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COAL RESOURCE OCCURRENCE AND COAL DEVELOPMENT POTENTIAL MAPS OF THE BITTER CREEK QUADRANGLE, SWEETWATER COUNTY, WYOMING

[Report includes 19 plates]

Prepared for

UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

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

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INTRODUCTION

Purpose

This text is to be used in conjunction with Coal Resource Occurrence (CRO) and Coal Development Potential (CDP) Maps of the Bitter Creek quadrangle, Sweetwater County, Wyoming. This report was compiled to support the land planning work of the Bureau of Land Management to provide a systematic coal resource inventory of Federal coal lands in Known Recoverable Coal Resource Areas (KRCRA's) in the western United States. This investigation was undertaken by Dames & Moore, Denver, Colorado, at the request of the U.S. Geological Survey under contract number 14-08-0001-17104. The resource information gathered for this report is in response to the Federal Coal Leasing Amendments Act of 1976 (P.L. 94-377). Published and unpublished public information available through May, 1978, was used as the data base for this study. No new drilling or field mapping was performed, nor was any confidential data used.

Location

The Bitter Creek quadrangle is located in central Sweetwater County, Wyoming, approximately 7 miles (11.3 km) west of the town of Table Rock and 9 miles (14.5 km) southeast of the town of Point of Rocks, Wyoming. The town of Bitter Creek lies in the central part of the quadrangle.

Accessibility

A hard-surface, medium-duty road extends northward across the quadrangle connecting the town of Bitter Creek and Interstate Highway 80 approximately 1.5 miles (2.4 km) north of the quadrangle boundary. Several improved light-duty roads cross the quadrangle, providing access to the town of Bitter Creek from the south, southwest and northeast. Numerous unimproved dirt roads and trails service the area of the Patrick Draw oil and gas field, located in the eastern third of the quadrangle, and also the remainder of the quadrangle.

The main east-west line of the Union Pacific Railroad runs northeasterly through the central part of the quadrangle. This line provides railway service across southern Wyoming, connecting Ogden, Utah, to the west, with Omaha, Nebraska, to the east.

Physiography

The Bitter Creek quadrangle lies on the eastern flank of the Rock Springs uplift and between the Great Divide Basin and the Washakie Basin. The landscape is characterized by mesas, escarpments, valleys and badland topography. Altitudes range from approximately 6,660 feet (2,030 m) along Bitter Creek in the southwestern corner of the quadrangle, to 7,166 feet (2,184 m) on an escarpment in the southeastern corner of the quadrangle.

Bitter Creek flows westerly through the southern half of the quadrangle. Patrick Draw, a tributary of Bitter Creek, flows southwesterly across the quadrangle. With the exception of Bitter Creek, all streams in the quadrangle are intermittent and flow mainly in response to snowmelt in the spring.

Climate and Vegetation

The climate of southwestern Wyoming is semiarid and is characterized by low precipitation, rapid evaporation, and large daily temperature changes. Summers are usually dry and mild, and winters are cold. The annual precipitation averages 9 inches (23 cm), with approximately two thirds falling during the spring and early summer months.

The average annual temperature is 42°F (6°C). The temperature during January averages 18°F (-8°C), with temperatures ranging from 8°F (-13°C) to 28°F (-2°C). During July temperatures range from 54°F (12°C) to 84°F (29°C), with an average of 69°F (21°C) (U.S. Bureau of Land Management, 1978; Wyoming Natural Resources Board, 1966).

Winds are usually from the west-southwest and southwest with an average velocity of 11 miles per hour (18 km per hr) (U.S. Bureau of Land Management, 1978).

Principal types of vegetation in the area include sagebrush, saltbush, rabbitbrush, greasewood, and grasses (U.S. Bureau of Land Management, 1978).

Land Status

The Bitter Creek quadrangle lies on the eastern edge of the Rock Springs Known Recoverable Coal Resource Area (KRCRA). Only the western edge of the quadrangle, approximately six percent of the quadrangle's total area, lies within the KRCRA boundary, although the entire quadrangle will be covered in this report. The Federal government owns the coal rights for approximately 50 percent of the quadrangle, as shown on plate 2. No outstanding Federal coal leases, prospecting permits, or licenses occur within the quadrangle.

