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COAL RESOURCE OCCURRENCE AND COAL DEVELOPMENT POTENTIAL MAPS OF THE JUNIPER HOT SPRINGS QUADRANGLE, MOFFAT COUNTY, COLORADO

[Report includes 27 plates]

Prepared for

UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

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INTRODUCTION

Purpose

This text is to be used in conjunction with Coal Resource Occurrence and Coal Development Potential Maps of the Juniper Hot Springs quadrangle, Moffat County, Colorado. This report was compiled to support the land-planning work of the Bureau of Land Management (BLM) and 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 United States Geological Survey under contract number 14-080001-15789. 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 Published and unpublished public information available through April, 1978, was used as the data base for this study.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 done as part of this study, nor was any confidential data used.

Location

The Juniper Hot Springs quadrangle is located in south-central Moffat County in northwestern Colorado, approximately 19 airline miles (31 km) west-southwest of the town of Craig and 23 airline miles (37 km) north of the town of Meeker. The town of Maybell lies approximately 5 airline miles (8 km) to the northwest. The town of Juniper Hot Springs is in the north-central part of the quadrangle. No major highways cross the quadrangle.

Accessibility

U.S. Highway 40 passes east-west approximately 1.5 miles (2.4 km) north of the Juniper Hot Springs quadrangle. An improved light-duty road follows the Yampa River valley northwesterly through the quadrangle connecting the town of Axial, approximately 11 miles (18 km) to the southeast, with U.S. Highway 40, 1.4 miles (2.3 km) to the northwest. A second improved light-duty road crossing through the northeastern part of the quadrangle connects the road along the Yampa River valley with the town of Lay 1.9 miles (3.1 km) north of the quadrangle boundary. Two other improved light-duty roads cross the quadrangle in a southwesterly direction following Jesse and Temple Gulches. The remainder of the quadrangle is accessible along several improved light-duty roads and unimproved dirt roads and trails.

Railway service for the Juniper Hot Springs quadrangle is provided by the Denver and Rio Grande Western Railroad from Denver to the railhead at Craig. The railroad, which terminates approximately 16 miles (26 km) east of the quadrangle, is the major transportation route for coal shipped east from northwestern Colorado (U.S. Bureau of Land Management, 1977).

Physiography

The Juniper Hot Springs quadrangle lies in the southern part of the Wyoming Basin physiographic province, as defined by Howard and Williams (1972). The quadrangle is approximately 63 miles (101 km) west of the Continental Divide. The southern half of the quadrangle lies in the northwestern part of the Axial Basin. The landscape throughout the quadrangle is characterized by moderate to steep slopes cut by gulches and narrow valleys. The Yampa River flows northwesterly across the quadrangle forming a broad, flat valley. Little Juniper Mountain lies in the northwestern corner of the quadrangle adjacent to Juniper Canyon.

Altitudes range from 6,702 feet (2,043 m) in the west-central part of the quadrangle to less than 5,960 feet (1,817 m) along the Yampa River in the northwestern part of the quadrangle. Little Juniper Mounain rises to an elevation of 6,666 feet (2,032 m) above sea level in the northwestern part of the quadrangle, approximately 700 feet (213 m) above the Yampa River valley.

Streams in the Juniper Hot Springs quadrangle drain into the Yampa River, which flows northwestward across the quadrangle. The southern part of the quadrangle is drained by Temple, Jesse, Maudlin, and Boxelder Gulches, which flow north-northeastward into the Yampa River. The northern part of the quadrangle is drained by a series of unnamed south-southwest-flowing creeks and gulches. Except for the Yampa River, all of the streams in the quadrangle are intermittent and flow mainly in response to snowmelt in the spring.

Climate and Vegetation

The climate of northwestern Colorado is semiarid. Clear, sunny days prevail in the Juniper Hot Springs quadrangle and daily temperatures typically vary from 1° to 34°F (-17° to 1° C) in January and from 46° to 86°F (8° to 30°C) in July. Annual precipitation in the area averages approximately 12 inches (30 cm). Snowfall during the winter months accounts for the major part of the precipitation in the area, but rainfall from thundershowers during the summer months also contributes to the total. Winds, averaging approximately 3 miles per hour (5 km per hour), are generally from the west, but wind directions and velocities vary greatly depending on the local terrain (U.S. Bureau of Land Management, 1977).

