaverson Reservoir quadrangle in his study of the western part of the Little Snake River coal field. Welder and McGreevy (1966) included the quadrangle in a report published on the geology and ground-water resources of the Great Divide Basin. Gill, Merewether, and Cobban (1970) described the stratigraphy of the Upper Cretaceous-age Lance Formation outcropping in the Rawlins area. Sanders made a detailed investigation of the geology and coal resources of the Riner quadrangle to the northeast in 1974 and of the adjacent Creston Junction quadrangle in 1975. Edson and Curtiss (1976) reported on lithologic descriptions and geophysical logs of holes drilled by the U.S. Geological Survey in the Seaverson Reservoir quadrangle in 1975. Recent unpublished data from reconnaissance mapping by Edson (in press, a and b), drilling by Edson and Barclay (in press), and from drilling by the Rocky Mountain Energy Company (RMEC) and the U.S. Geological Survey provided the location of coal outcrops and coal thickness information.

Stratigraphy

The formations exposed in the Seaverson Reservoir quadrangle range in age from Paleocene to Recent. Only the Paleocene-age Fort Union Formation is coal-bearing within the quadrangle.

The Lance Formation of Upper Cretaceous age is present in the subsurface of the Seaverson Reservoir quadrangle, but information from oil and gas wells drilled in the quadrangle indicate the coal-bearing basal portion of the formation is over 4,000 feet (1,219 m) deep. The

Lance Formation is composed of light-brown to dark-gray and greenish-gray, sandy, carbonaceous shale, grading upward into dark-gray, fissile carbonaceous shale. The shale is interbedded with brown to light-brown, very fine to fine-grained sandstone, which may occur in intervals up to 20 feet (6.1 m) thick throughout the formation (Berry, 1960, and Sanders, 1974).

Unconformably overlying the Lance Formation, the Paleocene-age Fort Union Formation crops out throughout the Seaverson Reservoir quadrangle. The Fort Union Formation is approximately 4,000 feet (1,219 m) thick in the quadrangle (Edson, in press, a). At the base of the formation are approximately 600 feet (183 m) of light-gray, thick-bedded to massive, medium- to coarse-grained, generally cross-bedded sandstones containing lenses of well-rounded chert pebbles, interbedded with dark-gray carbonaceous shale. These are overlain by approximately 1,300 feet (396 m) of interbedded light-brown to orange argillaceous siltstone, light-gray fine- to medium-grained sandstone, light- to dark-gray shale and coal. Above these are approximately 1,600 feet (488 m) of poorly exposed beds of arenaceous siltstone and carbonaceous shale. The upper 500 feet (152 m) of the Fort Union Formation consists of gray-brown argillaceous siltstone, brown micaceous sandstone, shale, coal and lignite (Edson, in press, a, and Sanders, 1974 and 1975).

Recent deposits of alluvium cover the stream valleys of Holler Draw, Chicken Springs Wash, and Fillmore Creek and its tributaries. Terrace remnants border Fillmore Creek, and areas of windblown sand and playa-lake clays are present throughout the quadrangle. Gravel derived from older pediment deposits caps many hills and ridges in the quadrangle.

The sediments of the Lance Formation accumulated near the western edge of a widespread Cretaceous sea, and reflect the location of the shoreline. The carbonaceous shales, sandstones, and coal beds were deposited in broad areas of estuarine, marsh, lagoonal, and coastal swamp environments present during the gradual recession of the Cretaceous sea.

After the final withdrawal of the Cretaceous sea, thick sections of detrital material, eroded from older deposits, were deposited as the coarse sandstones at the base of the Fort Union Formation. The siltstones, sandstones, shales, and coals of the Fort Union Formation were deposited in stream, lake, and swamp environments.

Structure

The Seaverson Reservoir quadrangle lies on the eastern end of the Wamsutter Arch, a low, broad, indistinct structure separating the Great Divide Basin to the northwest and the Washakie Basin to the southwest.

Throughout most of the quadrangle, beds strike northeasterly and dip gently to the northwest. Two coal beds correlated in three oil and gas wells drilled in T. 19 N., R. 91 W., indicate a dome-like structure may be present in the northeastern portion of the quadrangle, although it has not been mapped on the surface.

Two small normal faults were mapped by Edson (in press, a) in sec. 2, T. 18 N., R. 92 W.

COAL GEOLOGY

Coal beds of the Lower and Upper Fort Union Coal Zones crop out in portions of the Seaverson Reservoir quadrangle. The zones are separated by approximately 1,600 feet (488 m) of siltstone and carbonaceous shale. Although the Fort Union Formation is the only formation exposed in this quadrangle, the Lance Formation is present in the subsurface in several deep oil and gas wells.

Chemical analyses of coals.--Representative chemical analyses for coals of the Lower and Upper Fort Union Coal Zones are listed in table 1 (Rocky Mountain Energy Company, no date, and Sanders, 1975). These coals are generally subbituminous B or C in rank on a moist, mineral-matter-free basis according to ASTM Standard Specification D 388-77 (American Society for Testing and Materials, 1977).