GENERAL GEOLOGY

Previous Work

Schultz described the geology and coal resources of the northern part (1909) and the southern part (1910) of the Rock Springs coal field. Hale described the stratigraphy and depositional history of the formations cropping out on the flanks of the Rock Springs uplift in 1950 and 1955. Weimer (1960 and 1961) and Weichman (1961) described the stratigraphy and discussed the depositional environment of Upper Cretaceous formations in the Rock Springs area. Lawson and Crowson (1961) described the stratigraphy of the Wasatch and Fort Union Formations on the eastern flank of the Rock Springs uplift. Roehler described the Late Cretaceous-Tertiary unconformity (1961) and Early Tertiary depositional environments (1965) present in the Rock Springs area. Burton (1961) described the Patrick Draw oil and gas field. Bradley mapped and discussed the stratigraphy of the Wasatch and Green River Formations in the Rock Springs uplift in 1961 and 1964. Land mapped the Fox Hills Sandstone and associated formations on the eastern flank of the Rock Springs uplift in 1972 and described their stratigraphy and depositional history. Coal analyses, coal quality and measured sections of coals in the Rocks Springs coal field were described by Glass in 1975 and 1976. Roehler and others described the geology and coal resources of the

Rock Springs coal field in 1977. Roehler (1977a) prepared a geologic map of the Rock Springs uplift and adjacent areas, and mapped the geology and coal resources of the Sand Butte Rim NW quadrangle (1977b) and the Black Buttes quadrangle (1977c). Madden mapped the geology and coal resources of the Bitter Creek NW quadrangle in 1977.

Stratigraphy

The Tertiary-age Fort Union Formation (Paleocene) and Wasatch Formation (Eocene), as well as parts of the Green River Formation (Eocene), are exposed in the Bitter Creek quadrangle. The Lewis Shale, Fox Hills Sandstone, and Lance Formation, all Late Cretaceous in age, are present in the subsurface.

The Lewis Shale occurs deep within the subsurface and consists of silty shales and thin, very fine grained calcareous sandstones (Roehler, 1977b).

The Fox Hills Sandstone conformably overlies and intertongues with the Lewis Shale. It is composed of very fine to fine-grained cross-bedded sandstone and thin interbedded gray shale and siltstone (Roehler, 1977b). The formation is approximately 150 to 300 feet (46 to 91 m) thick where measured in oil and gas wells drilled in the quadrangle.

The Lance Formation conformably overlies the Fox Hills Sandstone and consists of partly carbonaceous gray shales and carbonaceous shale with interbedded fine-grained sandstones, siltstones, mudstones, and coal (Roehler, 1977b). This formation ranges from approximately 700 to 900 feet (213 to 274 m) thick, thinning to the south, where measured in oil and gas wells drilled in the quadrangle.

The Fort Union Formation, unconformably overlying the Lance Formation, crops out in the northwestern half of the quadrangle (Roehler, 1977a) and ranges in thickness from 1,300 to 1,650 feet (396 to 503 m) where measured in the Sand Butte Rim NW quadrangle to the southwest (Roehler, 1977b). The formation consists of mudstone, interbedded carbonaceous shale and very fine grained sandstone, carbonaceous claystone, coal, gray shale, and some beds of limy siltstone (Roehler, 1977b).

The main body of the Wasatch Formation crops out in the southeastern half of the quadrangle where it conformably overlies the Fort Union Formation (Roehler, 1977a). This part of the Wasatch Formation ranges from 1,280 to 2,150 feet (390 to 655 m) thick where measured in the Sand Butte Rim NW quadrangle (Roehler, 1977b). It consists of gray sandstone and siltstone with interbedded gray, green, and red mudstone; gray and brown partly carbonaceous shale; and sparce thin beds of gray limestone (Bradley, 1964; Roehler and others, 1977).

The Luman Tongue of the Green River Formation overlies the Wasatch Formation and crops out in the southeastern corner of the quadrangle. It is approximately 300 feet (91 m) thick where measured in the Sand Butte Rim NW quadrangle and consists of brown oil shale and thin interbedded sandstone, limestone, shale, mudstone, and carbonaceous shale (Roehler, 1977b).

The Niland Tongue of the Wasatch Formation overlies the Luman Tongue and also crops out in the southeastern corner of the quadrangle. The Niland Tongue consists of approximately 380 feet (116 m) of gray mudstone and interbedded very fine grained sandstone (Roehler, 1977b).

Holocene deposits of alluvium cover Patrick Draw and the stream valley of Bitter Creek.

The Upper Cretaceous formations in the Bitter Creek quadrangle indicate the transgressions and regressions of a broad, shallow, north-south-trending seaway that extended across central North America. They accumulated near the western edge of the Cretaceous sea and reflect the location of the shoreline (Weimer, 1960 and 1961).

