UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

Text to accompany:

Open-File Report 79-194

COAL RESOURCE OCCURRENCE MAPS OF THE ROUGH GULCH QUADRANGLE RIO BLANCO AND MOFFAT COUNTIES, COLORADO

By

AAA Engineering and Drafting, Inc.
Salt Lake City, Utah

Prepared for the U.S. Geological Survey
under contract No. 14-08-0001-17457

1980

CONTENTS

	Page
Introduction	1
Purpose	1
Location	1
Accessibility	1
Physiography	2
Climate	3
Land status	3
Previous work	4
General geology	4
Stratigraphy	4
Structure	8
Coal geology	8
Isolated data points	9
Proximate analyses of the coal	10
Mining operations	10
Coal resources	11
Coal development potential	12
References	15

ILLUSTRATIONS

Plates 1-3 Coal resource occurrence maps:

1. Coal data map
2. Boundary and coal data map
3. Coal data sheet

TABLES

Page

Table 1. Proximate analyses of samples (as-received) from the Staley or "D" coal bed in the Cactus Reservoir quadrangle, Rio Blanco and Moffat Counties, Colorado.---- 10

2. Sources of data used on plate 1---------- 13

INTRODUCTION

Purpose

These maps were compiled to support the land-use planning work of the Bureau of Land Management and to provide a systematic coal resource inventory of Federal coal lands in the Lower White River Known Recoverable Coal Resource Area (KRCRA) in response to the land-use planning requirements of the Federal Coal Leasing Amendments Act of 1976.

Published and nonpublished non-proprietary data sources were used for this study. No new drilling or field mapping was done to supplement this study. No confidential or proprietary data were used.

Location

The Rough Gulch 7½-minute quadrangle is located in the north central part of Rio Blanco County and the south central part of Moffat County in northwestern Colorado. The city of Meeker, the county seat of Rio Blanco County, is about 26 miles (42 km) southeast of the quadrangle. The city of Craig, the county seat of Moffat County, is 48 miles (77 km) east of the quadrangle. The Colorado-Wyoming state line is approximately 52 miles (84 km) north of the quadrangle and the Colorado-Utah state line is 29.5 miles (47.5 km) west. The town of Rangely is 16 miles (26 km) west of the quadrangle.

Accessibility

Colorado State Highway 64 runs through the central part of the Rough Gulch quadrangle in an east-west direction. Unimproved dirt roads occur in Spring Creek canyon, Short Canyon, Hay Canyon, Greasewood Creek canyon, and Yellow Creek canyon in the south half of the quadrangle. Three unimproved dirt roads enter the

northwest quarter of the quadrangle from the north and extend 1 to 2 miles (1.6 to 3.2 km) into the quadrangle. An unimproved dirt road runs northward from Colorado State Highway 64 near the central part of the quadrangle and crosses the White River. The northeast quarter of the quadrangle is quite rugged and is only crossed by a jeep trail that runs from McAndrews Gulch on the central east side of the quadrangle to the north side.

The nearest rail head is at Craig which is on the western end of a branch line of the Denver and Rio Grande Western Railroad which connects to Denver, Colorado. An airfield is maintained at Rangely.

Physiography

The general topography of the Rough Gulch quadrangle is hilly but not extremely rugged. The northwest quarter of the quadrangle consists of low hills, shallow washes, and badland topography. The northeast quarter and the south half of the quadrangle are mountainous with narrow canyons and ridges ranging from 300 to 800 ft (91 to 244 m) in height above the canyon bottoms. Pinyon Ridge is the dominant north-south trending ridge in the northeast quarter of the quadrangle. White River and its ¼ to ½ mile (0.4 to 0.8 km) wide flood plain wind sinuously across the central part of the quadrangle in an east-west direction. The most prominent feature south of the White River is a 700-ft (213 m) high east-west trending escarpment. South of this escarpment are numerous canyons and ridges which increase in elevation southward to the quadrangle boundary.

