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COAL RESOURCE OCCURRENCE AND COAL DEVELOPMENT POTENTIAL MAPS OF THE PINE BUTTE SCHOOL QUADRANGLE, BIG HORN COUNTY, MONTANA

(Report includes 64 plates)

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Contents

Illustrations

[Plates are separate]

Tables

Physiography

The quadrangle is located in a rolling upland and is entirely within the drainage divide between Tongue River and Hanging Woman Creek. The crest of the divide follows the western margin of the quadrangle; most of the streams in the quadrangle flow eastward to Hanging Woman Creek. Maximum local relief is about 640 feet (195 m) with the low elevation of 3,560 feet (1,086 m) above mean sea level along First Creek in the northeastern part of the quadrangle and the high elevation of 4,200 feet (1,281 m) above mean sea level in the northwestern part of the quadrangle along the crest of the divide.

Climate

Southeastern Montana in the vicinity of the Pine Butte School quadrangle has a semi-arid climate. Average annual precipitation at Decker, Montana, about 12 miles (19 km) to the west, is about 12 inches (30 cm) and the annual variation in temperature is commonly from 100° F to -40° F (38° C to -40° C).

Land Status

The quadrangle lies within the Northern Powder River Basin Known Recoverable Coal Resource Area. The Federal government owns all of the coal within the quadrangle except for the coal in about 3 square miles (7.8 sq. kms) that belongs to the State of Montana (see plate 2). In 1977, no Federal coal was covered by outstanding Federal coal leases, prospecting permits, or licenses.

General Geology

Sources of data

The coal deposits of the Pine Butte School quadrangle were first investigated by Baker (1929) as part of a study of the northern extension of the Sheridan coal field. Portions of the quadrangle were later investigated for strippable coal deposits by Matson, Blumer, and Wegelin (1973). In 1976, W. J. Mapel mapped the geology of the Pine Butte School quadrangle on a topographic base at a scale of 1:24,000 (Mapel, 1978).

Information on coal-bed thicknesses in-and-adjacent to the quadrangle are from measurements at the outcrop, measurements in shallow coal test holes, and measurements derived from interpretation of geophysical logs of oil and gas test wells. The measurements from coal test holes are considered to be accurate to within about 1 foot (0.3 m), and measurements from gamma-ray logs of oil and gas test wells are probably of similar accuracy. Thicknesses obtained only from the resistivity log of oil and gas test wells may be less reliable. Coal beds generally have high resistivity; however, some other types of rocks such as limestone and some kinds of sandstone also have high resistivity, so misinterpretations are possible. The coal beds shown in the well at locality 18 on plates 1 and 3 are interpretations from resistivity logs only.

Stratigraphy

The coal-bearing rocks underlying the Pine Butte School quadrangle are a maximum of about 2,500 feet (760 m) thick, and are assigned to the Wasatch Formation of Eocene age, and the Fort Union Formation of Paleocene age. As these formations are gradational lithologically, the contact is arbitrarily placed at the top of the Roland coal bed of Baker (1929), following the practice of Baker (1929) and other workers.

The Wasatch Formation underlies the higher divide in this quadrangle, and is a maximum of about 400 feet (122 m) thick in the southwestern part. It consists of lenticular beds of gray to dark-gray shale, gray siltstone, gray to yellowish-gray fine-grained sandstone, carbonaceous shale, and several coal beds. Near its base it contains a bed 1 to 2 feet (0.3 to 0.6 m) thick of molluscan-bearing coquinoid limestone. The underlying Tongue River Member of the Fort Union Formation, which is as much as 2,100 feet (640 m) thick, is lithologically similar to the Wasatch Formation, but contains more beds of yellowish-gray sandstone and siltstone, and numerous persistent coal beds.

Rocks comprising the Wasatch and Fort Union Formations were deposited during the Eocene and Paleocene epochs in rivers, flood plains, swamps, and small lakes which shifted back and forth on a vast, flat alluvial plain.

Representative samples of the sedimentary rocks overlying and interbedded with some of the minable coal beds on the quadrangle to the east of this quadrangle have been analyzed for their trace element content by the U.S. Geological Survey. The rocks contain no greater amounts of trace elements of environmental concern than do similar rock types found in other coal fields in the western United States.

Structure

The Pine Butte School quadrangle is in the trough of the Powder River structural basin near the basin axis, which in Montana trends generally northward. Regional dip is generally less than 1 degree towards the south.

