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COAL RESOURCE OCCURRENCE AND COAL DEVELOPMENT POTENTIAL MAPS OF THE NORTHWEST QUARTER OF THE HIAWATHA 15-MINUTE QUADRANGLE, EMERY AND SANPETE COUNTIES, UTAH

(Report includes 28 plates)

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."

This text is to be used in conjunction with the Coal Resource Occurrence (CRO) Maps (27 plates) and the Coal Development Potential (CDP) Map (1 plate) of the Northwest Quarter of the Hiawatha 15-minute quadrangle, Emery and Sanpete Counties, Utah (U.S. Geological Survey Open-File Report 79-487).

Published and unpublished public information were used as data sources for this study. No new drilling nor field mapping were done to supplement this study. No confidential nor proprietary information was used.

Location

The Northwest Quarter of the Hiawatha 15-minute quadrangle is located in the northern part of the Wasatch Plateau in central Utah. The town of Huntington is approximately 9 miles (14.5 km) southeast of the southeast corner of the quadrangle. The town of Hiawatha is 6 miles (9.7 km) east and 1.3 miles (2.1 km) south of the northeast corner of the quadrangle.

Accessibility

Paved Utah Highway 31 passes through the northeast part of the quadrangle in Huntington Canyon. This highway extends from the town of Huntington on the east side of the Wasatch Plateau to the town of Fairview on the west side. Unimproved dirt roads extend up several canyons tributary to Huntington Canyon and along Upper Joes Valley on the west side of the quadrangle.

The nearest railhead is on the Utah Railway Company railroad at Mohrland approximately 6 miles (9.7 km) due east of the quadrangle. To reach the railroad by highway requires traveling 10 miles (16 km) to Huntington on Utah Highway 31, about 1.8 miles (2.9 km) on Utah Highway 10, and then approximately 9 miles (14.5 km) on Utah Highway 236. The Utah Railway Company line extends from Mohrland to the city of Helper where it joins a main line of the Denver and Rio Grande Western Railroad.

Physiography

The Wasatch Plateau is a high and deeply dissected tableland which extends through central Utah over 80 miles (129 km) in a north-south direction. The eastern margin of the plateau is characterized by precipitous barren sandstone cliffs and ledges in the rugged canyons that have been cut into the high plateau area. The strata dip at low angles and the physiographic features of parallel lines of cliffs and ledges are typical of regions of flat-lying beds.

In the area of the quadrangle the terrain is mountainous with elevations ranging from 7,000 ft (2,134 m) to 10,730 ft (3,371 m). The coal exposures range in elevation from approximately 7,500 ft (2,286 m) to 8,500 ft (2,591 m). The deep canyon of Huntington Creek cuts across the northeast part of the quadrangle. Upper Joes Valley, along the west margin, is a

north-south trending fault-controlled valley with a steep scarp along its east side.

Climate

Due to the high elevations summer temperatures are cool and winter temperatures can be very cold. Maximum summer temperatures range from 80 to 90 degrees F (27 to 29 degrees C), while winter temperatures will fall to -20 degrees F (-29 degrees C) or lower. Annual normal precipitation in the quadrangle ranges from about 16 inches (41 cm) in lower Huntington Canyon to approximately 35 inches (89 cm) in the highest elevations along the west side of the quadrangle (U.S. Department of Commerce, (1964)).

Land Status

The Northwest Quarter of the Hiawatha 15-minute quadrangle is located near the center of the Wasatch Plateau Known Recoverable Coal Resource Area (KRCRA). In the quadrangle there are approximately 38,400 acres of Federal coal lands within the DRCRA boundary of which about 23,500 acres are unleased and about 4,900 acres are leased. Also within the KRCRA boundary are approximately 4,400 acres of non-Federal coal lands.

GENERAL GEOLOGY

Previous Work

Spieker (1931) mapped the Wasatch Plateau and his work is the most detailed presently available. The stratigraphy of the area is further described by Spieker and Reeside (1925) and Katich (1954). Doelling (1972) has summarized the geology and updated the coal data described by the earlier workers.

