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GEOLOGICAL SURVEY

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1979

COAL RESOURCES OF THE YOGO CREEK QUADRANGLE

SEVIER COUNTY, UTAH

By

AAA Engineering and Drafting, Inc.

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INTRODUCTION

Purpose

This report was compiled to support the land planning work of the Bureau of Land Management 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. It supplements the land planning requirements of the Federal Coal Leasing Amendments Act of 1976 (Public Law 94-377) sec. (3)(B) which states, in part, that "Each land-use plan prepared by the Secretary [of the Interior] (or in the case of lands within the National Forest System, the Secretary of Agriculture pursuant to subparagraph (A) (i)) shall include an assessment of the amount of coal deposits in such land, identifying the amount of such coal which is recoverable by deep mining operations and the amount of such coal which is recoverable by surface mining operations."

Published and unpublished public information were used as data sources for this study. No new drilling or field mapping were done to supplement this study. No confidential or proprietary data were used.

Location

The Yogo Creek 7½-minute quadrangle is located in the southern part of the Wasatch Plateau coal field in central Utah. The quadrangle lies in Sevier County and is approximately 25 miles (40 km) east of the city of Richfield, the county seat. The city of Salina is 6 miles (10 km) north and 13 miles (21 km) west of the quadrangle, and the town of Emery is 3 miles (5 km) north and 14 miles (23 km) east.

Accessibility

U.S. Interstate Highway 70 passes through the east side of the Yogo Creek quadrangle in a northwest-southeast direction parallel to Meadow

Creek. This is the only paved road in the quadrangle area. An unimproved dirt road runs up the valley of Niotche Creek from the north side to the central part of the quadrangle. Another dirt road follows the ridge between Catamount Canyon and Niotche Creek valley in the northwest quarter of the quadrangle. Several jeep trails cross canyons and ridges in the southern half of the quadrangle.

The nearest railhead is at Salina, approximately 6 miles (10 km) north and 13 miles (21 km) west of the quadrangle. A branch line of the Denver and Rio Grande Western Railroad runs north and south from Salina along the western side of the Wasatch Plateau. The railroad makes connections to Salt Lake City, Utah and Denver, Colorado.

Physiography

The eastern margin of the Wasatch Plateau is approximately 80 miles (129 km) long and consists of sparsely vegetated sandstone cliffs and steep shale slopes cut by numerous steep-walled canyons. The rocks are gently dipping, generally less than 10 degrees. Yogo Creek quadrangle is in the high mountainous part of the Wasatch Plateau, approximately 5 miles (8 km) west of the steep sandstone cliffs on the eastern side.

The quadrangle is rugged and mountainous. The lowest point in the quadrangle is 6,810 ft (2,076 m) above sea level where Meadow Creek leaves the north side of the quadrangle. The highest point is approximately 10,130 ft (3,088 m) on the mountain in the southwest corner of the quadrangle.

The main drainages in the quadrangle include Meadow Creek and Niotche Creek and their tributaries. These streams flow northward into Salina Creek which flows westward into Sanpete Valley on the west side of the Wasatch Plateau.

Climate

The climate of the Wasatch Plateau varies with altitude and ranges from semi-arid in the lower elevations to alpine in the higher areas. The normal annual precipitation in the Yogo Creek quadrangle ranges from approximately 15 inches (38 cm) on the north central side of the quadrangle to 29 inches (74 cm) on the high area in the southwest corner of the quadrangle (U.S. Department of Commerce, (1964)).

Temperatures on the high plateau are generally cool in the summer and cold in winter. Temperatures may reach a high of 85 degrees F (29 degrees C) in summer and a low of -30 degrees F (-34 degrees C) in winter.