Lower Fort Union Coal Zone

The Lower Fort Union Coal Zone crops out in the southeastern corner of the quadrangle. The major beds are identified by two names; RMEC uses an alpha-numeric designation (e.g., F2), while generic names (e.g., Red Rim) are used by Edson (in press, a) and others to designate the same coal beds. Both names are used in this report and on CRO maps where applicable. The beds dip to the northwest at an average of 10°, as measured by Edson (in press, a).

Daleys Ranch (G) Coal Bed

The Daleys Ranch or G coal bed is, stratigraphically, the lowest identified coal bed in the Lower Fort Union Coal Zone in this quadrangle. The bed was named for Daleys Ranch located in sec. 32, T. 21 N., R. 89 W. (Edson and Barclay, in press).

A maximum thickness of 12 feet (3.7 m) was recorded for the Daleys Ranch coal bed in secs. 20, 21, and 28, T. 19 N., R. 91 W., with a shale parting ranging from 1 to 2 feet (0.3 to 0.6 m) thick. In sec. 32, T. 19 N., R. 91 W., this coal bed is 9 feet (2.7 m) thick with a parting 4 feet (1.2 m) thick. In the Fillmore Ranch quadrangle to the east, the Daleys Ranch coal bed is 14 feet (4.3 m) thick with a 2-foot (0.6-m) shale parting in sec. 25, T. 19 N., R. 91 W., but pinches out to the northeast and southeast. The dotted line on plates 4, 5 and 6 represents a limit of confidence beyond which isopach and structure contours are not drawn, and resources not identified, because of insufficient data. However, it is believed that the coal bed continues to be of Reserve Base thickness (greater than 5 feet or 1.5 meters) in the area beyond this line. The dip of the coal bed, as derived from plate 4, is less than 3° to the northwest in most areas.

Red Rim (F2) Coal Bed

The Red Rim (F2) coal bed lies stratigraphically above and is separated from the Daleys Ranch coal bed by approximately 220 feet (67 m) of carbonaceous shale and sandstone. The Red Rim coal bed is named for Red Rim ridge located in T. 20 N., R. 90 W., in the northwest quarter of the Bridger Pass 15-minute quadrangle.

A maximum measured thickness of 21 feet (6.4 m) was recorded in an RMEC drill hole located in sec. 27, T. 18 N., R. 91 W. On plate 26, the Red Rim coal bed in the northeast corner of the quadrangle is shown as 26 feet (7.9 m) thick owing to the influence of a measurement of 28.5 feet (8.7 m) in the Fillmore Ranch quadrangle. To the south in the northwest quarter of the Doty Mountain 15-minute quadrangle, Red Rim coal bed thicknesses range from 9 to 11 feet (2.7 to 3.4 m). In general, this bed is prominent and widespread, both in this quadrangle and in the adjacent quadrangles to the east and south, and usually does not contain shale partings. However, shale partings were measured in two drill holes in secs. 8 and 16, T. 18 N., R. 91 W., that range from 3 to 12 feet (0.9 to 3.7 m) in total thickness. The dotted line shown on plates 26, 27, 28, and 29 represents a limit of confidence beyond which isopach and structure contours are not drawn, and resources not identified, because of insufficient data. However, it is believed that the coal bed continues to be of Reserve Base thickness in the area beyond this line. The dip of the bed near the outcrop, as calculated from plate 27, is 8° to the northwest and decreases down-dip to 5° or less.

Olson Draw (E1) Coal Bed

The Olson Draw (E1) coal bed lies stratigraphically above and is separated from the Red Rim coal bed by interbedded sandstone, siltstone and shale that ranges in thickness from 100 to 225 feet (30 to 69 m). This coal bed, designated E1 by RMEC, was named for Olson Draw located in T. 18 N., R. 91 W. (Edson, in press, a).

In this quadrangle, the Olson Draw coal bed reaches 9 feet (2.7 m) in thickness in sec. 10, T. 18 N., R. 92 W. Shale partings are usually, but not always, present in the Olson Draw coal bed and are reported to range from 2 to 10 feet (0.6 to 3.0 m) in thickness. In the Fillmore Ranch quadrangle to the east, the coal bed thickens locally to 10 feet (3.0 m), but is generally less than 5 feet (1.5 m) thick. To the south in the northwest quarter of the Doty Mountain 15-minute quadrangle, the coal bed is not as continuous as it is to the north and east and contains numerous partings. The dip, as derived from plate 8, averages 8° to the northwest near the outcrop and less than 5° down-dip from the outcrop.