The dominant vegetation in the Juniper Hot Springs quadrangle is sagebrush. Vegetation at higher altitudes along the east-central edge, in the west-central part, and in the northwestern corner of the quadrangle include pinyon, Utah juniper and Rocky Mountain juniper (U.S. Bureau of Land Management, 1977).

Land Status

The Juniper Hot Springs quadrangle lies on the western edge of the Yampa Known Recoverable Coal Resource Area (KRCRA). Only a small area along the northeastern edge of the quadrangle, approximately 3 percent, lies within the KRCRA boundary. The Federal government owns the coal rights for approximately 80 percent of this area, as shown on plate 2. There are no active coal leases within the KRCRA in the quadrangle.

GENERAL GEOLOGY

Previous Work

The first geologic description of the general area in which the Juniper Hot Springs quadrangle is located was reported by Emmons (1877) as part of a survey of the Fortieth Parallel. The decision to build a railroad into the region stimulated several investigations of coal between 1886 and 1905, including papers by Hewett (1889), Hills (1893), and Storrs (1902). A report by Hancock (1925) on the geology and coal resources of the Axial and Monument Butte 15-minute quadrangles included the Juniper Hot Springs 7 1/2 minute quadrangle. Tweto (1976) compiled a generalized regional geologic map which included this quadrangle. Results of drilling by the U.S. Geological Survey in the Juniper Hot Springs quadrangle during 1975 were reported by Muller (1976).

Stratigraphy

The rock formations that crop out in the Juniper Hot Springs quadrangle range from Cambrian to Miocene in age. These include the Late Cretaceous-age, coal-bearing Iles and Williams Fork Formations of the Mesaverde Group; the underlying Mancos Shale of Late Cretaceous age; and the overlying Browns Park Formation of Miocene age. The latter two formations do not contain coal.

The Mancos Shale crops out in the eastern half of the quadrangle (Hancock, 1925; Tweto, 1976) and is composed of a thick sequence of gray to dark-gray shale interbedded with tan silty sandstone and sandy shale in the upper 1,000 feet (305 m) of the formation (Hancock, 1925; Bass and others, 1955).

The Mesaverde Group conformably overlies the Mancos Shale and contains two formations, the Iles and the Williams Fork.

The Iles Formation is approximately 1,300 to 1,350 feet (396 to 411 m) thick and crops out in the northeastern part of the quadrangle (Hancock, 1925). The basal "rim rock" sandstone (Hancock, 1925; Konishi, 1959), approximately 60 feet (18 m) thick, consists of tan to brown massive sandstone. This is overlain by light-colored thin-bedded sandstone interbedded with gray sandy shale and coal. The coal beds found in this sequence, designated as the Lower Coal Group, were first described by Fenneman and Gale (1906). The overlying Trout Creek Sandstone Member consists of approximately 75 feet (23 m) of white fine-grained massive sandstone, and the top of the Trout Creek Sandstone forms the contact between the Iles Formation and the conformably overlying Williams Fork Formation (Hancock, 1925; Bass and others, 1955).

The Williams Fork Formation crops out in the northeast corner of the quadrangle (Hancock, 1925; Tweto, 1976) and consists of approximately 1,600 feet (488 m) of alternating sandstone, sandy shale, carbonaceous shale and coal beds (Hancock, 1925). The lower unit of the Williams Fork Formation consists of thin-bedded sandstone, dark-gray to black sandy shale, carbonaceous shale and lenticular coal beds (Hancock, 1925; Bass and others, 1955). Fenneman and Gale (1906) have designated the coal in this lower unit as the Middle Coal Group. A prominent sandstone, known as the Twentymile Sandstone Member, is often present in the Williams Fork Formation. Hancock (1925) indicates that the Twentymile Sandstone Member is not well defined westward beyond sec. 36, T. 6 N., R. 93 W., in the Horse Gulch quadrangle to the east, but he did infer it to crop out into the northeast corner of the Juniper Hot Springs quadrangle. However, according to Whitely (1962), the Twentymile Sandstone strandline lies to the east of the quadrangle, and the Twentymile Sandstone Member, a marine shore-line sand, is not present in the Juniper Hot Springs quadrangle. Because the exact location of the top of the Middle Coal Group is unknown, the authors have arbitrarily designated the 700 feet (213 m) of coal-bearing rocks above the base of the Williams Fork Formation as the Middle Coal Group. The upper unit of the Williams Fork Formation is composed of interbedded dark-gray shale, massive white sandstone and sandy shale (Bass and others, 1955).