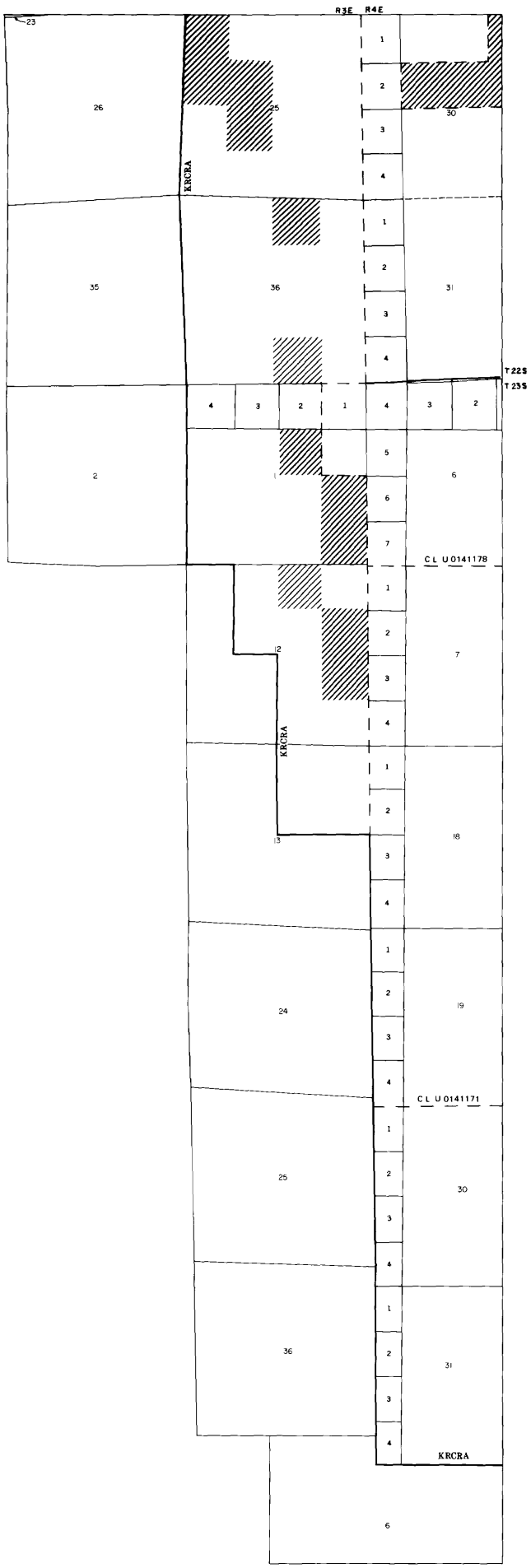
Land Status

The Yogo Creek quadrangle lies in the southwestern part of the Wasatch Plateau Known Recoverable Coal Resource Area (KRCRA). Approximately 6,200 acres (2,509 ha) of the quadrangle area lies within the KRCRA. Figure 1 shows the distribution, and table 1 lists the acres of Federal, non-Federal, and leased Federal lands in that area.

Table 1. Approximate distribution of coal lands within the KRCRA in the Yogo Creek quadrangle, Sevier County, Utah.

Category	Approximate Area (acres)*	Percent of KRCRA (%)
Non-Federal land	500	8
Leased Federal coal land	2,900	47
Unleased Federal coal land	2,800	45
Total	6,200	100

*To convert acres to hectares, multiply acres by 0.4047



EXPLANATION

KRCRA

KNOWN RECOVERABLE COAL RESOURCES AREA BOUNDARY – Label within KRCRA boundary.

NON-FEDERAL COAL LAND – Land within the KRCRA boundary for which the Federal Government does not own the coal rights.

CL U0141178

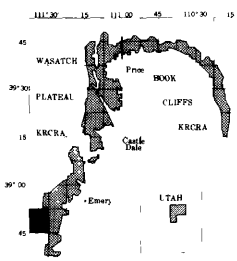
FEDERAL COAL LEASE BOUNDARY – Lease number within boundary.

SECTION OF LAND – Showing lots and lot numbers

NOTE BLM Coal Ownership Data current as of September 22, 1977.

REFERENCE

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 Bull 1450-B, 7p



MAP SHOWING LOCATION OF THE YOGO CREEK QUADRANGLE (SHADED) AND THE BOOK CLIFFS AND WASATCH PLATEAU KNOWN RECOVERABLE COAL RESOURCE AREAS (STIPPLED), UTAH.

0 1/4 1/2 MILE
SCALE

FIGURE 1. Boundary map, Yogo Creek Quadrangle, Sevier County, Utah.

GENERAL GEOLOGY

Previous Work

Spieker (1931) mapped and described the geology and coal of the Wasatch Plateau. The stratigraphy of the area was described by Spieker and Reeside (1925), Spieker (1949), Katich (1954), and Hayes and others (1977). Doelling (1972) compiled the geology and assembled the available coal data for the coal field.

The Emery West and Flagstaff Peak quadrangles to the northeast of the Yogo Creek quadrangle were recently mapped by Hayes and Sanchez (1977) and Sanchez and Hayes (1977). Detailed measurements and descriptions of closely spaced stratigraphic sections of the upper part of the Star Point Sandstone and the lower part of the Blackhawk Formation in those two quadrangles were made by Marley and Flores (1977). Marley, Flores, and Carovac (1978) presented in preliminary form a discussion of depositional environments and origin of rocks within the Blackhawk Formation and the Star Point Sandstone in the Wasatch Plateau. A detailed description of the lithostratigraphy of portions of these two formations was presented by Marley (1978). Coal resource occurrence and coal development potential maps for the adjoining quadrangles to the northeast (Acord Lakes), east (Old Woman Plateau), and southeast (Johns Peak) were prepared by AAA Engineering and Drafting Inc. (1979a, 1979b, and 1979c).

Stratigraphy

The coal beds of economic importance in the Wasatch Plateau coal field are Upper Cretaceous in age and are confined to the Blackhawk Formation of the Mesaverde Group. This group includes, in ascending order: Star Point

Sandstone, Blackhawk Formation, Castlegate Sandstone, and Price River Formation. The Upper Cretaceous Mancos Shale underlies the Star Point Sandstone. The North Horn Formation (Upper Cretaceous and Paleocene) overlies the Price River Formation and is overlain by the Flagstaff Limestone (Paleocene).