FU[1] Coal Bed

The FU[1] coal bed overlies the Olson Draw coal bed and is separated from it by 140 feet (43 m) of carbonaceous shale and siltstone. This coal bed is named with a bracketed number for identification purposes in this and the Fillmore Ranch quadrangles. A maximum thickness of 10 feet (3.0 m) was recorded in a U.S. Geological Survey drill hole located in sec. 22, T. 18 N., R. 91 W. The FU[1] coal bed crops out in the southeast corner of the quadrangle, but appears to pinch out down-dip except for two local thickenings of 5 feet (1.5 m) or more (plate 11). An 8° dip to the northwest, near the outcrop, was calculated from plate 11, decreasing to 3° or less down-dip from the outcrop.

Separation Creek (D1) Coal Bed

The Separation Creek (D1) coal bed occupies a position approximately 150 feet (46 m) stratigraphically above the FU[1] coal bed. The coal bed is named after Separation Creek (Edson, in press, a) in the northeast corner of the Fillmore Ranch quadrangle. A maximum coal thickness of 19 feet (5.8 m), excluding a 6-foot (1.8-m) carbonaceous shale parting, was measured in a drill hole in sec. 28, T. 18 N., R. 91 W (plate 22). In the Fillmore Ranch quadrangle, the bed averages 7 feet (2.1 m) in thickness, thinning to the northeast. To the south in the northwest quarter of the Doty Mountain 15-minute quadrangle, the Separation Creek coal bed splits and is identified as a zone rather than as a single bed. A maximum dip of approximately 8° to the northwest occurs near the outcrop, gradually decreasing down-dip.

Muddy Creek (C) Coal Bed

The Muddy Creek (C) coal bed is stratigraphically above and separated from the Separation Creek coal bed by 80 feet (24.4 m) of shale and siltstone. The coal bed was named by Edson (in press, a) for Muddy Creek, located in the northeastern corner of the northeast quarter of the Doty Mountain 15-minute quadrangle. The thickest coal measurement, 12 feet (3.7 m), was in a drill hole located in sec. 22, T. 18 N., R. 91 W. In the Fillmore Ranch quadrangle, the Muddy Creek coal bed averages 6 feet (1.8 m) in thickness, but thins gradually to the south. Carbonaceous shale partings are common, ranging from 1.0 to 10 feet (0.3

to 3.0 m) in thickness, but are not always present within the coal bed. The average dip, calculated from plate 15, is 9° to the northwest near the outcrop, decreasing to less than 3° down-dip.

Fillmore Ranch (B) Coal Bed

The Fillmore Ranch (B) coal bed is, stratigraphically, the highest isopachable coal bed in the Lower Fort Union Coal Zone, and is found approximately 200 feet (61 m) above the Muddy Creek coal bed. The coal bed was named for Fillmore Ranch (Edson, in press, a) located in sec. 6, T. 18 N., R. 90 W. This important coal bed is the thickest and most extensive of the Lower Fort Union Formation coals. In this quadrangle, the coal bed averages 20 feet (6.1 m) in thickness, with a maximum recorded thickness of 28 feet (8.5 m) in sec. 15, T. 18 N., R. 91 W. This coal bed may contain local thin shale partings up to 3 feet (0.9) thick but these partings are usually less than 1.5 feet (0.5 m) thick. In the Fillmore Ranch quadrangle to the east, the Fillmore Ranch coal bed averages more than 20 feet (6.1 m) thick and remains thick to the south, where it usually contains thin partings. The dotted line shown on plates 18, 19, 20, and 21 represents a limit of confidence beyond which isopach and structure contours are not drawn, and resources not identified, because of insufficient data although it is believed that the bed continues to be of Reserve Base thickness beyond this line. The dip, derived from plate 19, is 7° to the northwest, decreasing down-dip.

Chicken Springs Coal Bed

The Chicken Springs coal bed, as mapped by Edson (in press, a), crops out in the southeastern corner of the quadrangle but does not exceed Reserve Base thickness. This coal bed is considered not to have any development potential in this quadrangle.

Upper Fort Union Coal Zone

The Upper Fort Union Coal Zone contains three previously identified and two unnamed isopachable coal beds in this quadrangle. RMEC used an alpha-numeric system (e.g., D) to designate the coal beds, and Edson (in press, a) used generic names (e.g., Cow Butte) to identify the same

coal beds. Both are used in this report. Bracketed numbers were used for identification purposes to designate the previously unnamed beds.

The Upper Fort Union Coal Zone is approximately 200 feet (61 m) thick and crops out in the extreme northwestern corner of the quadrangle. The dip of the beds in this area averages 4° to the west-northwest as measured by Edson (in press, a).

FU[11] Coal Bed

The FU[11] coal bed was mapped in this quadrangle by extrapolating drill hole data from the High Point quadrangle to the west (plate 4). This coal bed reaches a thickness of 24.5 feet (7.5 m) in sec. 21, T. 19 N., R. 92 W., in the High Point quadrangle, and it is believed that, because of this significant thickness, the coal bed exists at depth within the boundaries of the Seaverson Reservoir quadrangle. Development potential for the FU[11] coal bed is not shown in tables 1 or 2 because the coal bed underlies a coal lease area and non-Federal land.