Stratigraphy

The coal beds of economic importance in the Wasatch Plateau field are Upper Cretaceous in age, and are confined to the Blackhawk Formation of the Mesaverde Group. The Mesaverde group consists of four formations which

are, in ascending order, the Star Point Sandstone, Blackhawk Formation, Castlegate Sandstone, and Price River Formation. The Upper Cretaceous Mancos Shale underlies the Mesaverde group and consists of three shale members, the Tunuk at the base, the Blue Gate and the Masuk interbedded with two sandstone members, the Ferron Sandstone and Emery Sandstone Members.

The oldest rocks which crop out in the quadrangle are the blue-gray sandy shales of the Masuk Shale Member of the Mancos Shale. This unit is exposed in the bottom of Huntington Canyon and a short distance into some of the tributary canyons.

The Star Point Sandstone overlies the Masuk and represents a change from offshore to nearshore and beach environments. The yellowish-gray, thick-bedded to massive sandstone bounds the lower part of Huntington Canyon and its tributaries and is between 245 and 350 ft (75 and 107 m) thick. The overlying Blackhawk Formation is 625 ft (191 m) thick in the southwest part of the quadrangle and consists of alternating sandstone, shale, and coal. The important coal seams are located in the lower 400 ft (122 m) of the formation.

The cliff-forming Castlegate Sandstone overlies the Blackhawk Formation and underlies the less-resistant Price River Formation. The Castlegate Sandstone is about 250 ft (76 m) thick and the Price River Formation about 500 ft (152 m) thick. The Castlegate consists of massive to thick-bedded gray to white, coarse-grained, gritty sandstone, with minor interbedded shale. The Price River Formation is similar in lithology but is more thinly bedded and contains a higher percentage of shale.

The overlying Tertiary strata consist of two formations of the Wasatch Group: the North Horn Formation (Upper Cretaceous and Paleocene) at the base and the Flagstaff Limestone (Paleocene). The North Horn Formation makes up most of the upper surface of East Mountain, where it consists of

about 750 ft (229 m) of variegated shale and subordinate interbedded sandstone and limestone. It is also exposed in Upper Joes Valley. The Flagstaff Limestone consists of yellowish-gray to cream-colored limestone with minor amounts of interbedded sandstone, shale, and volcanic ash and is exposed in isolated patches on East Mountain in the south part of the quadrangle.

Structure

Most of the quadrangle is a large block relatively free of faults. Two faults of the Pleasant Valley fault zone cross the southeast and northeast corners of the quadrangle. Joes Valley fault and Joes Valley graben lie along the west side of the quadrangle. The strata between the faults on the east and west sides of the quadrangle are nearly horizontal; dips rarely exceed 3 degrees.

COAL GEOLOGY

Six coal beds are Reserve Base thickness in the Northwest Quarter of the Hiawatha 15-minute quadrangle. The beds occur in the lower part of the Blackhawk Formation and their generalized vertical distribution is shown in the Composite Columnar Section (plate 3). The lowest of the six beds, the Hiawatha, lies on the Star Point Sandstone and is overlain by a non-coal interval of 40 to 55 ft (12 to 17 m) and the Blind Canyon coal bed. In a small area south of the township line between T. 15 S. and T. 16 S. on the east side of the quadrangle, the Blind Canyon bed occurs as the Upper Blind Canyon and Lower Blind Canyon beds. The lower split is thin and of limited extent. A non-coal interval of 25 ft (7.6 m) occurs between the Blind Canyon bed and the next highest coal named the Third Bed. In the southeast part of the quadrangle the next coal above the Third Bed is the Bear Canyon bed which is from 40 to 60 ft (12 to 18 m) above the Third Bed. In the northeast part of the quadrangle a coal bed 55 ft (17 m) above the

Third Bed is called the Fourth Bed, although its stratigraphic position suggests a correlation with the Bear Canyon bed. The uppermost coal bed of Reserve Base thickness in the quadrangle is the Castlegate "A" bed which is separated from the underlying Fourth Bed by a non-coal interval of 65 ft (20 m). Several thin lenticular local coal beds occur between the main beds referred to above. The six main coal beds are known from outcrops confined to the eastern half of the quadrangle. Data from only one drill hole was available. This hole was drilled on the west side of the quadrangle on the east side of the Joes Valley Fault.