The relief in the quadrangle is approximately 1,660 ft (506 m) with the high point of 7,090 ft (2,161 m) occuring in the southwest corner of the quadrangle. The low point is where the White River intersects

the west side of the quadrangle at 5,430 ft (1,655 m) above sea level. The White River flows westward to its confluence with the Green River in Utah.

Climate

The Rough Gulch quadrangle has a mid-latitude steppe climate and semi-arid conditions prevail in the area. The normal annual precipitation ranges from 11 inches (28 cm) in the northern three quarters of the quadrangle to 13 inches (33 cm) in the southwest corner. (U.S. Department of Commerce, (1964)).

The nearest weather data recording station is at Rangely where a record high temperature of 104° F (40° C) and a record low temperature of -37° F (-38° C) were recorded (National Weather Service Forecast Office, personal communication). The mean annual temperature at Rangely is 45.6° F (7.6° C). The temperatures in the Rough Gulch quadrangle are expected to be a few degrees cooler than at Rangely (elevation, 5,240 ft (1,597 m)) because of the higher altitudes in the quadrangle area. A flood hazard exists along the flood plain of the White River.

Land Status

The Rough Gulch quadrangle lies in the eastern part of the Lower White River Known Recoverable Coal Resource Area (KRCRA). The KRCRA covers approximately 9,970 acres (4,035 ha) of the quadrangle. The areas of non-Federal land and the KRCRA boundary are shown on plate 2. There were no existing Federal coal leases or preference right lease applications in this quadrangle at the date of the land check for this report as shown on plate 2. The total non-Federal land in the quadrangle comprises approximately 3,190 acres (1,291 ha) or 9 percent of the quadrangle area. The unleased Federal

coal rights land covers about 33,230 acres (13,448 ha) or 91 percent of the quadrangle area. The Federal land may or may not be underlain by coal.

Previous Work

Gale (1910) described the coal fields of northwestern Colorado and northeastern Utah including the Lower White River field. Hail (1974a) mapped the geology and surface exposures of the coal beds in the Rough Gulch quadrangle. He also mapped the adjoining Barcus Creek quadrangle (Hail, 1974b) and Smizer Gulch quadrangle (Hail, 1973). Dyni (1968) mapped the geology and coal exposures in the adjoining Elk Springs quadrangle.

GENERAL GEOLOGY

Stratigraphy

Sedimentary rocks in the Rough Gulch quadrangle are Late Cretaceous and Tertiary in age. Coal beds in the quadrangle occur in the rocks of the Iles and Williams Fork Formations. The oldest exposed formation is the Mancos Shale which crops out in the northwest quarter of the quadrangle. It is composed of brown to gray marine shale containing orange-weathering limestone concretions and a few thin sandstone and siltstone beds. The formation is generally nonresistant and forms slopes and lowlands.

The Mancos Shale is overlain by the Iles Formation of Late Cretaceous age. The Trout Creek Sandstone Member of the Iles Formation occurs in the north half of the northeast quarter of the quadrangle and is composed of light-gray to light-brown, massive to crossbedded, fine- to medium-grained sandstone. The Trout Creek, where present, constitutes the top of the Iles Formation and is about 110 ft (34 m) thick near the north edge of the

quadrangle. The main body of the Iles Formation ranges from 600 to 800 ft (183 to 244 m) in thickness. The upper part consists mostly of massive lenticular brown-weathering sandstone and light-gray-weathering mudstone and claystone, sparse carbonaceous shale, and local thin coal beds. The lower part of the formation is composed of mudstone, thin sandstones, abundant carbonaceous shale containing sparse thin coal beds. A basal sandstone unit, 35-65 ft (11-20 m) thick, consists generally of a lower cliff-forming brown-weathering fine-grained sandstone and an upper white-weathering sandstone which is overlain by a thin discontinuous bed of coal (Hail, 1974a).