Cow Butte (D) Coal Bed

The Cow Butte or D coal bed is the lowest identified coal bed in the Upper Fort Union Coal Zone. The bed is named for Cow Butte located in sec. 5, T. 19 N., R. 91 W. (Back, 1976). This coal bed averages 10 feet (3.0 m) in thickness in this quadrangle and thickens to 26.6 feet (8.1 m), excluding a 12.7-foot (3.9-m) carbonaceous shale parting, in the Creston Junction quadrangle to the north. Partings are significant in the Creston Junction quadrangle but are not present in the Seaverson Reservoir quadrangle. To the west in the High Point quadrangle, a measured section in sec. 3, T. 18 N., R. 92 W., shows 15.2 feet (4.6 m) of coal with 9.5 feet (2.9 m) of carbonaceous shale partings. The coal bed appears to pinch out to the south before reaching the southern boundary of the High Point quadrangle. From plate 23, the dip of the bed is calculated to be approximately 2.5° to the west-northwest.

FU[13] Coal Bed

The FU[13] coal bed is a minor bed that occurs approximately 40 feet (12.2 m) stratigraphically above the Cow Butte coal bed. Its

maximum thickness of 8 feet (2.4 m) was recorded in sec. 22, T. 19 N., R. 92 W (plate 11). This coal bed is also found to the west in the High Point quadrangle where it occurs in one drill hole located in sec. 28, T. 18 N., R. 91 W., and measures 6 feet (1.8 m) in thickness. Because of limited information, the dip of the FU[13] coal bed is uncertain, but it is believed that the bed is dipping at approximately 2° to the west-northwest, as are the beds above and below it. Similar to the FU[11] coal bed, the FU[13] coal bed underlies non-Federal and leased lands. Therefore, development potential for this coal bed is not shown in tables 1 or 2.

Cherokee Coal Bed

The Cherokee coal bed is split in a portion of the northwestern corner of the quadrangle as shown on plates 7, 8, 9, and 10. This coal bed is found approximately 55 feet (16.8 m) above the Cow Butte bed and is named for the abandoned Cherokee loading station on the Union Pacific railroad located in sec. 10, T. 20 N., R. 91 W. The lower split of the Cherokee coal bed, designated C by RMEC, averages 25 feet (7.6 m) thick in this quadrangle and 15 feet (4.6 m) thick in the Creston Junction quadrangle. The average thickness of the interburden in the Creston Junction quadrangle is 50 feet (15.2 m), reaching a maximum of over 100 feet (30.5 m).

The upper split of the Cherokee coal bed, designated B by RMEC, was recorded in sec. 14, T. 19 N., R. 92 W., as 18.5 feet (5.6 m) thick. In the Creston Junction quadrangle, the upper split averages 8.0 feet (2.4 m) thick, thinning gradually from south to north. The dotted line on plates 7, 8, 9, and 10 represents the approximate location where the splits combine to form the main Cherokee bed. To the south of this line, the Cherokee coal bed is not split. It averages approximately 35 feet (10.7 m) in thickness and contains numerous shale partings ranging in thickness from 1.0 to 11.0 feet (0.3 to 3.4 m). Further south the bed gradually thins, and eventually, in the High Point quadrangle, thins to less than 5 feet (1.5 m). The dip of the bed, as calculated from plate 8, ranges from 15° to less than 5° in a west-northwest direction.

Resources and development potential for the Cherokee coal bed and splits are limited to small areas of two sections because the coal bed underlies coal lease areas and non-Federal land.

High Point (A) Coal Bed

The High Point (A) coal bed is found stratigraphically above and separated from the Cherokee bed by an average of 75 feet (22.9 m) of shale and siltstone. The High Point coal bed is named for the High Point ridge located in sec. 17, T. 19 N., R. 92 W. (Edson, in press, a). The maximum recorded thickness of the High Point coal bed is 8 feet (2.4 m) in secs. 15 and 22, T. 19 N., R. 92 W (plate 26). In the High Point quadrangle, the bed measures 5.6 feet (1.7 m) in sec. 21, T. 19 N., R. 92 W. From plate 27, the dip of the bed is calculated to be less than 3° in a westerly direction. The High Point coal bed underlies the extreme northwest part of the quadrangle and is not shown as having development potential in tables 1 or 2 because it is either in a lease area or under non-Federal land.

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 applicable. 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-isopachable coal beds. The influences from isolated data points in the adjacent High Point and Fillmore Ranch quadrangles are the only non-isopachable beds included as isolated data points in this quadrangle.

COAL RESOURCES

Information from oil and gas wells, coal test holes drilled by the U.S. Geological Survey (no date) and RMEC (no date), and coal data from the Union Carbide Corporation and the Pacific Power and Light

Company provided by G. M. Edson of the U.S. Geological Survey, as well as surface mapping by Edson (in press, a), were used to construct outcrop, isopach, and structure contour maps of the coal beds in the Seaverson Reservoir quadrangle.