The Lewis Shale is composed of neritic shale and siltstone deposited in water depths ranging from a few tens of feet to several hundred feet (Land, 1972).

The Fox Hills Sandstone was deposited in estuary, littoral, and shallow neritic environments as the Cretaceous sea regressed eastward (Land, 1972).

The Lance Formation, consisting of swamp, lagoonal, floodplain and channel sand deposits, was deposited on the landward side of the Cretaceous sea shoreline as the sea retreated to the east (Gosar and Hopkins, 1969; Roehler and others, 1977).

After the final withdrawal of the Cretaceous sea, Fort Union Formation was deposited mainly in a paludal or fresh-water swamp environment across the Rock Springs uplift (Roehler, 1961).

The main body of the Wasatch Formation was deposited in an intermontane basin in fluvial and fresh-water swamp environments (Bradley, 1964; Roehler, 1965; Roehler and others, 1977).

The existence of fluctuating fresh-water lakes in the Rock Springs uplift and adjacent areas resulted in the deposition of the Luman Tongue of the Green River Formation (Roehler, 1965).

Lacustrine, paludal, and fluvial sediments of the Niland Tongue of the Wasatch Formation represent low-water stages of deposition in fresh-water lakes (Roehler, 1965).

Structure

The Bitter Creek quadrangle lies on the eastern flank of the Rock Springs uplift which separates the Great Divide and Green River structural basins. The Rock Springs uplift is a doubly plunging asymmetric anticline with west limb having the steeper dips (5° to 30° to the west). Dips along the east limb are from 5° to 8° to the east (Roehler and others, 1977).

The strike of the beds in this quadrangle is generally northeast, with dips ranging from 2° to 6° to the southeast. Several normal faults, perpendicular to the strike of the beds, are located in the northwestern part of the quadrangle.

COAL GEOLOGY

In the Bitter Creek quadrangle, it is indicated by geophysical logs from oil and gas wells in the Patrick Draw field that coal beds occur in both the Lance and Fort Union Formations. A few Fort Union Formation coal beds crop out in the southwestern part of the quadrangle. In most cases, these beds could not be correlated with the subsurface data because of casing in the upper part of the drill holes. Only the Fort Union [9] coal bed has been mapped at the surface (Schultz, 1909) and in the subsurface. Coal beds that are not formally named have been given bracketed numbers and letters for identification purposes in this quadrangle.

Chemical analyses of coal.--No chemical analyses were available for the coals within this quadrangle, but representative analyses from the Black Buttes area are included in table 1 for both the Lance and Fort Union coals. In general, chemical analyses indicate that coal beds in the Lance and Fort Union Formations rank as subbituminous A or B on a moist, mineral-matter-free basis according to ASTM Standard Specification D 388-77 (American Society for Testing and Materials, 1977).

Coal Beds of the Lance Formation

For the most part, Lance Formation coal beds encountered in this quadrangle are thin and occur deep within the subsurface. The Gibralter coal bed, located approximately 175 feet (53 m) above the base of the formation (Roehler and others, 1977), crops out in the Black Buttes quadrangle where it ranges from 3.0 to 9.7 feet (0.9 to 3.0 m) thick. The Gibralter coal bed has been inferred to be approximately 5 feet (1.5 m) thick where projected into this quadrangle (plate 16).

Two Lance Formation coal beds greater than Reserve Base thickness (5 feet or 1.5 meters) were encountered in oil and gas wells in the northern part of the quadrangle and have been treated as isolated data points (see Isolated Data Points section of this report).

Coal Beds of the Fort Union Formation

Several thick Fort Union Formation coal beds have been identified in geophysical logs from oil and gas wells drilled in this quadrangle. The coal beds are located in a stratigraphic interval approximately 1,400 feet (427 m) thick. They usually occur in the lower part of the formation, although intraformation thickening toward the southeast (down-dip) gradually raises their stratigraphic position in relation to the Fort Union-Lance contact.

The Hail coal bed in the Fort Union Formation, mapped by Roehler (1977) in the adjacent Black Buttes quadrangle, matches one of Schultz's (1909) outcrops in the west-central part of this quadrangle. Although subsurface data is lacking between the outcrop and where the Fort Union [8] coal bed was penetrated by oil and gas wells, it is believed that these coal beds are correlative. The same situation applies to other outcrops mapped by Schultz (1909), i.e., the Fort Union [8] and [11] coal beds.