The Iles Formation is overlain by the Williams Fork Formation of Late Cretaceous age. This formation ranges from about 2,500 to 2,950 ft (762 to 899 m) in thickness and consists of interbedded light-gray to brown, mostly fine-grained nonpersistent sandstone, and gray, greenish-gray, and light-brown shale and claystone. In the Stadtman Mesa area the upper part contains abundant orange-weathering septarian concretionary masses in greenish-gray shale. The formation also contains considerable brown carbonaceous shale and several lenticular coal beds in zones of carbonaceous shale. The most important coal beds are in the lower part of the formation (Hail, 1974a).

The Ohio Creek Formation of Paleocene age overlies the Williams Fork Formation and has a maximum thickness of about 80 ft (24 m). The Ohio Creek Formation consists of light-brown to white, massive to cross-bedded sandstone which locally contains very sparse chert or quartzite pebbles. The formation is nonpersistent and cannot be recognized with certainty throughout the quadrangle (Hail, 1974a).

The Fort Union Formation of Paleocene age overlies the Ohio Creek Formation and consists of an upper member and a lower member. The upper member is about 320 ft (98 m) thick and is composed of brown to gray shale, carbonaceous shale, minor coaly shale, a few thin shaly coal beds, thin relatively persistent sandstone beds, siltstone, claystone, and clay-pebble conglomerate. The lower member consists of olive-green to gray claystone, light-brown to light-gray lenticular sandstone mostly crossbedded to massive, minor siltstone, mudstone, and carbonaceous shale, and very sparse limestone. The lower member thins from about 800 ft (244 m) at the east edge of the quadrangle to about 150 ft (46 m) at the west edge (Hail, 1974a).

The Wasatch Formation of Eocene and Paleocene age overlies the Fort Union Formation and ranges in thickness from about 1,550 ft (472 m) at the east edge of the quadrangle to about 1,200 ft (366 m) at the west edge. The main body of the Wasatch Formation is composed of varicolored claystone and shale (mostly various shades of gray, red, purple, and grayish green), brown to gray massive to crossbedded lenticular sandstone, minor siltstone, limestone, and carbonaceous shale. The Wasatch Formation contains a unit with beds of probable lacustrine origin, including persistent ostracodal sandstone and limestone, shale containing limy ostracodal beds, and some carbonaceous shale. Nonlacustrine beds predominate in the unit and are similar in lithology to the main body of the Wasatch Formation. The lacustrine unit has a maximum thickness of about 340 ft (104 m) and the top of the unit lies about 100-200 ft (30-61 m) below the top of the formation.

The Green River Formation of Eocene age overlies the Wasatch Formation and consists of the following members in ascending order: basal sandstone member, Garden Gulch Member, Parachute Creek Member, tongue of the Parachute

Creek Member, and Thirteenmile Creek Tongue. The basal sandstone member ranges from about 10 to 35 ft (3 to 11 m) thick and is composed of gray to brown, massive to crudely evenbedded sandstone, gray claystone and a local thin bed of gray limestone. The Garden Gulch Member is about 880 ft (268 m) thick and consists mostly of dark-gray to brown fissle clay shale. The upper part contains a ledge of dolomitic siltstone grading laterally westward in the quadrangle to dolomitic shale. The lower part contains a few thin sandstone beds and ostracodal limestone beds. The main body of the Parachute Creek Member is about 1,200 ft (366 m) thick and is composed mostly of light-gray weathering massive to platy dolomitic marlstone, but also contains a considerable amount of silty dolomitic marlstone, dolomitic siltstone, and dolomitic shale. The member contains a few thin beds of sandstone, oil shale, and tuff. The Tongue of the Parachute Creek Member intertongues with the overlying Uinta Formation and is from 100 to 150 ft (30 to 46 m) thick. The tongue is composed of light-gray to light-brownish-gray dolomitic marlstone that is locally silty. The Thirteenmile Creek Tongue is the uppermost unit of the Green River Formation in this quadrangle and consists of very light-gray dolomitic marlstone and limestone. It merges far to the southeast with the Parachute Creek Member (Hail, 1974a).

