Text to accompany:

Open-File Report 78-062
1978

COAL RESOURCE OCCURRENCE MAPS OF THE LONE HAYSTACK MOUNTAIN QUADRANGLE, CARBON COUNTY, WYOMING

(Report includes 3 plates)

Prepared for:

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

Prepared by:

TEXAS INSTRUMENTS INCORPORATED
DALLAS, TEXAS

This report has not been edited for conformity with U.S. Geological Survey editorial standards or stratigraphic nomenclature.

CONTENTS

ILLUSTRATIONS

[Plates are in pocket]

APPENDICES

INTRODUCTION

Purpose

This text is to be used along with the acompanying Coal Resource Occurrence (CRO) Maps of the Lone Haystack Mountain quadrangle, Carbon County, Wyoming (3 plates; U.S. Geol. Survey Open-File Report 78-062), prepared by Texas Instruments Incorporated under contract to the U.S. Geological Survey. This report was prepared to support the land planning work of the U.S. Bureau of Land Management's Energy Minerals Activities Recommendation System (EMARS) program, and to contribute to a systematic coal resource inventory of Federal coal lands in Known Recoverable Coal Resource Areas (KRCRA) in the western United States. The Coal Resource Occurrence maps for this quadrangle cover part of the extreme western portion of the Hanna coal field. The lack of correlatable coal of Reserve Base thickness in this quadrangle, as indicated on the CRO maps, precluded the construction of Coal Development Potential (CDP) maps which normally accompany this type of report.