The oldest unit exposed in the quadrangle is the Blackhawk Formation which crops out in Meadow Creek canyon and Spring Canyon on the east side of the quadrangle and in Catamount Canyon and Niotche Creek canyon in the northwest quarter of the quadrangle. Some of the Blackhawk exposures are cut off by down-dropped fault blocks. The Blackhawk Formation is approximately 850 ft (259 m) thick (Doelling, 1972, p.35) in this quadrangle and thins eastward to 750 ft (229 m) in the Old Woman Plateau quadrangle. The formation consists of interbedded sandstone, shale, and coal beds. Marley and Flores (1977, p. ii and iii) report that "the Blackhawk Formation interfingers laterally with and locally unconformably overlies the Star Point Sandstone. . . The characteristics of the rock types of the Blackhawk Formation suggest that they represent delta-plain deposits, which grade (seaward) into the underlying delta-front and prodelta deposits of the Star Point Sandstone."

The Castlegate Sandstone is a massive, cliff-forming, yellow to gray sandstone unit. The overlying Price River Formation is composed of fine- to medium-grained sandstone with some interbedded shale and is generally less resistant than the Castlegate Sandstone. In some areas the cliff-forming characteristic of the Castlegate is not well developed and appears more like the typical Price River Formation. In the Salina Canyon area just north of the quadrangle, the Castlegate is 230 ft (70 m) thick and the Price River Formation is over 700 ft (213 m) thick (Doelling, 1972,

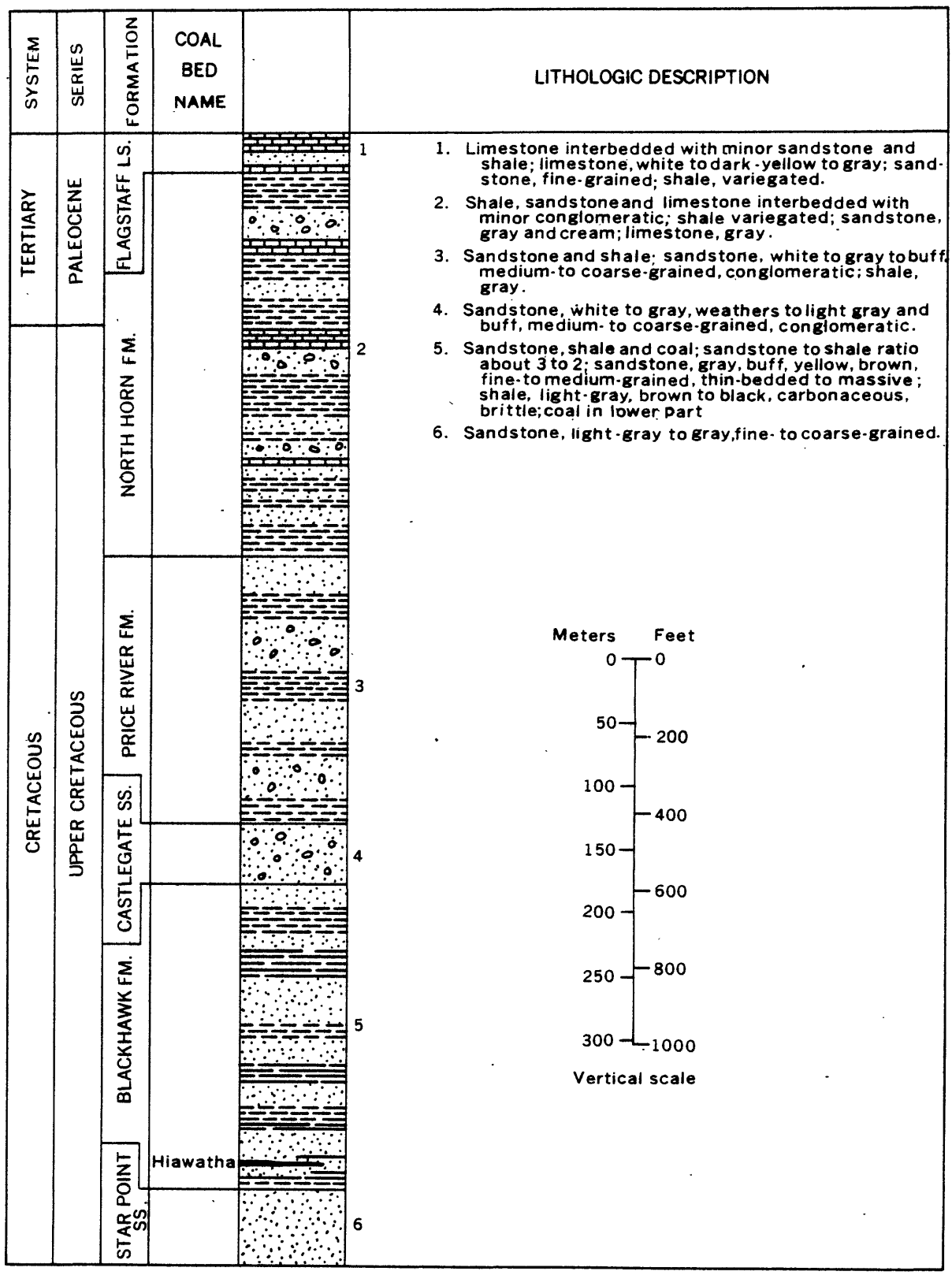


FIGURE 2. Composite columnar section, Yogo Creek Quadrangle, Sevier County, Utah.