The regional dip is modified by three normal faults (pl. 1) that are downthrown to the south. The fault at the southern edge of the quadrangle (sec. 35, T. 9 S., R. 42 E) is the largest and has a maximum displacement on the Anderson coal bed in this quadrangle of slightly more than 200 feet (61 m).

Coal Geology

About twenty-six coal beds, ranging in thickness from about 2 to 32 feet (0.6 to 9.8 m) were identified on the surface or in the subsurface in the Pine Butte School quadrangle (plate 3). Of these, fourteen coal beds are thick enough and shallow enough to be included in calculations of the Reserve Base. The other twelve are either too thin or too deeply buried.

The uppermost coal is the Badger coal bed. This coal is successively underlain by: an interval about 330 feet (100 m) thick containing two thin coal beds; the Roland coal bed of Baker (1929); an interval 280 to 305 feet (85 to 93 m) thick containing one or more thin lenticular coal beds; the Smith coal bed; a noncoal interval 100 to 150 feet (31 to 46 m) thick; the Anderson coal bed; a noncoal interval 60 to 120 feet (18 to 37 m) thick that locally contains a thin coal bed; the upper split of the Dietz coal bed; an interval 180 to 250 feet (55 to 76 m) that contains the lower split of the Dietz, the thin Cox coal bed, and an unnamed coal bed; the Canyon coal bed; a noncoal interval 80 to 110 feet (24 to 34 m) thick; the White coal bed; a noncoal interval 50 to 85 feet (15 to 26 m) thick; the Cook coal bed; a noncoal interval 6 to 50 feet (2 to 15 m) thick; the Otter coal bed; an interval 40 to 90 feet (12 to 27 m) thick containing at least one local coal bed; the Wall coal bed; a noncoal interval 60 to 160 feet (18 to 49 m) thick; an unnamed bed; a noncoal interval 220 to 270 feet (67 to 82 m) thick; the Brewster-Arnold coal bed; a noncoal interval 10 to 35 feet (3 to 11 m) thick; the Odell coal bed; a noncoal interval 110 to 130 feet (34 to 40 m) thick; the King coal bed; a noncoal interval 145 to 190 feet (44 to 58 m) thick; the Knobloch coal bed; a noncoal interval 170 to 190 feet (52 to 58 m) thick; the Roberts coal bed; a noncoal interval 70 to 190 feet (21 to 58 m) thick; a thin unnamed coal bed; a noncoal interval 130 to 200 feet (40 to 61 m) thick; and the Kendrick coal bed.

Coal bed thicknesses that are shown on the coal data map (pl. 1), the coal data sheet (pl. 3), and the isopach maps are the thicknesses of coal in the bed as recorded either at outcrops or in the drill holes, and are rounded to the nearest foot. Partings are excluded from the coal bed thickness where they are known to exist; however, the coal beds generally are free of partings.

In the past, several of the thicker coal beds have caught fire at the outcrop and have burned back under shallow cover for varying distances, some for nearly 1 mile (1.6 km). The heat from the burning coal has baked and fused the overlying rocks to form a resistant reddish-colored rock called clinker (also locally called scoria, or red shale). Clinker resulting from near-surface burning of the Anderson coal bed may be more than 50 feet (15 m) thick and caps a large area in the northeastern part of the quadrangle.

The only analyses of fresh coals in the Pine Butte School quadrangle are from drill cores of the Anderson bed in sec. 6, T. 9 S., R. 43 E. and sec. 31, T. 8 S., R. 43 E. (Matson, Blumer, and Wegelin, 1973, p. 52-53). Based on the analyses from these localities and on analyses of coal samples collected at nearby localities outside the quadrangle, the rank of the coal in the Pine Butte School quadrangle varies from subbituminous B to subbituminous C.

The trace element content of coals in the Pine Butte School quadrangle has not been determined; however, coals in the Northern Great Plains, including those in the Fort Union Formation in Montana, have been found to contain, in general, appreciably lesser amounts of most elements of environmental concern than coals in other areas of the United States (Hatch and Swanson, 1977, p. 147).

Badger coal bed

[pls. 19-23]

The Badger coal bed was named by Baker (1929) for outcrops in the southwestern part of this quadrangle. It underlies only small areas in the southwestern part of the quadrangle, where it ranges in thickness from 5 to 8 feet (1.5 to 2.4 m) under a maximum of about 100 feet (31 m) of overburden.