The Uinta Formation of Eocene age intertongues with the Green River Formation in the quadrangle. The Tongue of the Uinta Formation lies between the main body of the Parachute Creek Member and the Tongue of the Parachute Creek Member of the Green River Formation. The Tongue of the the Uinta Formation ranges from 40 to 300 ft (12 to 91 m) in thickness and consists of brown, massive to crossbedded, sandstone and siltstone; and minor marlstone. The main body of the Uinta Formation lies between the Tongue of the Parachute

Creek Member and the Three Mile Creek Tongue of the Green River Formation. The main body of the Uinta Formation has a maximum uneroded thickness of about 600 ft (183 m) and is composed of brown to brownish-gray locally tuffaceous and marly sandstone and siltstone; sparse conglomerate; several beds of light-gray dolomitic marlstone and siltstone; some shale and mudstone; and thin greenish-gray mudstone at the top just below the Thirteenmile Creek Tongue of the Green River Formation (Hail, 1974a).

Structure

The arcuate east-west trending axial trace of the eastward-plunging Crooked Wash syncline lies on the north side of the quadrangle (pl. 1). The axial trace of the eastward-plunging midland anticline lies about two miles (3 km) south of the Crooked Wash synclinal axis. The beds dip southward from the anticlinal axis at dips up to 45^{o} (Hail, 1974a) toward the Red Wash syncline in the south part of the quadrangle.

The main faults in the quadrangle are two roughly parallel faults bounding an east-west trending graben just north of the White River in the central part of the quadrangle. These faults offset coal beds in the Iles and Williams pork Formations in sections 29 and 30, T. 3 N., R. 98 W. Several small faults, mostly less than ½ mile (0.8 km) in length occur in other parts of the quadrangle (pl. 1).

COAL GEOLOGY

"Coal beds are present in the upper, middle, and lower parts of the Williams Fork Formation and near the top and base of the Iles Formation. A few very thin coal beds are also present in the upper member of the Fort Union Formation . . . The coal beds occur in generally nonpersistent carbonaceous shale zones, and individual coal beds are lenticular and nonpersistent. The measured beds range in thickness from less than 1 foot to 7.2 feet. Most

of the beds are less than 4 feet thick. The most important and relatively most persistent coal beds are those near the base of the Williams Fork Formation (groups I and J). These coal beds continue northward into the Elk Springs 15-minute quadrangle, where they constitute the middle Mesaverde Group coal zone as mapped by Dyni (1968). The coal beds near the base of the Iles Formation (groups K and P) correspond to the lower coal zone of the Mesaverde Group of the Elk Springs quadrangle." (Hail, 1974a)

In this report the coal beds near the base of the Williams Fork Formation are called the main coal zone abbreviated by the symbol MCZ on plates 1 and 3. The main correlatable coal beds in this zone are identified by the symbols MCZ I and MCZ J representing the main coal beds in groups I and J of Hail (1974a). Other poorly correlatable or non-correlatable coal beds are herein called local coal beds and have been labeled with the letter "L" on plates 1 and 3.

Isolated Data Point

In instances where isolated measurements of coal beds greater than 5 ft (1.5 m) thick 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 correlation with other coal beds. For this reason, an isolated data point map is included on a separate sheet (in U.S. Geological Survey files) for the non-isopachable coal bed at index number 77 on plate 1. Resource tonnage for the isolated data point was calculated for an area within ¼ mile (0.4 km) of the point of measurement. The local coal bed at that point is 7.2 ft (2.2 m) thick and the resource tonnage is 600,000 short tons (544,320 metric tons).

Proximate Analyses of the Coal

No analyses of coal from the Rough Gulch quadrangle are available. However, several analyses of coal from the Staley or "D" coal bed in the coal unit of the Mesaverde Group in the Cactus Reservoir quadrangle 7 miles (11 km) west are listed in table 1. The coal analysed is equivalent to the coal in the Williams Fork Formation in the Rough Gulch quadrangle.

Table 1.--Proximate analyses of samples (as-received) from the Staley or "D" coal bed in the Cactus Reservoir quadrangle, Rio Blanco and Moffat Counties, Colorado. (D. V. Haines, 1974, unpublished report.)