p.38). The North Horn Formation is composed of variegated shale, sandstone, and minor conglomerate and limestone. The North Horn is 700 to 1,000 ft (213 to 305 m) thick in the Salina Canyon area (Doelling, 1972). The Flagstaff Limestone overlies the North Horn Formation and caps several down-dropped fault blocks in the quadrangle area (Hintze and Stokes, 1964; and Hintze, 1963). The formation is composed of light-gray to cream limestone with subordinate interbedded sandstone and shale.

The Bullion Canyon volcanics of Tertiary age crop out on the south side of the quadrangle around Moroni Peak. The volcanics cover a large area south of the quadrangle and effectively terminate the Wasatch Plateau coal field.

Structure

The Musinia fault zone consisting of north-south trending normal faults passes into the quadrangle from the Water Hollow Ridge quadrangle to the north. Most of these faults die out in the southern half of the Yogo Creek quadrangle (Hintze, 1963, and Hintze and Stokes, 1964). Stratigraphic displacements of 2,000 ft (610 m) or more have been observed on some of the faults in the Water Hollow Ridge qaudrangle at Skumpah Canyon and Salina Canyon (Doelling, 1972). The distance between the bounding faults of the zone is approximately 3 miles (5 km).

The Cretaceous rocks in the Yoga Creek quadrangle and the adjoining quadrangles to the north and east generally have gentle dips of less than 10 degrees.