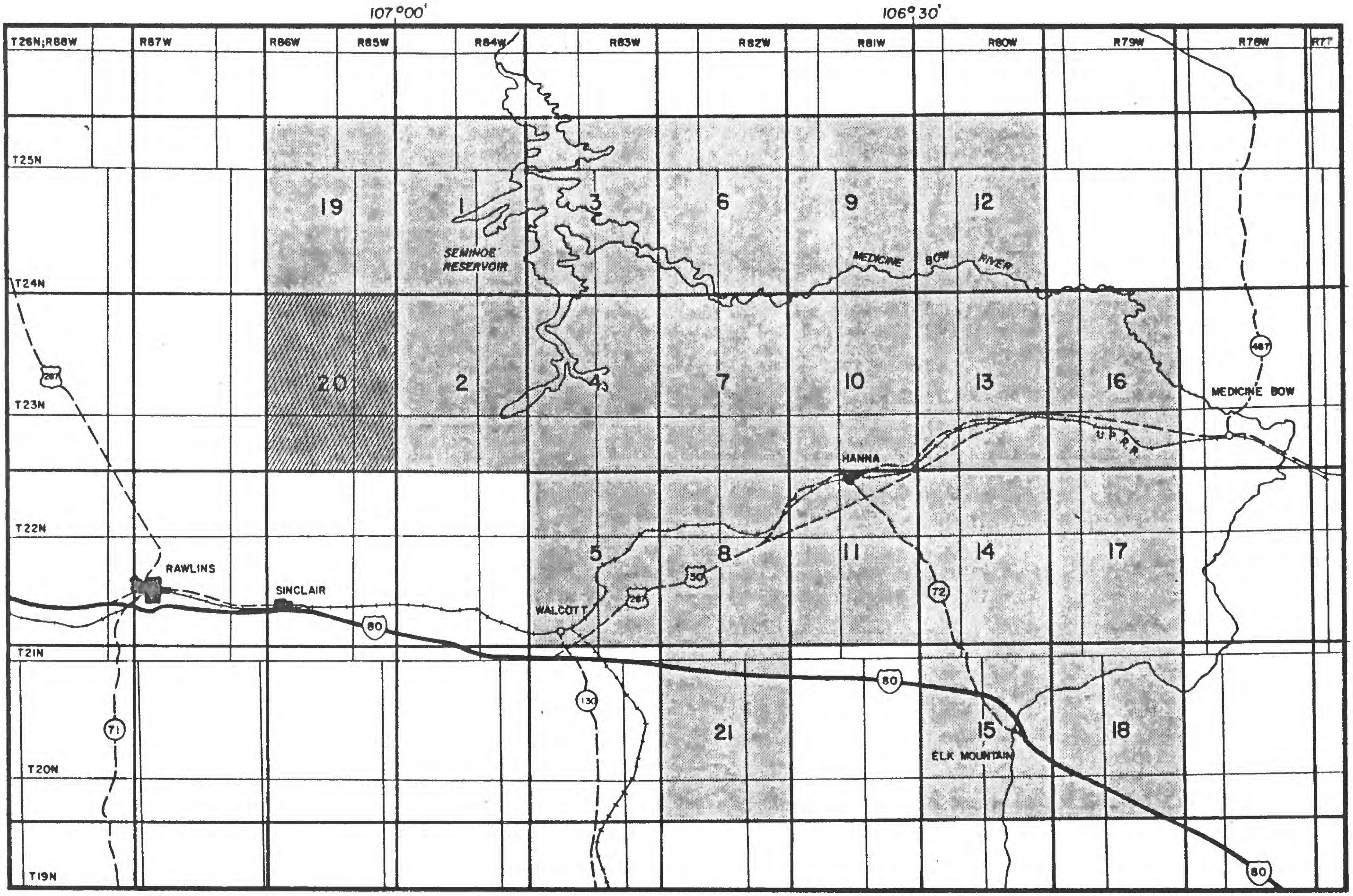
Acknowledgement

Texas Instruments Incorporated acknowledges the cooperation of the Rocky Mountain Energy Company, a wholly owned subsidiary of the Union Pacific Railroad Company, in supplying copies of survey sheets, drillers reports, electric logs, and coal analyses from the Union Pacific coal inventory program.

The Hanna and Carbon coal basins were studied as part of the Union Pacific coal inventory program and test drilling was conducted in 1970-1971. More than 650 Union Pacific coal drill holes have been evaluated as part of this contract study of 21 quadrangles in Carbon County, Wyoming, and the results of 230 coal analyses have been incorporated into these reports.

Location

The Lone Haystack Mountain 7½-minute quadrangle is in the northwestern part of Carbon County, Wyoming. The center of the quadrangle is approximately 14 miles (22 km) northeast of Rawlins and 17 miles (27 km) northwest of Walcott, Wyoming (Figure 1).



Lone Haystack Mountain quadrangle (20)

Scale 1:446,000

Figure 1. — Map of Hanna and Carbon Basins study area

Accessibility

Seminoe Road, classified as a secondary highway, crosses the quadrangle from southwest to northeast and connects with State Highway 220 to the north and State Highway 487 to the northeast. To the south, it connects with Interstate Highway 80 at Sinclair, Wyoming. Several local unimproved dirt roads provide access east and west from Seminoe Road.

The main east-west track of the Union Pacific Railroad is 11 miles (18 km) south of the center of the quadrangle and passes through the towns of Medicine Bow, Hanna, Walcott, Sinclair, and Rawlins.

Physiography

The quadrangle is on the western edge of the Hanna structural basin which, in this area, is bounded on the west by the Haystack Mountains. These mountains occupy the western half of the quadrangle and attain elevations in excess of 7,500 feet (2,286 m). The undulating high plains grasslands in the eastern half of the quadrangle are less than 6,800 feet (2,073 m) in elevation. Lone Haystack Mountain, a prominent north-northwest trending ridge in secs. 30 and 31, T.23N., R 85W., has a maximum elevation of 7,163 feet (2,183 m). The North Platte River flows easterly across the southeast part of the quadrangle; it empties into Seminoe Reservoir less than two and one-half miles (4 km) east of the quadrangle. Many minor intermittent streams drain the eastern slopes of the Haystack Mountains, flowing east into Seminoe Reservoir or, in some cases, disappearing as their gradients flatten near the eastern limits of the quadrangle.