Coal resources were calculated using data obtained from the coal isopach maps (plates 4, 7, 11, 14, 18, 22, and 26). 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 yields the coal resources in short tons of coal for each isopached coal bed. Reserve Base and Reserve tonnages for the isopached beds are shown on plates 6, 10, 13, 17, 21, 25, and 29, and are rounded to the nearest 10,000 short tons (9,072 metric tons). Coal beds thicker than 5 feet (1.5 m) that lie less than 3,000 feet (914 m) below the ground surface are included, although this criteria differs 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 maximum depth of 1,000 feet (305 m) for subbituminous coal. Only Reserve Base tonnages (designated as inferred resources) are calculated for areas in this quadrangle that are influenced by isolated data points. Coal Reserve Base tonnages per Federal section are shown on plate 2 and total approximately 679.09 million short tons (616.07 million metric tons) for the entire quadrangle. 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 portions 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 portion 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 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 is as follows:

$$MR = \frac{t_o\ (0.911)}{t_c\ (rf)}$$

where MR = mining ratio
t_o = thickness of overburden
t_c = thickness of coal
rf = recovery factor

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, as shown on plates 12, 16, 24, and 28. 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.

Unknown development potentials have been assigned to those areas where coal data is absent or extremely limited. Even though these areas contain coal thicker than 5 feet (1.5 m), limited knowledge of the areal

distribution of the coal prevents accurate evaluation of development potential.

The coal development potential for surface mining methods (less than 200 feet or 61 meters of overburden) is shown on plate 30.

Of the Federal land areas having known development potential for surface mining, 100 percent are rated high. The remaining Federal land is classified as having unknown development potential, indicating that no known coal beds 5 feet (1.5 m) or more thick occur within 200 feet (61 m) of the ground surface but that coal-bearing units are present.

Development Potential for Subsurface and In-Situ Mining Methods

The coal development potential for subsurface mining is shown on plate 31. Areas of high, moderate, and low development potential 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 to 2,000 feet (305 to 610 m), and 2,000 to 3,000 feet (610 to 914 m), respectively.

Of the Federal land areas classified as having known development potential for conventional subsurface mining methods, 59 percent have high potential, 40 percent have moderate potential, and 1 percent have low potential. The remaining Federal land is classified as having unknown development potential, implying that no known coal beds 5 feet (1.5 m) or more thick, not classified as isolated data points, occur between 200 feet (61 m) and 3,000 feet (914 m) below the ground surface but that coal-bearing formations are present. Tonnages for the unknown (subsurface) development potential for isolated data points totals 4.24 million short tons (3.85 million metric tons).

Because the coal beds in the quadrangle possess relatively gentle dips (less than 15°), development potential for in-situ mining methods is rated as unknown.

Table 1. Chemical analyses of coals in the Seaverson Reservoir quadrangle, Carbon 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. 27, T. 19 N., R. 92 W. (Sanders, 1975)	High Point (A)	A	15.87	34.76	29.01	20.36	3.33	-	-	-	-	-	7,782
Cherokee coal district, Creston Junction quadrangle (Sanders, 1975)	Upper Cherokee (B)	A	22.65	31.62	30.30	14.59	1.82	-	-	-	-	-	7,714
Cherokee coal district, Creston Junction quadrangle (Sanders, 1975)	Lower Cherokee (C)	A	22.37	34.85	30.42	12.80	1.66	-	-	-	-	-	8,293
Cherokee coal district, Creston Junction quadrangle (Sanders, 1975)	Cow Butte (D)	A	17.64	35.01	25.80	21.28	3.26	-	-	-	-	-	7,417
NW¼, SE¼, sec. 15, T. 18 N., R. 91 W. (CB-40, RMEC China Butte)	Fillmore Ranch (B)	A	26.42	0.0	0.0	7.28	0.36	-	-	-	-	-	8,337
NW¼, SW¼, sec. 27, T. 18 N., R. 91 W. (CB-68, RMEC China Butte)	Muddy Creek (C)	A	25.03	30.66	38.53	5.78	0.61	-	-	-	-	-	8,685
NW¼, SW¼, sec. 27, T. 18 N., R. 91 W. (CB-68, RMEC China Butte)	Separation Creek (D1)	A	25.46	29.92	38.65	5.97	0.42	-	-	-	-	-	8,655
SW¼, NE¼, sec. 27, T. 18 N., R. 91 W. (CB-65, RMEC China Butte)	Red Rim (F2)	A	21.64	28.46	38.42	11.48	0.45	-	-	-	-	-	8,384

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. Strippable coal Reserve Base data for Federal coal lands (in short tons) in the Seaverson Reservoir quadrangle, Carbon County, Wyoming.