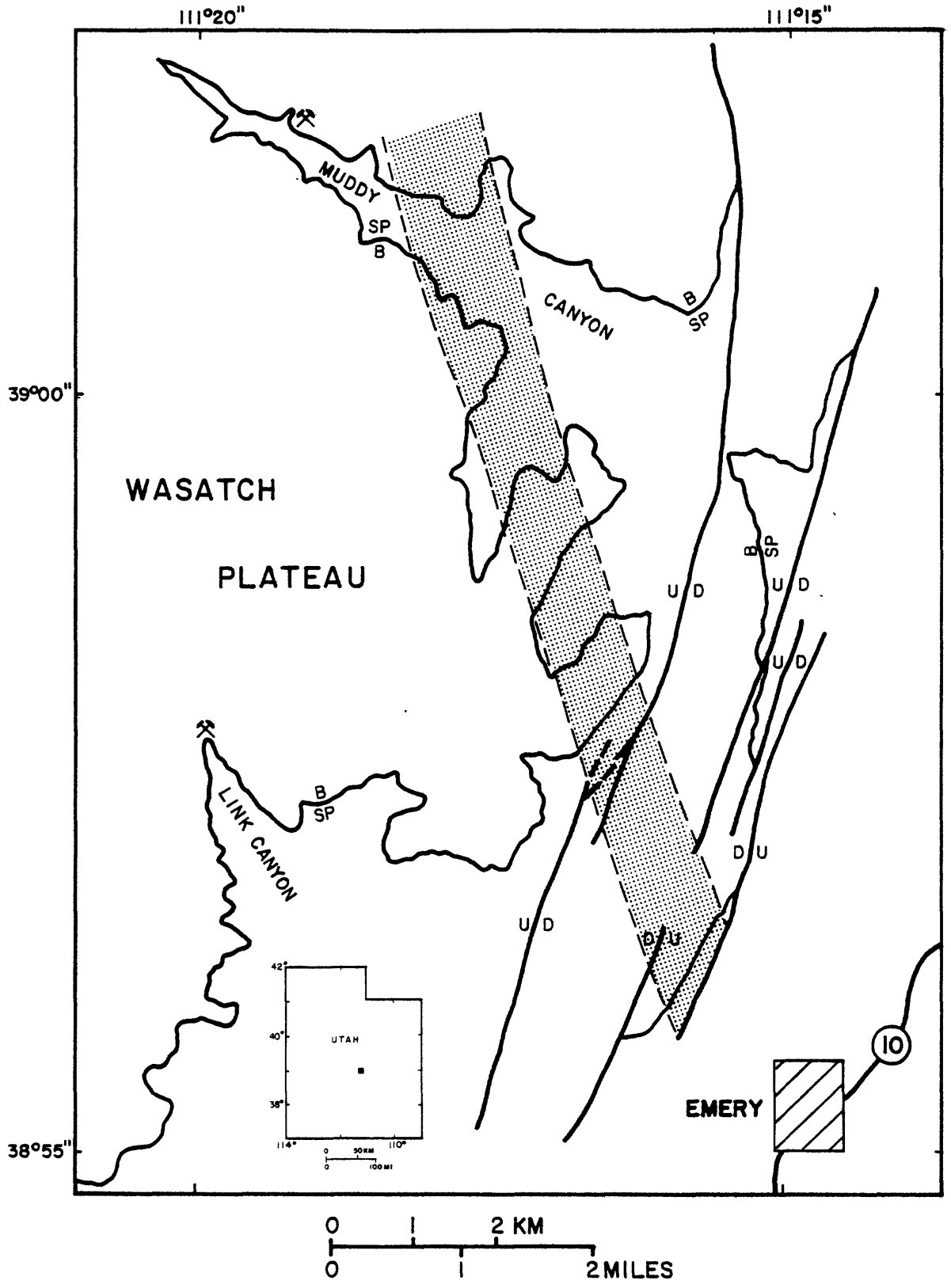
COAL GEOLOGY

Major coal beds in the southern part of the Wasatch Plateau coal field occur in the lower part of the Blackhawk Formation. Spieker (1931)

listed the following coal beds, in ascending order which occur in the adjoining Old Woman Plateau quadrangle: Hiawatha, Upper Hiawatha, Ivie, Upper Iview, and some thin local beds.

Sanchez and Hayes (1977) mapped the geology of the Flagstaff Peak quadrangle and the geology of the Emery West quadrangle (Hayes and Sanchez, 1977). Marley and Flores (1977) made detailed measurements and descriptions of closely-spaced stratigraphic sections of the upper part of the Star Point Sandstone and the lower part of the Blackhawk Formation in those quadrangles. A zone of intertonguing between the two formations was observed at several localities within a 6 mile (10 km) long and 0.6 mile (1 km) wide belt extending south-southeastward from the north wall of Muddy Creek Canyon in the Flagstaff Peak quadrangle to a point near the town of Emery in the Emery West quadrangle (figure 3). "As a result of this intertonguing, the contact between the two formations is about 20 m higher to the east than it is to the west and the coal-bed correlations of Spieker (1931) must be modified." (Flores and others, 1978).

As a consequence of the recognition of the intertonguing, a revision of the correlations of the lower Blackhawk Formation coal beds between the two sides of the intertonguing zone was suggested by Flores and others (1978). They pointed out, for example, that "the upper bed in the abandoned mine of Muddy Canyon and referred to as Muddy No. 2 coal bed by Spieker (1931) is apparently the Hiawatha coal bed. . ." and that, "The coal bed mined in the abandoned Link Canyon mine. . .and indentified by Doelling (1972) as the Upper Hiawatha coal bed merges laterally east-



EXPLANATION

ZONE OF INTERTONGUING

COAL MINE

B / SP — CONTACT BETWEEN BLACKHAWK FORMATION (B) AND STAR POINT SANDSTONE (SP)

U / D — FAULT - DASHED WHERE FAULT IS INFERRED U. UPTHROWN SIDE, D. DOWNTHROWN SIDE

FIGURE 3. Map showing zone of intertonguing (after Flores and others, 1978).

ward into the Star Point Sandstone and must be about 20 m below the stratigraphic position of the Upper Hiawatha coal bed of areas to the east of the zone of intertonguing." (Flores and others, 1978) Generalized cross sections through the zone of intertonguing are shown in figure 4.