Climate

The climate is semiarid with a mean annual temperature of 43°F (6°C) and extremes ranging from 98°F to -31°F (37°C to -35°C) as recorded at the Seminoe Dam Weather Substation (U.S. Dept. of Interior, 1975). Average annual precipitation at that location is 12 inches (30 cm). Forty-two percent of the precipitation falls as rain in April, May, and June, with the major portion of the remainder falling as snow in the winter months. High winds are common throughout most of the year. The average growing season is generally 60 to 70 days, from late April to early June. High temperatures and lack of precipitation restrict vegetative growth in late summer and frosts occur from September through April.

Land Status

The quadrangle is less than one mile (1.6 km) west of the Hanna and Carbon Basins Known Recoverable Coal Resource Area. The Federal Government owns approximately 40 percent of the coal rights in the quadrangle; the remaining 60 percent is non federally owned. There are no abandoned coal mines in the quadrangle. There are no known active leases, permits, or licenses and no active mining operations. Plate 2 illustrates the ownership status of the land in the quadrangle.

GENERAL GEOLOGY

Previous Work

Dobbin, Bowen, and Hoots (1929) mapped the area immediately to the east of the quadrangle and reported on the coal and oil resources of the Hanna and Carbon Basins. Weitz and Love (1952) compiled a geological map of Carbon County which incorporates available data, published and unpublished, to that date. Gill, Merewether, and Cobban (1970) defined and correlated the stratigraphic units exposed in this quadrangle.

Merewether (1973) mapped the geology of this quadrangle from 1969 to 1971. His map and sections served as the primary source of the following summary.

Stratigraphy

Rocks exposed in the Lone Haystack Mountain quadrangle are of Late Cretaceous age with the exception of scattered Quaternary deposits. Coal beds are found in the nonmarine formations of the Mesaverde Group.

The oldest rocks exposed are those of the Haystack Mountains Formation which is the basal unit of the Mesaverde Group. The formation consists of thick units of marine sandstone deposited in nearshore and offshore environments interbedded with thick units of marine shale deposited in deeper water environments. Four distinctive sandstone members have been mapped, of which the lower three are named: in ascending order, they are the Tapers Ranch

Sandstone, O'Brien Spring Sandstone, and the Hatfield Sandstone. The uppermost sandstone member, the three interbedded shale members, and an overlying shale member are unnamed. The marine sandstones are generally pale yellowish gray, very fine to fine grained, very thin to thin bedded, and commonly burrowed. The sandstone units generally have a gradational base and are as much as 275 feet (84 m) thick. The marine shales are gray to brownish gray and consist mostly of clay and sandy clay with fossiliferous concretions. The shales are interbedded with gray to dark gray siltstones and the units are as much as 700 feet (213 m) thick. Gill, Merewether, and Cobban (1970) report a thickness of 2,544 feet (775 m) for the Haystack Mountains Formation at the type locality in the Sinclair quadrangle immediately to the south. Merewether (1973) indicates a thickness of 2,160 feet (658 m) for the formation in the Lone Haystack Mountain quadrangle.

Conformably overlying the Haystack Mountains Formation with a sharp and abrupt contact is the dominantly nonmarine Allen Ridge Formation. The lower and major portion of the formation consists of a thick sequence of fluviatile sandstones and shales that weather brown and rusty brown. The sandstones are gray, fine grained, and silty: the shales are gray to grayish black, silty, and carbonaceous. Coal beds occur in this part of the formation. Overlying the thick basal unit is a thinner marine sequence composed of yellowish-gray fine-grained sandstones and dark-gray to dull-olive shales and siltstones. The marine unit grades upwards at the top of the formation to brackish-water sediments which consist of yellowish-gray fine-grained sandstones and brownish-gray carbonaceous shales with a few coal beds. Total thickness of the Allen Ridge Formation in this quadrangle is 1,295 feet (395 m).

Overlying the Allen Ridge Formation with apparent unconformity is the nonmarine Pine Ridge Sandstone. The formation consists mainly of pale-yellowish-gray fine-grained sandstones that weather light gray to white. The unit also includes beds of light gray carbonaceous siltstones, sandy carbonaceous shales and thin beds of impure coal. In this quadrangle the Pine Ridge Sandstone is 140 feet (43 m) thick.