Coal Bed	High Development Potential	Moderate Development Potential	Low Development Potential	Total
Cherokee	5,210,000	--	--	5,210.000
Cow Butte (D)	3,980,000	1,000,000	720,000	5,700,000
Fillmore Ranch (B)	25,780,000	--	--	25,780,000
Muddy Creek (C)	1,710,000	1,740,000	2,130,000	5,580,000
Separation Creek (D1)	1,570,000	760,000	660,000	2,990,000
FU {1}	70,000	150,000	950,000	1,170,000
	38,320,000	3,650,000	4,460,000	46,430,000

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 Seaverson Reservoir quadrangle, Carbon County, Wyoming.

Coal Bed or Zone	High Development Potential	Moderate Development Potential	Low Development Potential	Unknown Development Potential	Total
Fillmore Ranch (B)	206,020,000	98,330,000	--	--	304,350,000
Muddy Creek (C)	32,080,000	45,210,000	--	--	77,290,000
Separation Creek (D1)	27,410,000	5,470,000	--	--	32,880,000
FU [1]	3,840,000	400,000	--	--	4,240,000
Olson Draw (E1)	3,050,000	23,250,000	--	--	26,300,000
Red Rim (F2)	21,000,000	127,640,000	140,000	--	148,780,000
Daley's Ranch (G)	--	34,580,000	--	--	34,580,000
Isolated data points	--	--	--	4,240,000	4,240,000
TOTAL	293,400,000	334,880,000	140,000	4,240,000	632,660,000

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	Edson and Curtiss, 1976, U.S. Geological Survey Open File Report 76-272	Drill hole No. BS-92-1 (Union Carbide)
2	↓	Drill hole No. BS-653-1 (Union Carbide)
3	↓	Drill hole No. BS-218-1 (Union Carbide)
4	↓	Drill hole No. BS-200-1 (Union Carbide)
5	U.S. Geological Survey, (no date), unpublished table	Drill hole No. SR-D8
6	Edson and Curtiss, 1976, U.S. Geological Survey Open File Report 76-272	Drill hole No. SR-D3
7	Edson, in press, a, U.S. Geological Survey, unpublished map	Drill hole No. CB 37 (RME)
8	↓	Drill hole No. CB 40 (RME)
9	Rocky Mountain Energy Co., (no date), unpublished data	Drill hole No. 3AS
10	Edson, in press, a, U.S. Geological Survey, unpublished map	Drill hole No. CB 41 (RME)
11	Rocky Mountain Energy Co., (no date), unpublished data	Drill hole No. CB 42
12	Samedan Oil Corp.	Oil/gas well No. 1 State
13	Edson, in press, a, U.S. Geological Survey, unpublished map	Drill hole No. BS-256-1 (Union Carbide)

Table 4. -- Continued

Plate 1 Index Number	Source	Data Base
14	Edson, in press, a, U.S. Geological Survey, unpublished map	Drill hole No. BS-293-1 (Union Carbide)
15	↓	Drill hole No. CB 54 (RME)
16	Rocky Mountain Energy Co., (no date), unpublished data	Drill hole No. CB 55
17	Edson, in press, a, U.S. Geological Survey, unpublished map	Drill hole No. CB 57 (RME)
18	Rocky Mountain Energy Co., (no date), unpublished data	Drill hole No. 2AS
19	↓	Drill hole No. 1AS
20	↓	Drill hole No. CB 58
21	Edson, in press, a, U.S. Geological Survey, unpublished map	Drill hole No. CB 59 (RME)
22	Edson and Curtiss, 1976, U.S. Geological Survey Open File Report 76-272	Drill hole No. SR-D4
23	↓	Drill hole No. SR-D5
24	Edson, in press, a, U.S. Geological Survey, unpublished map	Drill hole No. CB 61 (RME)
25	Rocky Mountain Energy Co., (no date), unpublished data	Drill hole No. CB 63
26	Edson, in press, a, U.S. Geological Survey, unpublished map	Drill hole No. CB 64 (RME)
27	↓	Drill hole No. CB 65 (RME)
28	↓	Drill hole No. CB 68 (RME)

Table 4. -- Continued

Plate 1 Index Number	Source	Data Base
29	Rocky Mountain Energy Co., (no date), unpublished data	Drill hole No. CB 69
30	↓	Drill hole No. CB 67
31	↓	Drill hole No. CB 66
32	Edson and Curtiss, 1976, U.S. Geological Survey Open File Report 76-272	Drill hole No. SR-D6
33	Mountain Fuel Supply Co.	Oil/gas well No. 1 Unit
34	Edson and Curtiss, 1976, U.S. Geological Survey Open File Report 76-272	Drill hole No. SR-D7
35	Edson, in press, a, U.S. Geological Survey, unpublished map	Drill hole No. CD 72 (RME)
36	Rocky Mountain Energy Co., (no date), unpublished data	Drill hole No. CB 74
37	Edson, in press, a, U.S. Geological Survey, unpublished map	Drill hole No. 341-1 (Union Carbide)
38	Rocky Mountain Energy Co., (no date), unpublished data	Drill hole No. 1AS
39	↓	Drill hole No. 3AS
40	↓	Drill hole No. 1AS
41	Kemmerer Coal Co. and Michigan-Wisconsin Pipeline Co.	Oil/gas well No. 3-1 Creston
42	Rocky Mountain Energy Co., (no date), unpublished data	Drill hole No. 2AS