Chemical analyses have not been made of the Badger coal bed in this quadrangle.

Roland coal bed of Baker (1929)

[pls. 4-8]

The Roland coal bed was named by Taff (1909) in the Sheridan coal field, Wyoming. A coal assumed to be the same bed was called the Roland bed in the northern extension of the Sheridan coal field, Montana by Baker (1929). Subsequent work in the Sheridan coal field has shown that the Roland bed of Baker (1929) lies about 125 feet (38 m) above the original Roland bed of Taff (1909).

The top of the Roland bed of Baker (1929) is generally used in southern Montana as the contact between the Fort Union and overlying Wasatch Formations.

The Roland bed of Baker (1929) crops out extensively in the Pine Butte School quadrangle. It ranges in thickness from 1 foot (0.3 m) to about 12 feet (3.7 m); it is thickest in the southern part of the quadrangle (pl. 4). In most of its area of occurrence it is under less than 200 feet (61 m) of overburden and had potential for recovery by surface mining methods. Overburden on the coal reaches a maximum thickness of slightly more than 400 feet (122 m) at a few places along the southern edge of the quadrangle.

Chemical analyses have not been made of the Roland coal bed of Baker (1929) in this quadrangle.

Smith coal bed

[pls. 9-13]

The Smith coal bed was named by Taff (1909) in the Sheridan coal field, Wyoming, and was traced into the area of the Pine Butte School quadrangle by Baker (1929). It crops out in the northeastern part of the quadrangle and is present throughout most of the quadrangle. It ranges in thickness from 2 to 12 feet (0.6 to 3.7 m) (pl. 9). The coal is thickest along the western margin of the quadrangle, and thins generally eastward. Overburden is less than 200 feet (61 m) in areas near the outcrops in the northeastern part of the quadrangle (pl. 11) where it has potential for recovery by surface mining methods. Overburden on the coal reaches a maximum thickness of slightly more than 700 feet (214 m) along the southern margin of the quadrangle.

Chemical analyses have not been made of the Smith coal bed in the quadrangle.

Anderson coal bed

[pls. 14-18]

The Anderson coal bed was named by Baker (1929), probably for outcrops along Anderson Creek a few miles northwest of the Pine Butte School quadrangle. It crops out in the northeastern part of the Pine Butte School quadrangle and ranges in thickness from 22 to 32 feet (6.7 to 9.8 m). It is thickest in the eastern part of the quadrangle (pl. 14).

The Anderson bed is under less than 200 feet (61 m) of overburden and has potential for surface mining in the valleys in the northeastern part of the quadrangle (pl. 16). It is under more than 800 feet (244 m) of overburden at a few places along the southern edge of the quadrangle.

Chemical analyses have been made of cores of the Anderson coal bed collected from drill holes at localities 7 and 21 (pl. 1). The samples contained 0.13 to 0.31 percent sulfur; 3.3 to 8.5 percent ash; and had a heat value of 8665 to 9000 Btu per pound on the as-received basis, as reported by Matson, Blumer, and Wegelin (1973, p. 52-53).

Dietz coal bed

[pls. 19-23]

The name Dietz is used in this report as it was applied by Baker (1929) in the northern extension of the Sheridan coal field. The name is from the adjacent Sheridan coal field where Taff (1909) recognized and named, in descending order, the Dietz 1, 2, and 3 coal beds. Baker (1929, p. 35-36) correlated his Dietz bed with the Dietz 1 bed of Taff (1909). The stratigraphic relations of coal in the Dietz interval within the two coal fields are still being worked out, and the exact correlation is uncertain.

The bed here called Dietz is probably 5 to 6 feet (1.5 to 1.8 m) thick in the northwestern corner of the quadrangle (pl. 19). It contains a shale parting which thickens rapidly southward, splitting the coal into two beds. Coal in the lower split is locally more than 5 feet (1.5 m) thick in the northeastern part of the Pine Butte School quadrangle, and is included in Reserve Base calculations. The upper split is everywhere less than 5 feet (1.5 m) thick. A small amount of coal in the lower split of the Dietz bed is under less than 200 feet (61 m) of overburden and has potential for surface mining (pl. 21).

Analyses have not been made of the Dietz coal bed in the Pine Butte School quadrangle.