Fort Union [1] Coal Bed

The Fort Union [1] coal bed, lowest stratigraphically of the Fort Union coal beds, is located in the northeastern corner of the quadrangle. Measured thicknesses range from 4 feet (1.2 m) to a maximum of 13 feet (4.0 m) in this quadrangle. It is also reported to be up to 12 feet (3.7 m) thick to the north in the Bitter Creek NE quadrangle.

Fort Union [2A] Coal Bed

The Fort Union [2A] coal bed is located, stratigraphically, approximately 130 feet (40 m) above the Fort Union [1] coal bed where penetrated by three oil and gas wells in the northern part of the quadrangle. Measured thicknesses of this coal bed range between 8 and 9 feet (2.4 and

2.7 m) where encountered in this quadrangle and where projected into the Bitter Creek NE quadrangle.

Fort Union [3L] Coal Bed

The Fort Union [3L] coal bed has been mapped over much of the Bitter Creek quadrangle. This major coal bed lies approximately 80 feet (24 m) above the Fort Union [2A] coal bed and ranges in thickness from 2 to 10 feet (0.6 to 3.0 m) where measured in oil and gas wells. The Fort Union [3L] coal bed in this quadrangle has been tentatively correlated with the Lower Deadman coal bed in the Bitter Creek NE quadrangle, where the coal bed ranges up to 17 feet (5.2 m) thick.

Fort Union [3U] Coal Bed

The Fort Union [3U] coal bed can be considered to be the upper split of the Fort Union [3L] coal bed. The coal bed thickens to 8 feet (2.4 m) in the northern part of the quadrangle but it is more commonly 5 to 6 feet (1.5 to 1.8 m) thick.

Fort Union [4] Coal Bed

The Fort Union [4] coal bed has been mapped in the southwest corner of the quadrangle, predominantly on the basis of information obtained from the Black Buttes quadrangle where the coal bed is identified as the Fort Union [2] coal bed. Coal thickness reported in the Black Buttes quadrangle ranged from 4 to 7 feet (1.2 to 2.1 m), while oil and gas wells encountered thicknesses of 3 and 5 feet (0.9 and 1.5 m) for the Fort Union [4] coal bed in this quadrangle. The coal bed may be thickening to the south, as an oil and gas well in the northern part of the Sand Butte Rim NW quadrangle (south of the Black Buttes quadrangle) encountered 8 feet (2.4 m) of coal in the same general stratigraphic location.

Fort Union [5] Coal Bed

The Fort Union [5] coal bed has been mapped over much of the southern half of the quadrangle. Along the western edge of the quadrangle, thicknesses encountered range up to 15 feet (4.6 m), but the coal bed thins to the east. The Fort Union [5] coal bed has been correlated with the Deadman coal bed, which crops out in the Black Buttes quadrangle and where reported thicknesses range from 6.2 to 14 feet (1.9 to 4.3 m)

The Deadman is the thickest and most widely distributed Fort Union Formation coal bed cropping out on the flanks of the Rock Springs uplift. Along the eastern flank, the Deadman coal bed crops out for approximately 60 miles (97 km) or more. Geophysical logs of oil and gas wells in the Bitter Creek and Bitter Creek NE quadrangles indicate thick coal beds at depth that correlate well with existing surface data for the Deadman coal bed. Uncertainties do exist, however, due mainly to intra-information thickening. The Deadman coal bed probably does not exist as a single or even as a split coal bed in the Bitter Creek quadrangle, but as a zone which possibly includes the Fort Union [3L], [3U], and [5] coal beds. The Fort Union [5] coal bed is so widely distributed that it has been used as a marker bed in some regional stratigraphic correlations (Weimer, 1965).

Fort Union [9] Coal Bed

The Fort Union [9] coal bed, cropping out in the western half of the quadrangle, occurs approximately 1,100 feet (335 m) above the Fort Union [5] coal bed. It commonly contains a 2 to 4 foot (0.6 to 1.2 m) rock parting. The coal bed has been mapped over much of the eastern half of this quadrangle and in the southeastern part of the Bitter Creek NE quadrangle where it ranges from 3 to 11 feet (0.9 to 3.4 m) thick. This coal bed also has a wide areal distribution and the thin rock parting is distinctive, making it a good marker bed.

Isolated Data Points

In instances where isolated measurements of coal beds thicker than 5 feet (1.5 m) are encountered, the standard criteria for construction of isopach, structure contour, mining ratio, and overburden isopach maps are not available. The lack of data concerning these beds limits the extent to which they can be reasonably projected in any direction and usually precludes correlations with other, better known beds. For this reason, isolated data points are included on a separate sheet (in U.S. Geological Survey files) for non-isopached coal beds. The isolated data points found in this quadrangle are listed on below. Coal beds identified by bracketed numbers are not formally named, but are used for identification purposes in this quadrangle only.