The Browns Park Formation of Miocene age unconformably overlies older formations in large areas throughout the western and northern parts of the quadrangle (Hancock, 1925; Tweto, 1976). It is composed of fluvial siltstone, claystone, conglomerate, and loosely consolidated eolian tuffaceous sandstone. The formation becomes more conglomeratic toward the base (Tweto, 1976).

Holocene deposits of alluvium cover the stream valley of the Yampa River (Hancock, 1925; Tweto, 1976).

The Cretaceous formations cropping out in the Juniper Hot Springs quadrangle accumulated close to the western edge of a Late Cretaceous epeirogenic seaway which covered part of the western interior of North America. Several transgressive-regressive cycles caused the deposition of a series of offshore-marine, shallow-marine, marginal-marine, and non-marine sediments in the quadrangle area (Ryer, 1977).

The Mancos Shale was deposited in an offshore marine environment which existed east of the shifting strand line. Deposition of the Mancos Shale in the quadrangle area ended with the eastward migration of the shoreline, and the subsequent deposition of the Iles Formation (Konishi, 1959; Kucera, 1959).

The interbedded sandstone, shale, and coal of the Mesaverde Group were deposited as a result of minor changes in the position of the shoreline. Near-shore marine, littoral, brackish-tidal, brackish and fresh-water supratidal, and fluvial environments existed during the deposition of the Iles and Williams Fork Formations. The sandstones of the Iles and Williams Fork Formations were deposited in shallow-marine and near-shore marine environments as the shoreline fluctuated. Coal beds of limited areal extent, such as those in the Middle Coal Group, were generally deposited in environments associated with fluvial systems, such as back-levee and coastal plain swamps, interchannel basin areas, and abandoned channels (Konishi, 1959; Kucera, 1959).

The Browns Park Formation was deposited after a long period of non-deposition and erosion. It is a continental deposit consisting mostly of fluvial and eolian deposits and much of its thickness has been removed as a result of late Cenozoic erosion (Carey, 1955).

Structure

The Yampa KRCRA lies in the southern extension of the Washakie/ Sand Wash structural basin of south-central Wyoming. The basin is bordered on the east by the Park Range, approximately 63 miles (101 km) east of the Juniper Hot Springs quadrangle, and on the southwest by the Axial Basin anticline. The axis of the northwest-trending Axial Basin anticline crosses the southern part of the quadrangle (Sears, 1924; Hancock, 1925).

Strata within the KRCRA boundary in the northeastern part of the quadrangle lie on the northern part of the southeastern limb of the Round Bottom syncline (Sears, 1924; Hancock, 1925). In general, the coal beds in this area dip northeastwardly from approximately 10° to 16°.

The structure contour maps of the isopached coal beds are based on a regional structure map of the top of the Trout Creek Sandstone Member by Hancock (1925), and it is assumed that the structure of the coal beds nearly duplicates that of the Trout Creek Sandstone Member. Modifications were made where necessary in accordance with outcrop and drill-hole data.

COAL GEOLOGY

Coal beds have been identified in the Iles and Williams Fork Formations in the Juniper Hot Springs quadrangle. Coal beds in the Iles Formation have been designated as belonging to the Lower Coal Group, while coal beds in the lower 700 feet (213 m) of the Williams Fork Formation have been included in the Middle Coal Group (Fenneman and Gale, 1906). Coal beds known to exceed Reserve Base thickness (5.0 feet or 1.5 meters) in this quadrangle occur only in the Middle Coal Group. Coal beds exceeding Reserve Base thickness that are not formally named have been given bracketed numbers for identification purposes in this quadrangle. In instances where coal beds greater than Reserve Base thickness are measured at one location only and cannot be correlated with other coal beds, they are treated as isolated data points (see Isolated Data Points section of this report).

Chemical analyses of coal.--Chemical analyses of coals in the Middle Coal Group were not available in this quadrangle, but representative analyses from the Wise and Ratcliff Mines in the Round Bottom quadrangle to the east are listed in table 1. In general, these analyses indicate that the coals in the Middle Coal Group are high-volatile C bituminous in rank on a moist, mineral-matter-free basis according to ASTM Standard Specification D 388-77 (American Society for Testing and Materials, 1977).