Table 4. -- Continued

Plate 1 Index Number	Source	Data Base
43	Rocky Mountain Energy Co., (no date), unpublished data	Drill hole No. 2AS
44	↓	Drill hole No. 1AS
45	↓	Drill hole No. 3AS
46	Amoco Production Co.	Oil/gas well No. 1 Creston Unit
47	Edson, in press, a, U.S. Geological Survey, unpublished map	Drill hole No. BS 677-1 (Union Carbide)
48	Rocky Mountain Energy Co., (no date), unpublished data	Drill hole No. 2AS
49	↓	Drill hole No. 1AS
50	Edson, in press, a, U.S. Geological Survey, unpublished map	Drill hole No. BS-731-1 (Union Carbide)
51	Rocky Mountain Energy Co., (no date), unpublished data	Drill hole No. 1AS
52	↓	Drill hole No. 2AS
53	Edson, in press, a, U.S. Geological Survey, unpublished map	Drill hole No. BS 768-1 (Union Carbide)
54	Rocky Mountain Energy Co., (no date), unpublished data	Drill hole No. 3AS
55	↓	Drill hole No. 2AS
56	Edson, in press, a, U.S. Geological Survey, unpublished map	Drill hole No. BS 395-1 (Union Carbide)

Table 4. -- Continued

Plate 1 Index Number	Source	Data Base
57	Rocky Mountain Energy Co., (no date), unpublished data	Drill hole No. 2AS
58	Edson, in press, a, U.S. Geological Survey, unpublished map	Drill hole No. BS 400-1 (Union Carbide)
59	Michigan-Wisconsin Pipeline Co.	Oil/gas well No. 1-26 Creston
60	Rocky Mountain Energy Co., (no date), unpublished data	Drill hole No. 1AS
61	↓	Drill hole No. 2AS
62	Davis Oil Co. and Southland Royalty Corp.	Oil/gas well No. 1 Tom Federal
63	↓	Oil/gas well No. 1 North Creston
64	Edson, in press, a, U.S. Geological Survey, unpublished map	Drill hole No. BS 610-1 (Union Carbide)
65	Davis Oil Co. and Southland Royalty Corp.	Oil/gas well No. 1 Petroleum Federal
66	Edson, in press, a, U.S. Geological Survey, unpublished map	Drill hole No. BS 629-1 (Union Carbide)
67	↓	Drill hole No. 25 (PP & L)
68	↓	Drill hole No. 24 (PP & L)
69	↓	Drill hole No. T-1B (PP & L)
70	↓	Drill hole No. T-1A (PP & L)

Table 4. -- Continued

Plate 1 Index Number	Source	Data Base
71	Edson, in press, a, U.S. Geological Survey, unpublished map	Drill hole No. 27 (PP & L)
72		Drill hole No. 26 (PP & L)
73		Drill hole No. 23 (PP & L)
74		Drill hole No. 22 (PP & L)
75		Drill hole No. 21 (PP & L)
76		Drill hole No. 20 (PP & L)
77		Drill hole No. 5W (PP & L)
78		Drill hole No. 5AW (PP & L)
79		Drill hole No. 5 (PP & L)
80		Drill hole No. 18 (PP & L)
81		Drill hole No. 17 (PP & L)
82		Drill hole No. 16 (PP & L)
83		Drill hole No. 15 (PP & L)
84		Drill hole No. 14 (PP & L)

Table 4. -- Continued

Plate 1 Index Number	Source	Data Base
85	Edson, in press, a, U.S. Geological Survey, unpublished map	Drill hole No. 13 (PP & L)
86	↓	Drill hole No. 12 (PP & L)
87	↓	Drill hole No. 19 (PP & L)
88	↓	Drill hole No. 70 (PP & L)
89	Rocky Mountain Energy Co., (no date), unpublished data	Drill hole No. 1AS
90	Edson, in press, a, U.S. Geological Survey, unpublished map	Drill hole No. 68 (PP & L)
91	↓	Drill hole No. 6 (PP & L)
92	↓	Drill hole No. 1AS (RME)
93	↓	Drill hole No. 69 (PP & L)
94	Edson and Curtiss, 1976, U.S. Geological Survey Open File Report 76-272	Drill hole No. SR-D1
95	↓	Drill hole No. SR-D2
96	Rocky Mountain Energy Co., (no date), unpublished data	Drill hole No. 1AS
97	↓	Drill hole No. 2AS

SELECTED REFERENCES

American Society for Testing and Materials, 1977, Standard specification for classification of coals by rank, in Gaseous fuels; coal and coke; atmospheric analysis: ASTM Standard Specification D 388-77, pt. 26, p. 214-218.