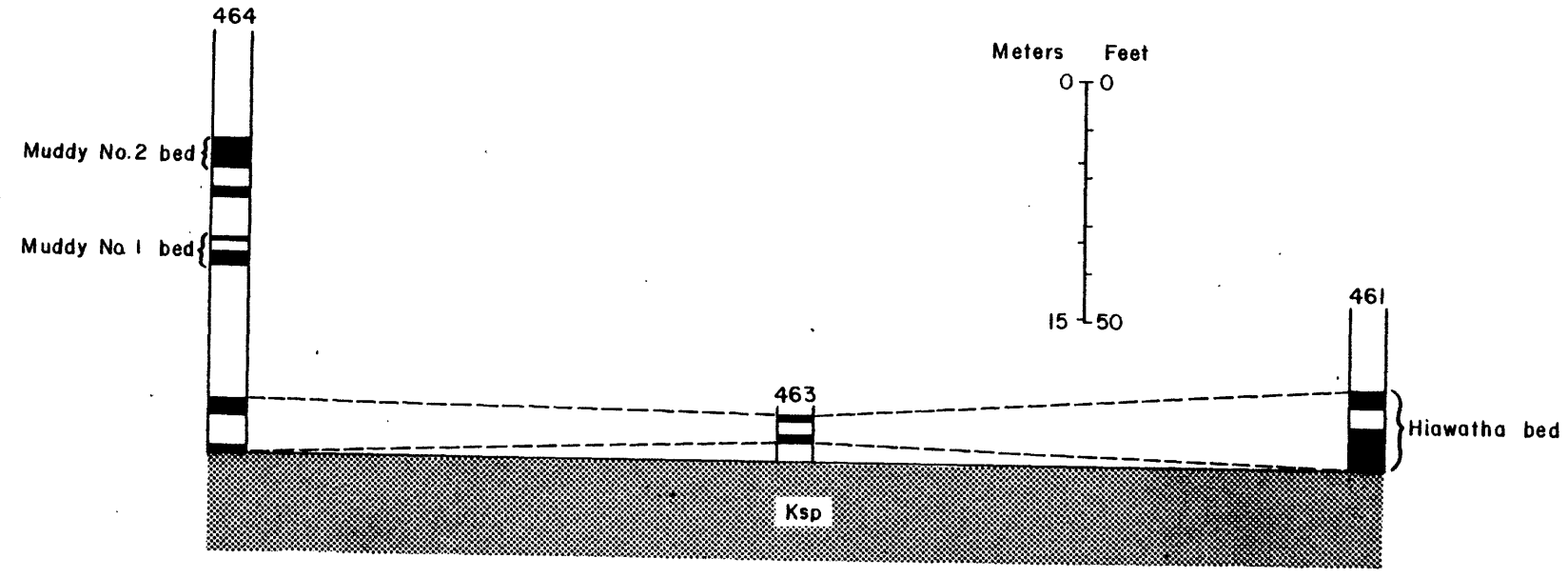
The Yogo Creek quadrangle lies approximately 15 miles (24 km) west of the zone of intertonguing and the coal-bed names used here reflect the stratigraphic correlations suggested by Flores and others (1978) in the Emery West and Flagstaff Peak quadrangles. The names "A" Bed and "B" Bed are substituted for the Hiawatha and Upper Hiawatha of Spieker (1931). Table 2 below shows the coal-bed correlations used in the adjoining Old Woman Plateau quadrangle and the Emery West quadrangle.

Table 2. Correlations of coal beds between the east and west sides of the zone of intertonguing, Old Woman Plateau and Emery West quadrangles, Sevier and Emery Counties, Utah.

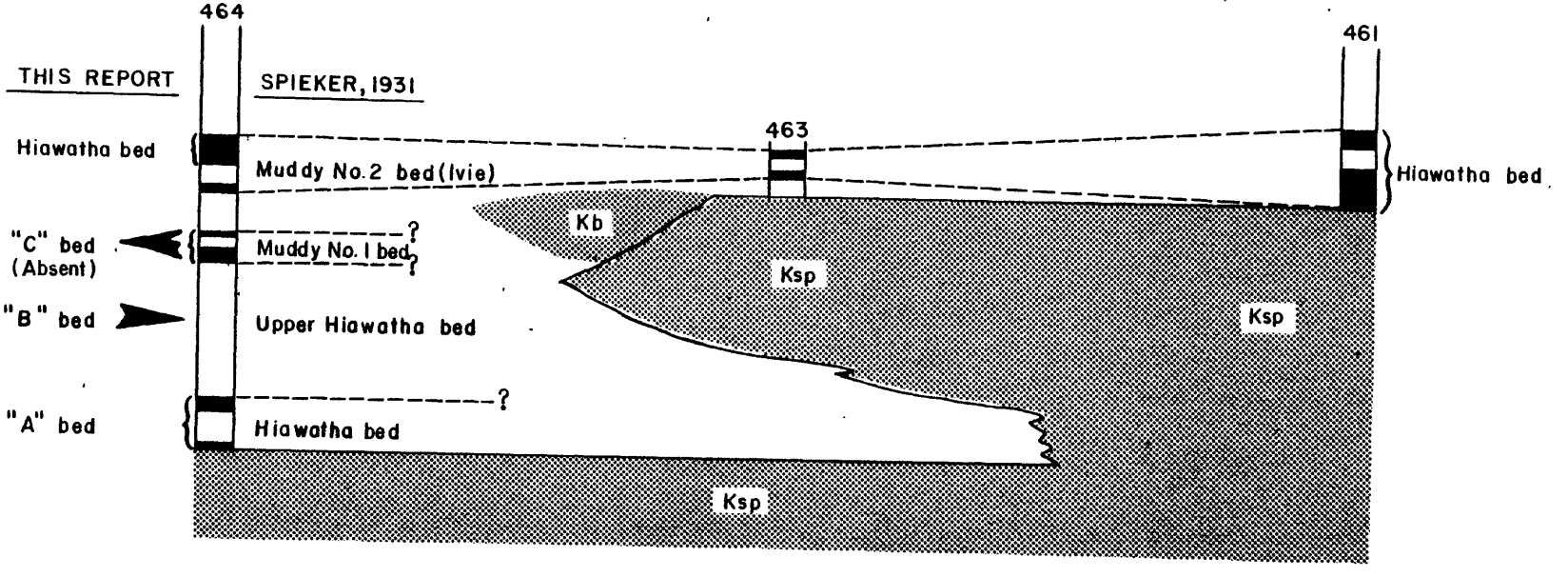
West Side of Zone of Intertonguing			East Side of Zone of Intertonguing
New Correlations Old Woman Plateau Quadrangle	New Correlations Emery West Quadrangle	Spieker (1931) and Doelling (1972)	Spieker (1931) and Doelling (1972)
			Upper Ivie
			Muddy No. 2
			Muddy No. 1
Upper Hiawatha	Upper Hiawatha	Upper Ivie	Upper Hiawatha
Hiawatha	Hiawatha	Muddy No. 2 (Ivie)	Hiawatha
(absent)	"C" Bed	Muddy No. 1	
"B" Bed	"B" Bed	Upper Hiawatha	
"A" Bed	"A" Bed	Hiawatha	