Local coal bed above the Canyon coal bed

[pls. 24-28]

This unnamed coal bed, which was encountered in most drill holes, may be equivalent to an unnamed local coal bed that Culbertson and others (1976) described as occurring about 30 feet (10 m) above their Upper Canyon bed along Hanging Woman Creek a few miles northeast of this quadrangle (pls. 1 and 3). It is 2 to 4 feet (0.6 to 1.2 m) thick in the northern part of the quadrangle and thickens southward to 10 feet (3.1 m) thick (pl. 24). Where it is more than 5 feet (1.5 m) thick, the overburden ranges in thickness from about 600 feet (180 m) to more than 1,000 feet (305 m) along the southern margin of the quadrangle.

Chemical analyses have not been made of this coal bed in the Pine Butte School quadrangle.

Canyon coal bed

[pls. 29-33]

The Canyon coal bed was named by Baker (1929) for outcrops in the northern extension of the Sheridan coal field. The same coal is referred to as the Upper Canyon coal bed by Culbertson and others (1976) in the Stroud Creek quadrangle, which is the quadrangle to the northeast of the Pine Butte School quadrangle. The Canyon bed is about 10 feet (3.1 m) thick on the western margin of the quadrangle and thickens generally eastward to more than 18 feet (5.5 m) (pl. 29). The overburden ranges in thickness from about 300 feet (90 m) in the northeast to more than 1,000 feet (305 m) in the southern part of the quadrangle (pl. 31).

Chemical analyses have not been made of the Canyon coal bed in the Pine Butte School quadrangle.

White coal bed

[pls. 34-38]

The White coal bed is named for a coal bed encountered at a depth of 470 feet (143 m) in an oil-and-gas test hole, the Samuel Gary 30-3 Federal White, about 6 miles (10 km) east of the Pine Butte School quadrangle in NW 1/4 sec. 30, T. 8 S., R. 44 E. It probably is not correlative with any named bed on the outcrop.

The White coal bed is 8 and 10 feet (2.4 and 3 m) thick, respectively in drill holes at localities 20 and 13 (pl. 34), and is not present in drill holes to the south. Where the White coal is inferred to be more than 5 feet (1.5 m) thick, its overburden ranges in thickness from about 400 feet (120 m) in the northeast to more than 800 feet (240 m) in the south central part of the quadrangle.

Chemical analyses have not been made of the White coal bed in the Pine Butte School quadrangle.

Cook coal bed

[pls. 39-43]

The Cook coal bed was named by Bass (1932) for coal outcrops in the Cook Creek Mountains about 40 miles (64 km) northeast of the Pine Butte School quadrangle. It was mapped southwestward by Warren (1959) in the Birney-Broadus coal field, and south along Hanging Woman Creek by Culbertson and others (1976) to a point 5 miles (8 km) north of the Pine Butte School quadrangle. The Cook coal bed in believed to be less than 5 feet (1.5 m) thick in the northwestern part of the Pine Butte School quadrangle, but it thickens eastward to 12 feet (3.7 m) (pl. 39). The overburden ranges in thickness from about 400 feet (120 m) in the northeast to more than 1,000 feet (305 m) in the southern part of the quadrangle (pl. 41).

Chemical analyses have not been made of the Cook coal bed in the Pine Butte School quadrangle.

Otter coal bed

[pls. 44-48]

The Otter coal bed was named by Bryson and Bass (1973) for exposures along Otter Creek about 20 miles (32 km) northeast of the Pine Butte School quadrangle. The Otter coal bed is believed to be less than 5 feet (1.5 m) thick in the western part of the quadrangle and thickens eastward to 10 feet (3.1 m). Where it is more than 5 feet (1.5 m) thick its overburden ranges in thickness from more than 400 feet (120 m) in the northeast to more than 1,000 feet (305 m) in the southern part of the quadrangle.

Chemical analyses have not been made of the coal in the Otter coal bed in the Pine Butte School quadrangle.

Local coal bed below Otter coal bed

[pls. 34-38]

An unnamed local bed is 5 to 6 feet (1.5 m to 2 m) thick only in a small area in the southeast corner of the quadrangle (pl. 34). Where it is more than 5 feet (1.5 m) thick, its overburden ranges from about 800 to 1,000 feet (240 to 305 m). Chemical analyses have not been made of coal in this coal bed in the Pine Butte School quadrangle.