Middle Coal Group

The Middle Coal Group contains numerous relatively thin coal beds that have been identified in outcrops and a single drill hole in the northeastern part of the quadrangle. Only six of these coal beds can be correlated between outcrops and/or drill holes in this and the adjacent Horse Gulch quadrangle to the east with enough accuracy to construct isopach maps for the individual coal beds in this coal group. Numerous other coal beds, especially in the adjacent Horse Gulch quadrangle, that are thin, lenticular, discontinuous, and cannot be correlated with accuracy have been placed into a zone and the cumulative thickness of the coal in the zone has been isopached. An additional six coal beds, the MG[100] (i.e., Middle Coal Group, coal bed [100]), MG[101], MG[103], MG[105], MG[106], and MG[107], that could not be correlated with the isopached coal beds and zone were each identified at one location only and are treated as isolated data points.

The MG[1] coal bed (plate 4) was measured at one location along the outcrop in sec. 19, T. 6 N., R. 93 W., in this quadrangle. At that location, the coal bed is 5.7 feet (1.7 m) thick. This coal bed is inferred to thin northward from that point based on measurements made in the Horse Gulch quadrangle to the east where the coal bed ranges in thickness from 5.5 to 6.5 feet (1.7 to 2.0 m).

The MG[102] coal bed (plate 7) ranges in thickness from 2.5 to 6.4 feet (0.8 to 2.0 m) where measured along the outcrop and in a drill hole. A rock parting 1.0 foot (0.3 m) thick was reported in the drill hole. This coal bed extends into the Horse Gulch quadrangle where it is inferred to range from 5 to 8 feet (1.5 to 2.4 m) in thickness.

The Peacock coal bed (plate 10) ranges in thickness from 11.7 to 17.0 feet (3.6 to 5.2 m) where measured in an outcrop and a drill hole in the northeast corner of the quadrangle. It extends into the Horse Gulch quadrangle to the east, the Lay SE quadrangle to the northeast, and the Lay quadrangle to the north. In the Horse Gulch quadrangle, the coal bed ranges in thickness from 2.7 feet (0.8 m), where measured along the outcrop, to a reported maximum of 16.0 feet (4.9 m) where penetrated by a drill hole in sec. 18, T. 6 N., R. 93 W. The coal bed thins to the southeast from that drill-hole location. In the Lay SE quadrangle, the Peacock coal bed ranges from 11 to 16 feet (3.4 to 4.9 m) in thickness in the area where it has been projected into that quadrangle. In the Lay quadrangle, the coal bed ranges from 11.5 to 14.0 feet (3.5 to 4.3 m) thick where measured along the outcrop and may be as much as 16 feet (4.9 m) thick in the extreme southeast corner of that quadrangle.

Individual coal beds in the Middle Coal Group zone [22] thicken, thin, and split over short distances, ranging from less than 2.0 feet (0.6 m) to as much as 15.0 feet (4.6 m) in thickness in the adjacent Horse Gulch quadrangle. Only one coal bed in the zone (plate 14) was identified in the coal test hole drilled in sec. 6, T. 6 N., R. 93 W. At that location the coal bed is 6.0 feet (1.8 m) thick and contains a rock parting 1.0 foot (0.3 m) thick. Based on drill-hole data in the Horse Gulch quadrangle, the coal zone thickens to the southeast where cumulative coal thicknesses range from 11.5 to 27.3 feet (3.5 to 8.3 m) and contain rock partings totalling from 3.2 to 35.7 feet (1.0 to 10.9 m) in thickness in that quadrangle.

The MG[104] coal bed (plate 17) ranges from 3.3 to 10.0 feet (1.0 to 3.0 m) in thickness where measured along the outcrop and in a drill hole. The area over which the coal bed exceeds Reserve Base thickness covers approximately 0.04 square miles (0.1 sq. km). The coal bed is believed to extend into the Horse Gulch quadrangle.

The MG[108] coal bed (plate 20) ranges in thickness from 6.0 to 6.3 feet (1.8 to 1.9 m) in sec. 6, T. 6 N., R. 93 W., where it was measured in an outcrop and a drill hole. Although this coal bed has not been identified in the Horse Gulch quadrangle, it is believed to extend into that quadrangle at a thickness greater than Reserve Base.

The MG[40] coal bed has been identified in the drill hole in sec. 6, T. 6 N., R. 93 W., where it is 8.5 feet (2.6 m) thick, excluding a rock parting 1.5 feet (0.5 m) thick. This coal bed extends eastward into the Horse Gulch quadrangle where it was penetrated by another drill hole in sec. 18, T. 6 N., R. 93 W. The coal bed is reported to be 6.0 feet (1.8 m) thick at that location and does not contain rock partings. The dotted lines shown on the derivative maps of the MG[40] coal bed represent a limit of confidence beyond which isopach, structure contour, overburden isopach, and areal distribution and identified resources maps are not drawn because of insufficient data.