Conformably overlying the Pine Ridge Sandstone is the Almond Formation, the uppermost formation of the Mesaverda Group. The formation is a sequence of fluviatile, brackish-water, and nearshore marine rocks that intertongue with the overlying Lewis Shale. The unit consists of yellowish-gray to dusky-yellow very fine grained thin-bedded sandstones, gray sandy siltstones, and gray to dark-gray silty carbonaceous shales. In this quadrangle the Almond Formation contains the most abundant coal exposures. The total thickness for the Almond Formation reported for the quadrangle is 565 feet (172 m).

The marine Lewis Shale overlies the Almond Formation with a gradational and conformable contact. In this quadrangle four distinct shale units and three distinct sandstone units are mapped. The uppermost sandstone unit is named the Dad Sandstone Member and the remaining units are unnamed. Sandstones of the Lewis Shale are pale yellowish gray to brown, very fine to medium grained, and thin bedded to massive. The shales are dark gray to olive gray, silty to sandy, and interbedded with yellowish-gray siltstones. The reported thickness for the Lewis Shale in this quadrangle is 2,210 feet (674 m).

The Fox Hills Formation conformably overlies the Lewis Shale. The unit represents a transitional depositional environment from marine to lagoonal and continental as the Cretaceous sea withdrew from the area. The Fox Hills consists dominantly of thick units of friable sandstone but also includes shale units. The sandstone is pale yellowish gray, very fine to fine grained, thin bedded to massive, cross bedded, and ripple marked. The shale units are olive gray to dark gray and sandy. Thin beds of carbonaceous shale and thin beds of impure coal are reported in the formation in other areas but do not occur in the limited exposures in the Lone Haystack Mountain quadrangle. The reported thickness of the Fox Hills in this quadrangle is 485 feet (148 m).

The Medicine Bow Formation conformably overlies the Fox Hills Formation and is a thick unit of continental beds ranging from 4,000 to 6,200 feet (1,219 to 1,890 m) thick. The formation consists of light-gray fine-grained partly silty sandstones, gray to grayish-black silty partly carbonaceous shales, and light-gray to grayish-black sandy partly carbonaceous siltstones. Numerous coal beds occur in the lower part of the formation. In the Lone Haystack Mountain quadrangle only the basal few hundred feet of the Medicine Bow Formation are exposed in the extreme northeast corner. This limited exposure is stratigraphically lower than the coal horizons.

Quaternary alluvium occurs in most of the modern drainage channels. Quaternary pediment deposits are found along the east side of the mountain front and terrace gravel deposits occur along the banks of the North Platte River in the southeastern part of the quadrangle.

Structure

The Lone Haystack Mountain quadrangle lies on the extreme western edge of the Hanna Basin and on the eastern edge of the Rawlins Uplift. In the eastern part of the quadrangle a series of parallel arcuate faults are mapped which are concave to the east and downthrown predominantly to the east. This fault zone approximates the western edge of the Hanna Basin. The Hanna Basin is a relatively small intermontane basin but it is very deep. It extends 40 miles (64 km) east-west, 25 miles (40 km) north-south, and contains in its central portion approximately 30,000 to 35,000 feet (9,140 to 10,670 m) of sediments overlying crystalline basement. In this quadrangle the sediments are about 5,300 feet (1,615 m) thick in the southwest corner and about 15,800 feet (4,816 m) thick in the northeast corner (Knight, 1951, p. 46).

The present Hanna Basin was primarily defined during the Laramide Orogeny. At that time the bordering highlands of the basin were raised and deformed and sediments accumulated rapidly. The present basin structure is characterized by complexly folded and faulted borders, with relatively mild deformation within the basin expressed by a few broad folds and normal faults. The Late Cretaceous sea retreated from the area in Late Haystack Mountains time and again in Fox Hills time with a resultant change from marine to continental depositional environments.