	Moisture (percent)	Volatile matter (percent)	Fixed carbon (percent)	Ash (percent)	Heating value (Btu/lb [1])	Sulphur (percent)
1.	11.09	36.97	46.65	5.29	11,361	0.34
2.	11.7	33.5	49.2	5.6	11,210	0.4
3.	10.8	34.5	50.5	4.2	11,450	0.5
4.	13.2	36.6	45.3	4.9	11,070	0.4

[1] To convert Btu/lb to Kj/kg multiply by 2.326

On the basis of the analyses in table 1, the Staley or "D" coal is ranked as high-volatile C bituminous coal (American Society for Testing and Materials, 1977). The coal in the Rough Gulch quadrangle may be of similar quality.

MINING OPERATIONS

No coal has been produced in the Rough Gulch quadrangle except for local use by ranches from two small long-abandoned mines--the Jesse Bassett mine in the N½ section 31, T. 3 N., R. 98 W., and the W. W. McGruder mine in the N½ section 35, T. 3 N., R. 99 W (Hail, 1974a and Gale, 1910). Gale (1910) reported the coal bed in the McGruder mine to be 8 ft (2.4 m) thick, but Hail (1974a) reported that only 4 ft (1.2 m) are exposed at the caved mine entry.

COAL RESOURCES

The source of data used in the construction of the coal data map (pl. 1) and coal data sheet (pl. 3) was Hail (1974a). Several oil and gas test wells have been drilled in the quadrangle and the available logs of these wells were inspected, but the logs were generally non-definitive for coal, or the wells were drilled in non-coal areas.

The following criteria for coal resource determinations are given in U.S. Geological Survey Bulletin 1450-B: "Measured.--Resources are computed from dimensions revealed in outcrops, trenches, mine workings, and drill holes. The points of observation and measurement are so closely spaced and the thickness and extent of coals are so well defined that the tonnage is judged to be accurate within 20 percent of true tonnage. Although the spacing of the points of observation necessary to demonstrate continuity of the coal differs from region to region according to the character of the coal beds, the points of observation are no greater than ¼ mile (0.4 km) wide belt from the outcrop or points of observation or measurement.

"Indicated.--Resources are computed partly from specified measurements and partly from projection of visible data for a reasonable distance on the basis of geologic evidence. The points of observation are ½ (0.8 km) to 1½ miles (2.4 km) apart. Indicated coal is projected to extend as a ½ mile (0.8 km) wide belt that lies more than ¼ mile (0.4 km) from the outcrop or points of observation or measurement.

"Inferred.--Quantitative estimates are based largely on broad knowledge of the geologic character of the bed or region and where few measurements of bed thickness are available. The estimates are based primarily on an assumed continuation from Demonstrated coal (a collective term for the sum of coal in both Measured and Indicated Resources and Reserves) for which

there is geologic evidence. The points of observation are 1½ (2.4 km) to 6 miles (9.5 km) apart. Inferred coal is projected to extend as a 2¼-mile (3.6 km) wide belt that lies more than 3/4 mile (1.2 km) from the outcrop or points of observation or measurement." (U.S. Bureau of Mines and U.S. Geological Survey, 1976, p. B6 and B7).

In this quadrangle coal resources could not be determined for measured indicated, and inferred categories for isopached coal beds because no coal beds were 5 ft (1.5 m) or more thick except at one isolated data point. Resource tonnages calculated for isolated data points (non-isopached coal beds) are classified as inferred coal and placed in the unknown development potential category. The coal resources for the isolated data point at index no. 79 on plate 1 are 0.6 million short tons (0.5 million metric tons). In this quadrangle, coal resources of unknown development potential are projected to extend as a ¼ mile (0.4 km) wide belt from the outcrop or point of measurement at the isolated data point.

AAA Engineering and Drafting, Inc. has not made any determination of economic recovery for any of the coal beds described in this report.