Isolated Data Points

In instances where single or isolated measurements of coal beds thicker than 5 feet (1.5 m) are encountered, the standard criteria for construction of isopach, structure contour, mining ratio, and overburden isopach maps are not available. The lack of data concerning these beds limits the extent to which they can be reasonably projected in any direction and usually precludes correlations with other, better known coal beds. For this reason, isolated data point maps are included on a separate sheet (in U.S. Geological Survey files) for non-isopached coal beds. Descriptions and Reserve Base tonnages for the isolated data points occurring in this quadrangle and the influences from isolated data points in the adjacent Horse Gulch quadrangle are listed in table 4.

COAL RESOURCES

Data from drill holes and outcrop measurements (Hancock, 1925; Muller, 1976) were used to construct outcrop, isopach, and structure contour maps of the coal beds in the Juniper Hot Springs quadrangle. The source of each indexed data point shown on plate 1 is listed in table 5.

Coal resources for Federal land were calculated using data obtained from the coal isopach maps (plates 4, 7, 10, 14, 17, 20, and 23) and the areal distribution and identified resources maps (plates 6, 9, 13, 16, 19, 22, and 25). The coal bed acreage (measured by planimeter), multiplied by the average thickness of the coal bed and by a conversion factor of 1,800 short tons of coal per acre-foot (13,238 metric tons per hectare-meter) for bituminous coal, yields the coal resources in short tons of coal for each coal bed. Coal beds greater than Reserve Base thickness that lie less than 3,000 feet (914 m) below the ground surface are included. These criteria differ somewhat from those stated in U.S. Geological Survey Bulletin 1450-B which call for a minimum thickness of 28 inches (70 cm) and a maximum depth of 1,000 feet (305 m) for bituminous coal.

Reserve Base and Reserve tonnages for the isopached coal beds are shown on plates 6, 9, 13, 16, 19, 22, and 25, and are rounded to the nearest 10,000 short tons (9,072 metric tons). Only Reserve Base tonnages (designated as inferred resources) are calculated for areas influenced by the isolated data points. Coal Reserve Base tonnages per Federal section are shown on plate 2 and total approximately 30.07 million short tons (27.28 million metric tons) for the entire quadrangle, including the tonnages for 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 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 below:

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

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 potential for surface mining methods. This applies to areas where coal beds 5 feet (1.5 m) or more thick are not known, but may occur, and to those areas influenced by isolated data points. Limited knowledge pertaining to the areal distribution, thickness, depth, and attitude of the coal beds prevents accurate evaluation of development potential in the high, moderate, and low categories. The areas influenced by isolated data points in this quadrangle total 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 26. Of the Federal land areas having a known development potential for surface mining, 94 percent are rated high, 4 percent are rated moderate, and 2 percent are rated low. The remaining Federal lands within the KRCRA boundary are classified as having unknown develop-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 which have dips of 15° or less. Unfaulted 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 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) 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 the areas influenced by isolated data points and to those areas where coal beds of Reserve Base thickness are not known, but may occur. The areas influenced by isolated data points in this quadrangle contain approximately 1.11 million short tons (1.01 million metric tons) of coal available for subsurface mining.

The coal development potential for conventional subsurface mining methods is shown on plate 27. All of the Federal land areas having a known development potential for conventional subsurface mining methods are rated high. The remaining Federal land within the KRCRA boundary is classified as having unknown development potential for conventional subsurface mining methods.

Based on criteria provided by the U.S. Geological Survey, coal beds of Reserve Base thickness dipping between 15° and 35°, regardless of tonnage, have low development potential for in-situ mining methods. Coal lying between the 200-foot (61-m) overburden isopach and the outcrop is not included in total coal tonnages available because it is needed for cover and containment in the in-situ process.

All of the Federal lands where the dip of the coal beds exceeds 15° are rated low for in-situ development potential because only approximately 60,000 short tons (54,000 metric tons) of coal in the MG[40] coal bed are believed to be available for in-situ mining. The remaining Federal lands within the KRCRA boundary in this quadrangle are classified as having unknown development potential for in-situ mining methods.

Table 1. -- Chemical analyses of coals in the Juniper Hot Springs quadrangle, Moffat County, Colorado.