In the Lone Haystack Mountain quadrangle several large folds are mapped. The Haystack anticline in the northwestern part of the quadrangle has an easterly trend that changes to south-southeasterly, to roughly parallel the edge of the Hanna Basin. The anticline is complicated by several large high-angle reverse faults and low-angle thrust faults. The Cedar Ridge anticline in the southeast part of the quadrangle has a south-southeasterly trend that also roughly parallels the southwestern edge of the Hanna Basin. This latter anticline is also complicated by several large faults. The Lost Springs syncline is mapped one to one and one-half miles

(1.6 to 2.4 km) west of the Cedar Ridge anticline and parallels the trend of the anticline. Dips in the quadrangle vary from 5° to 30°, except for a local steepening to 70° on the west flank of the Haystack anticline in the center of the quadrangle.

COAL GEOLOGY

Previous Work

The coal deposits of the Hanna and Carbon Basins have been studied by Veatch (1907), Dobbin, Bowen, and Hoots (1929), Berryhill and others (1950), and Glass (1972 and 1975).

Twenty-six coal analyses have been published since 1913 for coal beds of the Mesaverde Group and the Medicine Bow, Ferris, and Hanna Formations within the Hanna and Carbon Basins (Appendices 1 and 2). Samples collected and analyzed prior to 1913 have not been considered in this report (American Society for Testing and Materials, 1977, p. 218). An average analysis of coal beds in each of these four stratigraphic units has also been calculated for the 230 analyses from the Union Pacific coal inventory program (Appendices 1 and 2). An apparent rank has been calculated from the average analysis for coal in each of the four stratigraphic units. A standard rank determination (ASTM, 1977, p. 216, sec. 6.2.2) cannot be made because: (a) some of the published analyses are from weathered coal samples; and (b) the procedure and quality of sampling for the Union Pacific coal evaluation program are not known.

Glass (1975) and U.S. Department of Interior (1975) published not only proximate coal analyses for 17 samples collected in the Hanna Basin, but also assays for 10 major and minor oxides, 12 major and minor elements, and up to 32 trace elements. Glass (1975, p. 1) stresses that his assay data are insufficient to characterize the chemical and physical properties of any individual coal bed, but that this will be possible at a later date as the study continues. Assay results of the 17 Hanna Basin samples show that these coals contain no significantly greater amounts of trace elements of environmental concern than are found in the 42 samples collected in six other Wyoming coal fields.

General Features

In this quadrangle, six coal beds have been mapped by Merewether (1973). One coal bed is in the Allen Ridge Formation and five in the Almond Formation. In addition, numerous isolated coal occurrences were mapped in the Allen Ridge, Pine Ridge Sandstone, and Almond Formations (Plate 1). Five of the six coal beds were located in the subsurface by drill holes; two additional coal beds were also intersected (LH2 and LH3). Two local coal lenses located in the subsurface occur in the Medicine Bow Formation; at least seven local coal lenses occur in the 1,300 feet (396 m) of Mesaverde Group sediments below coal bed LH2 (Plate 3). Analyses of coal samples obtained from drill holes in this quadrangle are shown in Appendix 3. Four coal beds in the Almond Formation and one local coal lens in the Medicine Bow Formation were sampled during the Union Pacific coal inventory program.

Mesaverde Coal Beds

The six coal beds mapped by Merewether (1973) crop out on the flanks of the Lost Springs syncline in the southern half of the quadrangle. Coal bed LH1, at the top of the Allen Ridge Formation, dips to the east-northeast at 10° to 15°. Measured thicknesses range from 0.6 to 3.4 feet (0.2 to 1m). There are no known analyses for this coal bed.

Coal beds LH2, LH3, LH4, LH5, and LH8 in the Almond Formation also crop-out on the flanks of the Lost Springs syncline, and dip toward the axis at angles varying from 7° to 30°. Coal beds LH6, LH7, and LH8 crop out on the northeast limb of the Lone Haystack anticline, dipping toward the northeast at 20° to 22°. Thicknesses of these beds vary from 1.2 to 7 feet (0.4 to 2.1 m). Analyses of samples of these coal beds indicate apparent ranks of high volatile C bituminous.

The remaining coal exposures in the Mesverde Group formations are very thin and non-correlatable. Generally, exposures are less than 2 feet (0.6 m) thick.