"A" Coal Bed"

The "A" coal bed occurs on the west side of the zone of intertonguing. The bed in this area is the one formerly called the "Hiawatha" coal bed by



Correlations of Spieker (1931)



Revised correlations

FIGURE 4. Generalized cross sections showing former and revised coal-bed correlations (after Flores and others, 1978).

Spieker (1931) and Doelling (1972). Based on work by Flores and others (1978) the bed merges laterally into the Star Point Sandstone about 15 miles (24 km) northeast of the quadrangle in the zone of intertonguing and is approximately 65 ft (20 m) stratigraphically below the Hiawatha coal bed on the east side of the zone.

In the Old Woman Plateau guadrangle the "A" bed is generally less than 5 ft (1.5 m) thick where it has been found. The bed was missing in the holes drilled in the western part of that quadrangle (AAA Engineering and Drafting, Inc., 1979b) and is expected to be absent in the Yogo Creek guadrangle.

"B" Coal Bed

The "B" coal bed occurs on the west side of the zone of intertonguing and was formerly called the Upper Hiawatha coal bed by Spieker (1931), Doelling (1972), and others. This bed is also missing in much of the Old Woman Plateau quadrangle. It is lenticular and thin, but reaches a thickness of over 4 ft (1.2 m) in the northeast corner of that quadrangle.

"C" Coal Bed

The "C" coal bed, formerly called the Muddy No. 1 by Spieker (1931) occurs in the Emery West quadrangle but is apparently absent in the Old Woman Plateau quadrangle.

Hiawatha Coal Bed

Based on field work by Flores and others (1978) the Hiawatha coal bed on the east side of the zone of intertonguing correlates with the coal bed formerly called the Muddy No. 2 coal bed on the west side of the zone by Spieker (1931) and Doelling (1972). In the Ivie Creek area Spieker (1931, p. 180) suggests the equivalency of the Muddy No. 2 and the Ivie coal beds. In this report the coal bed called "Hiawatha" is the one formerly called the Ivie coal bed by Spieker (1931). Points of measurements for this coal

bed occur in numerous measured sections and drill holes in the central part of the Old Woman Plateau quadrangle. There the coal bed ranges in thickness from 3.0 to 11.7 ft (0.9 to 3.6 m) in thickness. The bed apparently thin westward toward the Yogo Creek quadrangles.

Upper Hiawatha Coal Bed

The coal bed called the Upper Hiawatha in this report was formerly called the Upper Ivie coal bed by Spieker (1931) on the west side of the zone of intertonguing. The bed is generally thin and somewhat lenticular in the Old Woman Plateau quadrangle. It is missing in some of the drill holes but ranges up to 10.3 ft (3.1 m) in thickness in the other drills holes and measured sections. At most of the points where the bed has been measured in that quadrangle it is less than 5.0 ft (1.5 m) thick and is expected to have similar characteristics in the Yogo Creek quadrangle.

Local Coal Beds

Several thin non-correlatable coal beds occur at various positions in the measured sections and drill holes in the Old Woman Plateau quadrangle. Most of the local beds are very lenticular and less than 5.0 ft (1.5 m) thick.

Chemical Analyses of the Coal

No chemical analyses of coal from the Yogo Creek or Old Woman Plateau quadrangles are available. However, analyses of the Upper Hiawatha coal bed (formerly the Upper Ivie bed of Spieker, 1931) from the adjoining Acord Lakes quadrangle (Doelling, 1972) to the northeast indicate that this coal ranges in rank from high volatile C bituminous to high volatile B bituminous. Proximate analyses of coal samples from the Hiawatha coal bed (formerly Ivie bed of Spieker, 1931) from the adjoining Johns Peak quadrangle to the southeast indicate that this coal is ranked as high volatile C bituminous if it is agglomerating (American Society for Testing

and Materials, 1977). The following tables show the range and average proximate analyses of coal samples from those adjoining quadrangles.