Intervals reported as "bony coal," "bone," "shaly coal," or other similar terms in the data sources are shown as "rock" intervals in this report on plates 1 and 3. These bony coal intervals were not included in the coal thicknesses used to construct the coal isopach maps.

Chemical Analyses of the Coal

Only 41 coal analyses are available for the quadrangle and these represent the Blind Canyon and Hiawatha beds. The analyses have been summarized by Doelling (1972) and are shown in the following table.

Table 1. Average proximate coal analyses, Northwest Quarter of the Hiawatha 15-minute quadrangle, Emery and Sanpete Counties, Utah.

	No. Analyses	As received (percent)	
		Average	Range
Moisture	41	4.9	3.1-6.9
Volatile matter	35	43.4	40.4-46.0
Fixed carbon	35	45.7	43.5-51.1
Ash	41	6.0	2.8-10.7
Sulfur	40	0.55	0.28-0.80
Btu/lb*	35	13,080	12,290-13,690

* To convert Btu/lb to Kj/kg multiply by 2.326

On the basis of the above average analysis the coal from the Hiawatha and Blind Canyon beds is classified, according to the ASTM system of classification (American Society for Testing and Materials, 1977), as borderline between high-volatile bituminous B rank and high volatile bituminous A rank. Details of the above analyses and other test results including carbonization product yields are given in Doelling (1972).

Castlegate "A" Coal Bed

The Castlegate "A" bed is present in the northeast corner of the quadrangle and attains Reserve Base thickness in only a small area. The maximum measured thickness is 8.8 ft (2.7 m) and on the isopach map, (plate 4) the portion of the bed which reaches this thickness is a narrow lenticular mass which thins and apparently pinches out southward. The bed, however, thickens northward in the adjoining quadrangle.

Fourth Bed Coal Bed

The area where the Fourth Bed is of Reserve Base thickness is localized in the north central part of the quadrangle where the maximum thickness measured is 5.8 ft (1.8 m). The area of Reserve Base thickness is small because of the limited number of outcrop measurements and absence of drill holes.

Third Bed Coal Bed

The limited data for the Third Bed shows that it reaches Reserve Base thickness in the north central part of the quadrangle and apparently thickens somewhat in a westerly direction. The maximum measured thickness is 5.5 ft (1.7 m).

Bear Canyon Coal Bed

Outcrop measurements show that the Bear Canyon coal bed reaches a maximum thickness of 16 ft (5 m) in Mill Fork Canyon near the central part of the southeast quarter of the quadrangle. The bed thins to less than

5 ft (1.5 m) north of Crandall Canyon and exhibits a small area of thinning in Rilda Canyon. The hole drilled in Section 22, T. 16 S., R. 6 E. encountered the Bear Canyon as three beds, 3.6 ft (1.1 m), 2.9 ft (0.9 m), and 1.0 ft (0.3 m) thick which had apparently split from the thicker single bed measured on the east side of the quadrangle. The sparcity of thickness data for the bed only allows an estimate of the location of the split line of the bed which has been placed near the center of the quadrangle (plate 16).

Blind Canyon Coal Bed

The Blind Canyon coal bed is lenticular and is Reserve Base thickness in three local areas in the quadrangle; the southeast corner, east center, and northeast corner. It reaches its maximum thickness of 11.5 ft (3.5 m) in the southeast corner of the quadrangle, but in the northern half of the quadrangle it splits into two seams. The lower split pinches out northward and then farther north in the extreme northeast corner of the quadrangle the upper split pinches out. The upper split reaches a maximum recorded thickness of 7.5 ft (2.3 m) before it pinches out.

Hiawatha Coal Bed

The Hiawatha coal bed is somewhat lenticular in the eastern part of the quadrangle. The absence of drill holes in the central and western parts of the quadrangle prevent the extension of isopach and structure contour lines in those areas. The maximum measured thickness of the Hiawatha bed in the quadrangle occurs in the southeast corner where it is 13.5 ft (4.1 m) thick. In Huntington Canyon near the eastern edge of the quadrangle, the bed is 10 ft (3 m) thick. The Hiawatha bed appears to thin westward and northward although it may be Reserve Base thickness over a larger part of the area than the isopach map (plate 24) indicates.