Wall coal bed

[pls. 49-53]

The Wall coal bed was named by Baker (1929) for exposures of the coal along Wall Creek, about 10 miles (16 km) north of the Pine Butte School quadrangle. Coal in the bed is a maximum of 20 feet (6.1 m) thick in the northwestern part of the quadrangle, based on its identification on the resistivity log of an oil and gas well about 2 miles (3 km) north of the northwest corner of this quadrangle. It thins rapidly eastward and southward, and is less than 5 feet (1.5 m) thick in the southwest corner and east central part of the quadrangle. The overburden on the Wall bed ranges in thickness from about 500 feet (150 m) in the northweast to more than 1,000 feet (305 m) in the southwestern part of the quadrangle (pl. 51).

Chemical analyses have not been made of the coal from the Wall coal bed in the Pine Butte School quadrangle.

Local coal bed below the Wall coal bed

[pls. 54-58]

An unnamed local coal bed is present in all of the deep drill holes, ranging in thickness from 3 to 7 feet (0.9 to 2.1 m) thick. It is more than 5 feet (1.5 m) thick in two small areas, one in the southeast corner, the other in the northeast part of the quadrangle (pl. 54). In the northern area the overburden ranges from about 750 feet to 900 feet (230 to 275 m) thick, and in the southeast it is mostly more than 1,000 feet (305 m) thick (pl. 56).

Chemical analyses have not been made of the coal from this coal bed in the Pine Butte School quadrangle.

Brewster-Arnold coal bed

[pls. 59-63]

The Brewster-Arnold coal bed was named by Bass (1924) for coal at the Brewster-Arnold mine about 12 miles (19 km) north of the Pine Butte School quadrangle. The coal bed is 7 feet (2.1 m) thick in the southeastern part of the quadrangle and thickens northward to about 10 feet (3.1 m) (pl. 54). It is beneath less than 1,000 feet (305 m) of overburden only in the northeastern part of the quadrangle (pl. 56).

Chemical analyses have not been made of coal from the Brewster-Arnold coal bed in the Pine Butte School quadrangle.

Coal resources

Coal resource estimates in this report are restricted to the Reserve Base part of the Identified Coal Resource, which is the part most likely to be developed in the foreseeable future (see U.S. Geol. Survey Bull. 1450-B for a discussion of these terms). The Reserve Base for subbituminous coal is coal that is 5 feet or more (1.5 m) thick, under less than 1,000 feet (305 m) of overburden, and within 3 miles (4.8 km) of a complete measurement of the coal bed. Reserve Base coal is further subdivided into categories according to its nearness to a measurement of the coal bed. Measured coal is coal within 1/4 mile (0.4 km) of a measurement, Indicated coal extends 1/2 mile (0.8 km) beyond Measured coal to a distance of 3/4 mile (1.2 km) from the measurement, and Inferred coal extends 2 1/4 miles (3.6 km) beyond Indicated coal to a distance of 3 miles (4.8 km) from the measurement.

The total Reserve Base for federally owned coal in the Pine Butte School quadrangle is estimated to be about 3.9 billion short tons (3.5 billion metric tons). Table 1 shows the Reserve Base subdivided according to coal bed, resource category, and thickness of overburden; plate 2 shows the total Reserve Base for each section of land underlain by federally owned coal. The Identified Resources plate for each bed shows the Reserve Base coal in that bed in each section of land underlain by federally owned coal. About 6 percent of the total Reserve Base is classified as measured; 25 percent as indicated; and 69 percent as inferred. About 13 percent is under less than 200 feet (61 m) of overburden; the remainder is under 200-1,000 feet (61 to 305 m) of overburden.

Table 1.--Coal Reserve Base for surface-mining methods (0-200 feet overburden) and underground-mining methods (200-1,000 feet overburden) in Federal coal lands in the Pine Butte School quadrangle, Big Horn County, Montana

[In millions of short tons. To convert short tons to metric tons, multiply by 0.907]