COAL DEVELOPMENT POTENTIAL

No coal development potential maps were made for this quadrangle because there are no known areas where a coal bed is 5 ft (1.5 m) or more thick except at the isolated data point discussed above. Therefore, the land with Federal coal rights in this quadrangle has an "unknown"-development-potential rating in those areas that are underlain by coal-bearing formations which are less than 3,000 ft (914 m) below the surface.

Table 2.--Sources of data used on plate 1.

Plate 1 Index No.	Source	Measured Section No. in Source Reference
1	Hail, 1974a	1
2	Do.	2
3	Do.	3
4	Do.	4
5	Do.	5
6	Do.	6
7	Do.	7
8	Do.	8
9	Do.	9
10	Do.	10
11	Do.	11
12	Do.	12
13	Do.	13
14	Do.	14
15	Do.	15
16	Do.	16
17	Do.	17
18	Do.	18
19	Do.	19
20	Do.	20
21	Do.	21
22	Do.	22
23	Do.	23
24	Do.	24
25	Do.	25
26	Do.	26
27	Do.	27
28	Do.	28
29	Do.	29
30	Do.	30
31	Do.	31
32	Do.	32
33	Do.	33
34	Do.	34
35	Do.	35
36	Do.	36
37	Do.	37
38	Do.	38
39	Do.	39
40	Do.	40
41	Do.	41
42	Do.	42
43	Do.	43
44	Do.	44
45	Do.	45
46	Do.	46
47	Do.	47
48	Do.	48
49	Do.	50
50	Do.	49

Table 2.--Continued

Plate 1 Index No.	Source	Measured Section No. in Source Reference
51	Do.	51
52	Do.	52
53	Do.	53
54	Do.	54
55	Do.	55
56	Do.	56
57	Do.	57
58	Do.	58
59	Do.	59
60	Do.	60
61	Do.	61
62	Do.	62
63	Do.	63
64	Do.	64
65	Do.	65
66	Do.	66
67	Do.	67
68	Do.	68
69	Do.	69
70	Do.	70
71	Do.	71
72	Do.	72
73	Do.	73
74	Do.	74
75	Do.	75
76	Do.	76
77	Do.	77
78	Do.	78
79	Do.	79
80	Do.	80
81	Do.	81
82	Do.	82
83	Do.	83
84	Do.	84
85	Do.	85

REFERENCES

American Society of Testing and Materials, 1977, Standard specifications for classification of coals by rank, in Gaseous fuels, coal, and coke: atmospheric analysis; ASTM Publication D 388-77.

Dyni, J. R., 1968, Geologic map of the Elk Springs quadrangle, Moffat County, Colorado: U.S. Geol. Survey Geologic Quadrangle Map GQ-702.

Gale, H. S., 1910, Coal fields of northwestern Colorado and northeastern Utah: U.S. Geol. Survey Bulletin 415.

Hail, W. J., Jr., 1973, Geologic map of the Smizer Gulch quadrangle, Rio Blanco and Moffat Counties, Colorado: U.S. Geol. Survey Geologic Quadrangle Map GQ-1131.

Hail, W. J., Jr., 1974a, Geologic map of the Rough Gulch quadrangle, Rio Blanco and Moffat Counties, Colorado: U.S. Geol. Survey Geologic Quadrangle Map GQ-1195.

Hail, W. J., Jr., 1974b, Preliminary geologic map and section of the Barcus Creek quadrangle, Rio Blanco County, Colorado: U.S. Geol. Survey Misc. Field Studies Map MF-619.

Haines, D. V., 1974, Geologic evaluation of preference right coal lease application Colorado 0126669, Rio Blanco County, Colorado: U.S. Geol. Survey unpublished report.

U.S. Bureau of Mines and U.S. Geological Survey, 1976, Coal Resource classification system of the U.S. Bureau of Mines and U.S. Geological Survey: U.S. Geol. Survey 1450-B.

U.S. Department of Commerce, (1964), Normal annual precipitation, 1931-1960, Colorado: Environmental Science Services Admin., Weather Bureau.