MINING OPERATIONS

At least six mines have produced some coal from the quadrangle area. Most of these mined the Hiawatha bed, although one or two operated on the Blind Canyon bed. The Leamaster mine in Mill Fork had been the largest producer with a total production of almost 127,000 short tons by 1964 when it became inactive.

Up to 1969 the total coal mined from the quadrangle was about 232,500 short tons (Doelling, 1972). In 1977 the Swisher Coal Company reopened the Leamaster mine and commenced mining the Blind Canyon bed. This mine is now known as Swisher No. 4 mine.

The following table lists the known mines and their approximate locations and productions (after Doelling, 1972).

COAL RESOURCES

The principal sources of data used in the construction of the coal isopach maps, structure contour maps, and the coal data map were Doelling (1972) and Spieker (1931).

Coal resource tonnages were calculated for measured, indicated, and inferred categories in unleased areas of Federal coal land within the KRCRA boundary. Data obtained from the coal isopach maps (plates 4, 8, 12, 16, 20, and 24) were used to calculate the Reserve Base values. The coal-bed acreage (measured by planimeter) multiplied by the average isopached thickness of the coal bed times a conversion factor of 1,800 short tons of coal per acre-foot of bituminous coal yields the coal resources in short tons of coal for each isopached coal bed. Reserve Base and Reserve values for the Castlegate "A", Fourth Bed, Third Bed, Bear Canyon, Blind Canyon, and Hiawatha beds are shown on plates 7, 11, 15, 19, 23, and 27 respectively and are rounded to the nearest tenth of a million short tons. The Reserve values are based on a subsurface mining recoverability factor of 50 percent.

Table 2. Mines and their locations and productions, Northwest Quarter of the Hiawatha 15-minute quadrangle, Emery and Sanpete Counties, Utah.

Mine	Approximate Location	Remarks	Bed Mined	Estimated Production (Short tons)*
Swisher No. 4 (Leamaster, Mill Fork)	SE¼ NE¼ SW¼ Sec. 16 T. 16 S., R. 7 E.	Active 1943 - 1964, 1977 -	Hiawatha and Blind Canyon	127,000 (to 1964)
Helco mine (Black Magic, Rilda Canyon)	NW¼ NW¼ SW¼ Sec. 28 T. 16 S., R. 7 E.	Active 1938 - 1969	Blind Canyon (?)	32,000
Tip Top mine (Sam and Jim's, Jim Peterson)	SW¼ SW¼ NE¼ Sec. 29 T. 16 S., R. 7 E.	Active 1939 - 1956	Hiawatha	41,500
Comfort mine (Smith)	SE¼ SW¼ NW¼ Sec. 28 T. 16 S., R. 7 E.	Active 1936 - 1954	Hiawatha	44,000
Rominger mine	SW¼ SW¼ NW¼ Sec. 28 T. 16 S., R. 7 E.	Intermittently active 1938 - 1954	Hiawatha	Less than 3,000
Johnson mine	SW¼ SW¼ NE¼ Sec. 29 T. 16 S., R. 7 E.	Active 1943 - 195?	Hiawatha	Less than 3,000

* To convert short tons to metric tons, multiply by 0.9072

"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 ½ mile (0.8 km) apart. Measured coal is projected to extend as a 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 1/2 (0.8 km) to 1 1/2 miles (2.4 km) apart. Indicated coal is projected to extend as a 1/2-mile (0.8 km) wide belt that lies more than 1/4 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 for which there is geologic evidence. The points of observation are 1 1/2 (2.4 km) to 6 miles (9.6 km) apart. Inferred coal is projected to extend as a 2 1/4-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).

Coal Reserve Base tonnages per Federal section are shown on plate 2 and total approximately 147.7 million short tons (134.0 million metric tons) for the unleased Federal coal lands within the KRCRA boundary in the Northwest Quarter of the Hiawatha 15-minute quadrangle.

The Reserve Base tonnages shown in the following tabulation are for unleased Federal coal lands which lie within the KRCRA of the quadrangle.

Table 3. Coal Reserve Base data for subsurface mining methods for Federal coal lands (in short tons) in the Northwest Quarter of the Hiawatha 15-minute quadrangle, Emery and Sanpete Counties, Utah.