Back, Judith, 1976, Coal resource occurrence map of the Creston Junction quadrangle, Carbon and Sweetwater Counties, Wyoming: U.S. Geological Survey Conservation Division, unpublished map, sheet 8, scale 1:24,000.

Ball, M. W., 1909, The western part of the Little Snake River coal field, Wyoming, in Coal fields of Wyoming: U.S. Geological Survey Bulletin 341-B, p. 243-255.

Barclay, C. S. V., Jobin, D. A., and Storrs, J. P., 1978, Minutes for the revision of the Rawlins (Little Snake River) Known Recoverable Coal Resources Area, Carbon and Sweetwater Counties, Wyoming, January 31, 1978: U.S. Geological Survey Conservation Division, unpublished report, 15 p.

Berry, D. W., 1960, Geology and ground-water resources of the Rawlins area, Carbon County, Wyoming: U.S. Geological Survey Water-Supply Paper 1458, 74 p.

Bradley, W. H., 1964, Geology of Green River Formation and associated Eocene rocks in southwestern Wyoming and adjacent parts of Colorado and Utah: U.S. Geological Survey Professional Paper 496-A., p. A1-A10.

Edson, G. M., in press (a), Preliminary geologic map and coal sections of the Seaverson Reservoir quadrangle, Carbon County, Wyoming: U.S. Geological Survey Conservation Division, unpublished maps, sheets 1 and 2, scale 1:24,000.

_____ in press (b), Preliminary geologic map of the northwestern part of the Rawlins (Little Snake River) Known Recoverable Coal Resources Area (KRCRA): U.S. Geological Survey Conservation Division, unpublished map, scale 1:63,360.

Edson, G. M., and Barclay, C. S. V., in press, Preliminary geologic map and coal sections of the Fillmore Ranch quadrangle, Carbon County, Wyoming: U.S. Geological Survey Conservation Division, unpublished map, tables, cross-sections, and field notes.

Edson, G. M., and Curtiss, G. S., 1976, Lithologic and geophysical logs of holes drilled in the High Point, Seaverson Reservoir, and Fillmore Ranch quadrangles, Carbon County, Wyoming: U.S. Geological Survey Open-File Report 76-272.

Selected References--Continued

Gill, J. R., Merewether, E. A., and Cobban, W. A., 1970, Stratigraphy and nomenclature of some Upper Cretaceous and Lower Tertiary rocks in south-central Wyoming: U.S. Geological Survey Professional Paper 667, 53 p.

Hale, L. A., 1961, Late Cretaceous (Montanan) stratigraphy, eastern Washakie Basin, Carbon County, Wyoming, in Symposium on Late Cretaceous Rocks of Wyoming and adjacent areas, Wyoming Geological Association Guidebook, 16th Annual Field Conference, 1961: p. 129-137.

Rocky Mountain Energy Company, (no date), Unpublished drill hole data from the China Butte project and the Union Pacific coal inventory of 1971.

Sanders, R. B., 1974, Geologic map and coal resources of the Riner quadrangle, Carbon and Sweetwater Counties, Wyoming: U.S. Geological Survey Coal Investigations Map C-68, scale 1:24,000.

_____ 1975 Geologic map and coal resources of the Creston Junction quadrangle, Carbon and Sweetwater Counties, Wyoming: U.S. Geological Survey Coal Investigations Map C-73, scale 1:24,000.

Smith, J. B., Ayler, M. F., Knox, C. C., and Pollard, B. C., 1972, Strippable coal reserves of Wyoming, location, tonnages, and characteristics of coal and overburden: U.S. Bureau of Mines Information Circular 8538, 51 p.

U.S. Bureau of Land Management, 1978, Draft environmental statement, proposed domestic livestock grazing management program for the Seven Lakes area: U.S. Bureau of Land Management, Rawlins district, Wyoming, v. 1.

U.S. Geological Survey, 1976, Coal resource classification system of the U.S. Bureau of Mines and U.S. Geological Survey: U.S. Geological Survey Bulletin 1450-B, 7 p.

_____ (no date), Holes drilled for classification and evaluation of lands in the Rawlins (Little Snake River) KRCRA, Carbon and Sweetwater Counties, Wyoming by the Conservation Division during 1975, 1976, and 1977: U.S. Geological Survey Conservation Division, unpublished table.

Welder, G. E., and McGreevy, L. J., 1966, Ground-water reconnaissance of the Great Divide and Washakie Basins and some adjacent areas, southwestern Wyoming: U.S. Geological Survey Hydrologic Investigations Atlas HA-219.

Wyoming Natural Resources Board, 1966, Wyoming weather facts: Cheyenne, p. 14-15.