Table 3. Average proximate analysis of coal from the Upper Hiawatha coal bed (formerly Upper Ivie bed of Spieker, 1931), Acord Lakes quadrangle, Sevier County, Utah.*

	No. Analyses	As-received (percent) Average	Range
Moisture	12	8.7	5.6-10.4
Volatile matter	11	38.3	36.2-40.6
Fixed carbon	11	46.6	43.3-50.4
Ash	12	6.5	5.9- 7.1
Sulfur	12	0.46	0.3- 0.6
Btu/lb**	11	11,770	11,390-12,260

*Doelling, 1972, p. 141
**To convert Btu/lb to Kj/kg multiply by 2.326

Table 4. Average proximate analysis of coal samples from the Hiawatha coal bed (formerly Ivie bed of Spieker, 1931), Johns Peak quadrangle, Sevier County, Utah.*

	No. Analyses	As-received (percent) Average	Range
Moisture	2	13.4	12.9-13.9
Volatile matter	2	36.2	35.2-37.2
Fixed carbon	2	43.8	43.6-43.9
Ash	2	6.7	6.0- 7.3
Sulfur	2	.6	.6
Btu/lb**	2	10,570	10,540-10,600

*After Doelling, 1972, p.96
**To convert Btu/lb to Kj/kg multiply by 2.326

Mining Operations

No coal-mining operations are known to have occured in the Yogo Creek quadrangle. However, Doelling (1972) reports that a number of old prospects are present around Ivie Creek, Red Creek, and Clear Creek canyons in the Old Woman Plateau quadrangle. The specific locations of these prospects are unknown. The only active mine in that quadrangle (1979), the Knight mine, is located in Ivie Creek Canyon in Section 34, T. 23 S., R. 4 E. The mine is producing from the Hiawatha bed (formerly the Ivie bed of Spieker, 1931). It was opened in 1923 and has been intermittently active with a 20-year period of inactivity preceding its reactivation in 1977. The total coal production from that quadrangle is unknown.

Two known coal mines occur in the Acord Lakes quadrangle. The Queatchappel or Queatch-up-pah Creek mine in Quitchupah Canyon operated intermittently from 1901-1920 and produced about 6,600 short tons (5,988 metric tons) (Doelling, 1972). The mine is now abandoned (1979). The Southern Utah Fuel mine in East Spring Canyon, a tributary of Convulsion Canyon, became active in 1941 and is presently operating (1979). Doelling (1972) reports that the mine had produced 1.1 million short tons (1.0 million metric tons) by 1969 from the Upper Hiawatha bed (formerly the Upper Ivie bed of Spieker, 1931).

COAL RESOURCES AND COAL DEVELOPMENT POTENTIAL

There are no coal bed measurements in the Yogo Creek quadrangle KRCRA and no coal beds of Reserve Base thickness have been projected into the area from adjoining quadrangles. Therefore, no coal resources are shown.

Development Potential for Surface Mining Methods

No development potential for surface mining methods exists in the KRCRA of this quadrangle because of the thick overburden. Based on the

depth and dip of the coal beds in the adjoining quadrangle to the east (AAA Engineering and Drafting, Inc., 1979a) depths to the lower Blackhawk Formation coal beds are estimated to range from 400 to 2,000 ft (122 to 610 m) in the Yogo Creek quadrangle KRCRA.

Development Potential for Subsurface Mining and In Situ Coal Gasification Methods

The coal development potential for subsurface mining of coal is based on thickness of overburden for beds dipping less than 15 degrees. Areas where coal beds 5 ft (1.5 m) or more in thickness are overlain by less than 1,000 ft (305 m) of overburden are classified as having a high development potential for subsurface mining. Areas where such beds are overlain by 1,000 to 2,000 ft (305 to 610 m) and 2,000 to 3,000 ft (610 to 914 m) of overburden are classified as having moderate and low development potentials, respectively. Areas that contain no known coal in beds 5 ft (1.5 m) or more thick, but coal-bearing units are present at depths of less than 3,000 ft (914 m) are classified as areas of unknown coal development potential. Areas where no coal beds are known to occur or where coal beds are present at depths greater than 3,000 ft (914 m) have no coal development potential.

There are no known coal bed measurements in the Yogo Creek quadrangle KRCRA. Projections of coal bed thicknesses into the quadrangle from adjoining quadrangles indicate that several coal beds probably occur in the lower part of the Blackhawk Formation in the east and northeast parts of the quadrangle and that these beds may be more or less than 5 ft (1.5 m) in thickness. These coal beds are overlain by 400 to 2,000 ft (122 to 610 m) of overburden. Even though this area may contain coal thicker than 5 ft (1.5 m) the limited knowledge of the areal distribution of the coal prevents an evaluation of development potential and therefore, the entire KRCRA

area in the Water Hollow Ridge quadrangle is classified as having an unknown development potential.

Classification of development potential for in situ coal gasification was not done because dips are less than 15 degrees within the quadrangle KRCRA. The criteria for selection of areas suitable for in situ coal gasification are a minimum coal thickness of 5 ft (1.5 m), dips of 15 to 90 degrees, and overburden greater than 200 ft (61 m) and less than 3,000 ft (914 m).

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

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