(To convert short tons to metric tons, multiply by 0.9072)

Coal bed name	High Development Potential	Moderate Development Potential	Low Development Potential	Total
Castlegate "A"	4,170,000	-0-	-0-	4,170,000
"Fourth Bed"	11,760,000	60,000	-0-	11,820,000
"Third Bed"	11,020,000	-0-	-0-	11,020,000
Bear Canyon Bed	39,540,000	16,910,000	-0-	56,450,000
Blind Canyon	26,500,000	2,790,000	-0-	29,290,000
Hiawatha	20,220,000	14,720,000	-0-	34,940,000
Total	113,210,000	34,480,000	-0-	147,690,000

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

COAL DEVELOPMENT POTENTIAL

Development Potential for Surface Mining Methods

No development potential for surface mining methods exists in the area of this quadrangle because of the rugged topography, steep-sided canyons, extreme relief, and thick overburden. There may be very small areas where some rim stripping could be done, but in general the area is not conductive to surface mining methods.

Development Potential for Subsurface Mining and In Situ Gasification

The coal development potential for the subsurface mining of coal is shown on plate 28. In this quadrangle the 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 considered to have a high development potential for subsurface mining.

Areas where such beds are overlain by 1,000-2,000 ft (305-610 m) and 2,000-3,000 ft (610-914 m) of overburden are rated as having a moderate and a low development potential 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 (194 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 areas of unleased Federal coal land within the KRCRA in the Northwest Quarter of the Hiawatha 15-minute quadrangle that are known to fall within "low" development potential classifications.

The designation of a coal development potential classification is based on the occurrence of the highest-rated coal-bearing area that may occur within any fractional part of a 40-acre BLM land grid area or lot area of unleased Federal coal land. For example, a certain 40-acre area is totally underlain by a coal bed with a "moderate" development potential. If a small corner of the same 40-acre area is also underlain by another coal bed with a "high" development potential, the entire 40-acre area is given a "high" development potential rating even though most of the area is rated "moderate" by the lower coal bed. Another possibility is a 40-acre

area devoid of any coal except a small corner where a 5-ft (1.5 m) coal bed crops out. In this case the 40-acre area will have a "high" development potential rating.

In the quadrangle approximately 9,600 acres of unleased Federal land have a high development potential rating, 3,000 acres have a moderate development potential rating, approximately 10,060 acres are classified as having an unknown potential, while 840 acres have no coal-development potential.

The in situ coal gasification methods of development potential classification are based on the dip and depth of coal beds having a minimum thickness of 5 ft (1.5 m). There are only two development potential classifications--moderate and low. The criteria for in situ classifications include coal bed dips of 15 to 90 degrees and coal bed depths of 200-3,000 ft (61-914 m). Inasmuch as the coal beds dip less than 15 degrees in this quadrangle, the in situ coal gasification methods of development potential classification do not apply.

The following table summarizes the sources of data used to compile plate 1.

Table 4. Sources of data used on plate 1.

Source	Plate 1-Index Number	Data Base Drill Hole or Measured Section No.	Page No.
Spieker, E.M., 1931	1	207	pl.21
	2	206	pl.21
	3	208	pl.21
	4	209	pl.21
	5	210	pl.21
	6	211	pl.21
	7	212	pl.21
	8	213	pl.21
	10	215	pl.21
	12	216	pl.22
	13	219	pl.22
	14	220	pl.22
	15	221	pl.22
	16	222	pl.22
	18	225	pl.22
	20	228	pl.22
	21	227	pl.22
	22	229	pl.22
	23	230	pl.22
	24	231	pl.22
	25	232	pl.22
	26	233	pl.22
	27	234	pl.22
	29	235	pl.22
	31	244	pl.22
	32	245	pl.22
	33	246	pl.22
	35	263	pl.22
Doelling, H.H., 1972	9	12,18, and 34	192
	11	5,22, and 23	192
	17	37, and 61	192 and 193
	19	19 and 51	192
	28	7.43, and 69	192 and 193
	34	9.46, and 75	192 and 193
	36	48 and 76	192 and 193
Davis, F.D., and Doelling, H.H, 1977	30	Drill hole No. 2	23 to 34

REFERENCES

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