Coal bed name	Overburden 0-200 feet (0-61 m)				Overburden 200-1,000 feet (61-305 m)				Grand Total
	Measured	Indicated	Inferred	Total	Measured	Indicated	Inferred	Total	
Badger------	2.20	1.89	------	4.09	------	------	------	------	4.09
Roland of Baker (1929)	30.11	71.56	60.65	162.32	------	1.90	48.94	50.84	213.16
Smith-------	13.85	40.02	33.28	87.15	3.97	39.97	296.02	339.96	427.11
Anderson----	76.60	153.25	8.63	238.48	37.43	270.70	950.45	1,258.58	1,497.06
Dietz-------	2.18	8.43	------	10.61	0.90	7.30	6.22	14.42	25.03
Local above Canyon----	------	------	------	------	3.46	23.82	95.25	122.53	122.53
Canyon------	------	------	------	------	32.81	197.97	475.20	705.98	705.98
White-------	------	------	------	------	4.10	24.23	83.40	111.73	111.73
Cook--------	------	------	------	------	8.65	66.15	321.63	396.43	396.43
Otter-------	------	------	------	------	9.32	40.15	142.44	191.91	191.91
Local below Otter----	------	------	------	------	1.38	5.92	0.51	7.81	7.81
Wall-------	------	------	------	------	1.63	11.38	117.93	130.94	130.94
Local below Wall-----	------	------	------	------	1.97	8.07	1.07	11.11	11.11
Brewster-Arnold---	------	------	------	------	1.69	7.02	45.82	54.53	54.53
Total	124.94	275.15	102.56	502.65	107.31	704.58	2,584.88	3,396.77	3,899.42

Coal Reserves are defined as the economically minable part of the Reserve Base tonnage. In this quadrangle, only coal recoverable by surface-mining methods is considered to be economically minable. Reserves for this quadrangle are determined by multiplying the amount of Reserve Base coal under less than 200 feet (61 m) of overburden by a recovery factor of 85 percent. The total Reserves for federally owned coal in the Pine Butte School quadrangle is estimated to be 430 million short tons (390 million metric tons) of which 47 percent is in the thick Anderson coal bed. Reserves for the five coal beds containing surface-minable coal are shown by section of federally owned coal on the Identified Resources plate of these coal beds (pls. 8, 13, 18, and 23).

COAL DEVELOPMENT POTENTIAL

Development potential of coal recoverable by surface-mining methods

Areas where the coal beds are more than 5 feet (1.5 m) thick and are overlain by 200 ft (61 m) or less of overburden are considered to have potential for surface mining and are assigned a high, moderate, or low development potential based on the mining ratio (cubic yards of overburden removed per short ton of coal recovered). The formula used to calculate the mining ratio for subbituminous coal is as follows:

$$MR = \frac{t_o\,(0.911)}{t_c\,(rf)}$$

where MR = mining ratio

t_o = thickness of overburden, in feet

t_c = thickness of coal, in feet

rf = recovery factor (0.85)

Areas of high, moderate, and low development potential are here defined as areas underlain by coal beds having respective mining-ratio values of 0 to 10, 10 to 15, and greater than 15, as shown on plates 6, 11, 16, and 21. The mining-ratio values for each development-potential category are based on economic and technological criteria, and were derived in consultation with A. F. Czarnowsky, Area Mining Supervisor, U.S. Geological Survey.

In the Pine Butte School quadrangle, the amount of Reserve Base coal in the high development potential category is 289 million tons (262 million metric tons), of which 82 percent is in the Anderson coal bed (table 2). Reserve Base coal in the moderate and low development potential categories are, respectively, 60 and 152 million tons (54 and 138 million metric tons). Plate 64 shows the areas underlain by coal beds having high, moderate, and low development potential for recovery by surface-mining methods.

Table 2. -- Coal Reserve Base for surface-minable coal according to its development potential, in Federal coal lands in the Pine Butte School quadrangle, Big Horn County, Montana.

[In millions of short tons. To convert short tons to metric tons, multiply by 0.907. Development potentials are based on mining ratios expressed as cubic yards of overburden per short ton of recoverable coal. To convert to cubic meters per metric ton, multiply by 0.843. To convert Reserve Base to Reserves multiply by 0.85.]

Coal bed	High development potential (0-10 mining ratio)	Moderate development potential (10-15 mining ratio)	Low development potential (>15 mining ratio)	Total
Badger----	0.35	3.74	----	4.09
Roland of Baker (1929)---	30.46	43.15	88.71	162.32
Smith------	19.46	13.20	54.49	87.15
Anderson--	238.48	----	----	238.48
Dietz-----	----	0.58	10.03	10.61
Total	288.75	60.67	153.23	502.65

Development potential of coal recoverable by underground-mining methods

The Reserve Base for federally owned coal beneath 200-1,000 feet (61-305 m) of overburden is estimated to be about 2.6 billion short tons (2.4 billion metric tons) as shown in table 1. Coal at these depths would be recoverable only by underground-mining methods. Coal is not now being mined underground in the Powder River Basin and recovery factors have not been established so the development potential of this coal was not evaluated.

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