Medicine Bow Coal Beds

One local coal lens penetrated in Sec. 5, T.23N., R.85W. has been analysed. Its apparent rank is subbituminous B.

COAL RESOURCES

Previous Work

Coal reserves of the Hanna and Carbon Basins have been estimated or calculated by Dobbin, Bowen, and Hoots (1929), Berryhill and others (1950), and Glass (1972).

Method of Calculating Resources

Data from Merewether (1973), oil and gas well logs, and coal drill holes (written communication, Rocky Mountain Energy Company, 1977) were used to construct the Coal Data Map (Plate 1) and the Coal Data Sheet (Plate 3) for the Lone Haystack Mountain quadrangle. U.S. Geological Survey reviewed these two plates and concluded that no individual coal bed or coal zone on unleased Federal land was thick enough and extensive enough to be selected for coal reserve evaluation. However, the calculation of coal Reserve Base was requested for the isolated or noncorrelatable data points in the quadrangle.

The information on Plates 1 and 3 served as the basis for estimating coal resources in areas of sparse, isolated coal data, insufficient to construct isopach and structure contour maps. The estimates of coal resources were made in accordance with the classification system given in U.S. Geological Survey Bulletin 1450-B and by following methods suggested by the U.S. Geological Survey:

- All outcrop measurements and subsurface measurements are considered as one planar unit.
- All coal deeper than 3,000 feet (914 m) is excluded.
- Coal bed thicknesses from surface mapping are true thicknesses; thicknesses from subsurface data are apparent thicknesses. No corrections were made for coal bed thicknesses to compensate for the dip of the containing rocks.
- Coal resources are calculated for a single coal bed at least 5 feet (1.5 m) thick or for an aggregate thickness of multiple coal beds each at least 5 feet (1.5 m) thick.
- Areal subsurface distribution of coal from outcrop data points is determined by constructing an arc with a radius

equal to one-half the length of the outcrop within a five-foot or greater thickness limit, and centered on a point midway on the outcrop.

- Areal subsurface distribution for a subsurface data point with a five-foot or greater thickness of coal is defined by a circle with a radius of 0.5 mile (805 m).
- Coal resources at depths of less than 200 feet (61 m) are tabulated separately from coal resources at depths between 200 and 3,000 feet (61 and 914 m).

When estimating coal resources in areas of sparse, isolated data some data require a unique solution. For example:

- Where a coal bed outcrop has data points with a coal thickness less than 5 feet (1.5 m), a 5-foot (1.5 m) cut-off point is interpolated, and the resulting segments with values greater than 5 feet (1.5 m) are used to generate arcs (radii equal to half the partial outcrop length).
- Where areas within outcrop segments arcs and areas within 0.5 mile (805 m) of a drill hole coincide, the areas are combined, and drill hole coal thickness values are averaged with outcrop coal thickness values.
- When evaluating multiple coal beds of an isolated or noncorrelatable data point, the interburden between subsurface coal beds may be too great to allow the aggregate thickness of coal to be considered as one planar unit. In such instances, a conservative judgment is made and the resources for each bed are calculated separately and then totaled.

Results

The coal resource acreage from isolated or noncorrelatable data points was determined by planimetering the areas which occurred in unleased Federal land. Coal Reserve Base values were obtained by multiplying the coal resource acreage for each section of Federal land by the average thickness of the coal bed, or the average aggregate thickness of multiple coal beds, times a conversion factor of 1,770 short tons (1,606 t) of coal per acre-foot for subbituminous coal. Reserve Base values are shown on Plate 2 and are considered to be in the inferred reliability category of identified coal resources.

The total coal Reserve Base of unleased Federal lands in the Lone Haystack Mountain quadrangle is 2.04 million short tons (1.83 million t) of inferred resources with 0-200 feet (0-61 m) overburden; 8.0 million short tons (6.99 million t) of inferred resources with 200 to 3,000-feet (61 to 914-m) overburden. Coal reserves were not calculated and therefore the coal development potential could not be assessed. The coal Reserve Base data are for rough inventory estimates only.