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 sec. 6, T. 5 N., R. 91 W., Wise Mine (George and others, 1937) from Round Bottom quadrangle	Middle Coal Group	A	13.3	33.5	45.8	7.4	0.5	-	-	-	-	-	10,510
		C	-	38.6	52.9	8.5	0.6	-	-	-	-	-	12,110
SW¼ SE¼ sec. 31, T. 6 N., R. 91 W., Ratcliff Mine (George and others, 1937) from Round Bottom quadrangle	Middle Coal Group	A	13.5	35.5	47.8	3.5	0.3	-	-	-	-	-	11,010
		C	-	41.0	55.3	3.7	0.4	-	-	-	-	-	12,720

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 Juniper Hot Springs quadrangle, Moffat County, Colorado.

Coal Bed or Zone	High Development Potential	Moderate Development Potential	Low Development Potential	Unknown Development Potential	Total
MG {40}	470,000	340,000	890,000	-	1,700,000
MG {108}	70,000	40,000	160,000	-	270,000
MG {104}	-	10,000	40,000	-	50,000
MG {22}	1,360,000	590,000	870,000	-	2,820,000
Peacock	2,000,000	840,000	980,000	-	3,820,000
MG {102}	20,000	10,000	130,000	-	160,000
MG {1}	260,000	120,000	470,000	-	850,000
Isolated Data Points	-	-	-	670,000	670,000
Totals	4,180,000	1,960,000	3,540,000	670,000	10,340,000

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 Juniper Hot Springs quadrangle, Moffat County, Colorado.

Coal Bed or Zone	High Development Potential	Moderate Development Potential	Low Development Potential	Unknown Development Potential	Total
MG {40}	1,760,000	-	-	60,000*	1,820,000
MG {108}	210,000	-	-	-	210,000
MG {104}	160,000	-	-	-	160,000
MG {22}	6,060,000	-	-	-	6,060,000
Peacock	9,330,000	-	-	-	9,330,000
MG {102}	480,000	-	-	-	480,000
MG {1}	560,000	-	-	-	560,000
Isolated Data Points	-	-	-	1,110,000	1,110,000
Totals	18,560,000	-	-	1,170,000	19,730,000

*Tonnages for coal beds dipping greater than 15 degrees.

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

Table 4.--Descriptions and Reserve Base tonnages (in million short tons) for isolated data points

Coal Bed	Source	Location	Thickness	Reserve Base Tonnages Surface	Reserve Base Tonnages Subsurface
MG[100]	Hancock (1925)	sec. 7, T. 6 N., R. 93 W.	6.7 ft (2.0 m)	0.41	0
MG[101]	Muller (1976)	sec. 6, T. 6 N., R. 93 W.	7.0 ft (2.1 m)	0	0.25
MG[103]	Muller (1976)	sec. 6, T. 6 N., R. 93 W.	6.5 ft (2.0 m)	0	0.23
MG[105]	Muller (1976)	sec. 6, T. 6 N., R. 93 W.	15.0 ft (4.6 m)	0	0.54
MG[106]	Hancock (1925)	sec. 6, T. 6 N., R. 93 W.	12.8 ft (3.9 m)	0.24	0
MG[107]	Hancock (1925)	sec. 6, T. 6 N., R. 93 W.	7.1 ft (2.2 m)	0.02	0
		From Horse Gulch quadrangle			
MG[2]	Brownfield (1976)	sec. 18, T. 6 N., R. 93 W.	5.2 ft (1.6 m)	0	0.02
MG[33]	Brownfield (1976)	sec. 18, T. 6 N., R. 93 W.	7.0 ft (2.1 m)	0	0.02
MG[41]	Brownfield (1976)	sec. 18, T. 6 N., R. 93 W.	9.6 ft (2.9 m)	0	0.03
MG[42]	Brownfield (1976)	sec. 18, T. 6 N., R. 93 W.	6.5 ft (2.0 m)	0	0.02

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

Table 5. -- Sources of data used on plate 1

Plate 1 Index Number	Source	Data Base
1	Hancock, 1925, U.S. Geological Survey Bulletin 757, pl. 9	Measured Section Nos. 108-113
2	Muller, 1976, U.S. Geological Survey Open-File Report 76-383	Drill hole No. Y-4
3	Hancock, 1925, U.S. Geological Survey Bulletin 757, pl. 9	Measured Section Nos. 115-117
4	↓	Measured Sections Nos. 119-121
5	Hancock, 1925, U.S. Geological Survey Bulletin 757, p. 77	Measured Section No. 163
6	↓	Measured Section No. 162

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