REFERENCES CITED

American Society for Testing and Materials, 1977, Standard specification for classification of coals by rank, ANSI/ASTM D388-77, in 1977 Annual Book of ASTM Standards, pt. 26, Am. Soc. for Testing and Materials, Philadelphia, Pa., 840 p., p. 214-218.

Berryhill, H.L., Jr., Brown, D.M., Brown, A., and Taylor, D.A., 1950, Coal resources of Wyoming: U.S. Geol. Survey Circ. 81, 78 p., 4 figs.

Dobbin, C.E., Bowen, C.F., and Hoots, H.W., 1929, Geology and coal and oil resources of the Hanna and Carbon Basins, Carbon County, Wyoming: U.S. Geol. Survey Bull. 804, 88 p., 27 pls., 3 figs.

Gill, J.R., Merewether, E.A., and Cobban, W.A., 1970, Stratigraphy and nomenclature of some Upper Cretaceous and Lower Tertiary rocks in south-central Wyoming: U.S. Geol. Survey Prof. Paper 667, 53 p., 15 figs.

Glass, G.B., 1972, Mining in the Hanna coalfield: Wyoming Geol. Survey Misc. Rept., 45 p., 13 figs.

__________, 1975, Analyses and measured sections of 54 Wyoming coal samples (collected in 1974): Wyoming Geol. Survey Rept. Inv. no. 11, 219 p., 130 figs.

Knight, S.H., 1951, The late Cretaceous-Tertiary history of the northern portion of the Hanna basin - Carbon County, Wyoming, in Wyoming Geol. Assoc. Guidebook, 6th Ann. Field Conf., south central Wyoming, p. 45-53., 3 pls., 2 figs.

Merewether, E.A., 1973, Geologic map of the Lone Haystack Mountain quadrangle, Carbon County, Wyoming: U.S. Geol. Survey Geol. Quad. Map GQ-1064.

Rocky Mountain Energy Company, 1977, Survey sheets, coal drill hole data, and coal analyses from the Union Pacific coal evaluation program: unpublished publicly available data from company files.

U.S. Bureau of Mines, 1931, Analyses of Wyoming coals: U.S. Bur. Mines Tech. Paper 484, 159 p.

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, 7 p., 1 fig.

U.S. Department of Interior, 1975, Hanna Basin study site, Hanna coal field, Wyoming: Bur. Land Management EMRIA rept. no. 2, 193 p., 10 pls., 10 figs.

Veatch, A.C., 1907, Coal fields of east-central Carbon County, Wyoming: U.S. Geol. Survey Bull. 316-D, p. 244-260, 1 pl.

Weitz, J.L., and Love, J.D., 1952, Geologic map of Carbon County, Wyoming: U.S. Geol. Survey, prepared in cooperation with Wyoming Geol. Survey and Wyoming Univ. Dept. Geology, scale 1:159,400.

Appendix 1. — Average analyses of coal samples from the Hanna and Carbon Basins

Source of Data	Number of samples (1)	Total footage Ft	Total footage in	Average analyses – as-received basis: Percent: Moisture	Ash	Volatile matter	Fixed carbon	Sulfur	Btu/lb	Calorific Value, Btu/lb, Moist, mineral-matter-free basis (2)	Apparent rank of coal (3)
Published analyses	26	318	6	12.5	7.1	36.2	44.2	0.6	10,553	11,438	sub A <u>or</u> hvCb
Union Pacific coal inventory program	230	1,605	10	12.48	8.74	35.12	43.68	0.82	10,398	11,494	sub A <u>or</u> hvCb

Notes:

(1) Published data from USBM (1931, p. 40-45, sample nos. 2623, 2624, 22800, 22972, 93486, 93488, 93541, A14123, A14124); Glass (1975, p. 16-19, sample nos. 74-23 to 74-34, inclusive); Dept. of Interior (1975, p. 38, sample nos. D169597-99, D169607-08). Union Pacific coal inventory program data from company files, Rocky Mountain Energy Company (1977).

(2) Moist, mineral-matter-free Btu/lb calculated from average analyses, as-received basis, using Parr formula (ASTM, 1977, p. 216, sec. 8.2).

(3) Sub A – subbituminous A; hvCb – high volatile C bituminous (ASTM, 1977, p. 215, sec 4.2, and p. 217).

[To convert feet and inches to meters, multiply feet by 0.3048 and inches by 0.0254. To convert Btu/lb to kilojoule/kilogram, multiply by 2.326].

Appendix 2. — Average analyses of coal grouped by coal-bearing formations in the Hanna and Carbon Basins

Source of data	Formation or Group	Number of samples (1)	Total footage Ft	Total footage in	Average analyses — as-received basis: Percent Moisture	Ash	Volatile matter	Fixed carbon	Sulfur	Btu/lb	Calorific Value, Btu/lb: Moist, mineral-matter-free basis (2)	Apparent rank of coal (3)
Published analyses	Mesaverde	1	4	0	14.1	7.8	36.5	41.6	1.1	10,290	11,251	sub A or hvCb
	Medicine Bow	2	10	1	12.8	3.8	33.3	50.2	0.8	11,050	11,534	hvCb
	Ferris	10	93	1	13.0	8.3	34.3	44.3	0.4	9,970	10,956	sub A or hvCb
	Hanna	13	211	4	12.0	6.6	38.1	43.3	0.7	11,946	11,797	hvCb
Union Pacific coal inventory program	Mesaverde	13	70	5	9.45	8.41	35.42	46.72	0.77	11,112	12,237	hvCb
	Medicine Bow	16	93	4	13.09	4.03	35.46	47.42	0.80	10,927	11,446	sub A or hvCb
	Ferris	114	863	1	12.69	7.96	34.39	44.97	0.44	10,331	11,309	sub A or hvCb
	Hanna	87	579	0	12.51	10.67	35.96	40.85	1.33	10,280	11,640	hvCb

Notes:

(1) Published data from USBM (1931, p. 40-45, sample nos. 2623, 2624, 22800, 22972, 93486, 93488, 93541, A14123, A14124); Glass (1975, p. 16-19, sample nos. 74-23 to 74-34, inclusive); Dept. of Interior (1975, p. 38, sample nos. D169597-99, D169607-08). Union Pacific coal inventory program data from company files, Rocky Mountain Energy Company (1977).

(2) Moist, mineral-matter-free Btu/lb calculated from average analyses, as-received basis, using Parr formula (ASTM, 1977, p. 216, sec. 8.2).

(3) Sub A — subbituminous A; hvCb — high volatile C bituminous (ASTM, 1977, p. 215, sec. 4.2, and p. 217).

[To convert feet and inches to meters, multiply feet by 0.3048 and inches by 0.0254. To convert Btu/lb to kilojoule/kilogram, multiply by 2.326].

Appendix 3. — Coal analyses, Lone Haystack Mountain quadrangle

Drill hole	Location			Coal bed	Sample interval				Sample width		Analyses — as-received basis					
					From		To				Percent					
	Sec.	Twp.	Rge.		Ft	in	Ft	in	Ft	in	Moisture	Ash	Volatile matter	Fixed carbon	Sulfur	Btu/lb
6	1	23N	86W	LH5	102	0	105	6	3	6	7.56	8.04	37.38	47.02	0.38	11,614
6	1	23N	86W	LH4	213	0	221	0	8	0	6.98	5.01	39.92	48.09	0.46	12,138
7	7	23N	85W	LH2	119	9	125	6	5	9	7.06	6.03	39.32	47.59	0.60	12,083
8	7	23N	85W	LH7	90	6	95	0	4	6	9.40	8.69	33.53	48.38	0.72	11,117
15	5	23N	85W	L	49	3	54	7	5	4	19.74	3.81	31.82	44.63	0.80	9,500

Data from Rocky Mountain Energy Company (1977)

[To convert feet and inches to meters (m) multiply feet by 0.3048 and inches by 0.0254. To convert Btu/lb to kilojoules/kilogram (kJ/kg) multiply by 2.326].