Source	Location	Coal Bed	Thickness
El Paso Natural Gas Products Co.	sec. 1, T. 18 N., R. 99 W.	FU[10]	9 ft (2.7 m)
El Paso Natural Gas Products Co.	sec. 10, T. 18 N., R. 99 W.	FU[9]	6 ft (1.8 m)
El Paso Natural Gas Products Co.	sec. 10, T. 18 N., R. 99 W.	FU[6]	6 ft (1.8 m)
El Paso-U.P.R.R.	sec. 11 T. 18 N., R. 99 W.	FU[10]	10 ft (3.0 m)
El Paso Natural Gas Products Co.	sec. 13, T. 18 N., R. 99 W.	FU[8]	6 ft (1.8 m)
Colorado Oil & Gas	sec. 26, T. 19 N., R. 99 W.	FU[2]	8 ft (2.4 m)
Texaco, Inc.	sec. 27, T. 19 N., R. 99 W.	La[2]	10 ft (3.0 m)
Texaco, Inc.	sec. 29, T. 19 N., R. 99 W.	FU[2?]	25 ft (7.6 m)
Texaco, Inc.	sec. 29, T. 19 N., R. 99 W.	La[1]	7 ft (2.1 m)

COAL RESOURCES

Information from representative oil and gas wells, as well as surface mapping by Schultz (1909), were used to construct outcrop, isopach, and structure contour maps of the coal beds in the Bitter Creek quadrangle.

Coal resources were calculated using data obtained from the coal isopach maps (plates 4, 7, 10, 13, and 16). The coal bed acreage (measured by planimeter) multiplied by the average isopached thickness of the coal bed, and by a conversion factor of 1,770 short tons of coal per acre-foot (13,018 metric tons per hectare-meter) for subbituminous coal, yields the coal resources in short tons for each isopached coal bed. Coal beds thicker than 5 feet (1.5 m) that lie less than 3,000 feet (914 m) below the ground surface are included. These criteria differ somewhat from that used in calculating Reserve Base and Reserve tonnages as stated in U.S. Geological Survey Bulletin 1450-B which calls for a maximum depth of 1,000 feet (305 m) for subbituminous coal.

Reserve Base and Reserve tonnages for the isopached beds are shown on plates 6, 9, 12, 15, and 18, and are rounded to the nearest 10,000 short tons (9,072 metric tons). Coal Reserve Base tonnages per Federal section are shown on plate 2 and total approximately 365.35 million short tons (331.45 million metric tons) for the entire quadrangle, including tonnages from the isolated data points. Reserve Base tonnages in the various development potential categories for subsurface mining methods are shown in table 2. The source of each indexed data point shown on plate 1 is listed in table 3.

Dames & Moore has not made any determination of economic recoverability for any of the coal beds described in this report.

COAL DEVELOPMENT POTENTIAL

Coal development potential areas are drawn so as to coincide with the boundaries of the smallest legal land subdivisions shown on plate 2. In sections or parts of sections where no land subdivisions have been surveyed by the BLM, approximate 40-acre (16-ha) parcels have been used to show the limits of the high, moderate, or low development potentials. A constraint imposed by the BLM specifies that the highest development potential affecting any part of a 40-acre (16-ha) lot, tract, or parcel be applied to that entire lot, tract, or parcel. For example, if 5 acres (2 ha) within a parcel meet criteria for a high development potential, 25 acres (10 ha) a moderate development potential, and 10 acres (4 ha) a low development potential, then the entire 40 acres (16 ha) are assigned a high development potential.

Development Potential for Surface Mining Methods

Areas where the coal beds of Reserve Base thickness are overlain by 200 feet (61 m) or less of overburden are considered to have potential for surface mining and were assigned a high, moderate, or low development potential based on the mining ratio (cubic yards of overburden per ton of recoverable coal). The formula used to calculate mining ratios for surface mining of coal is shown below:

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

where MR = mining ratio

t_o = thickness of overburden in feet

t_c = thickness of coal in feet

rf = recovery factor (85 percent for this quadrangle)

cf = conversion factor to yield MR value in terms of cubic yards of overburden per short tons of recoverable coal:
0.911 for subbituminous coal
0.896 for bituminous coal

Note: To convert mining ratio to cubic meters of overburden per metric ton of recoverable coal, multiply MR by 0.8428.

Areas of high, moderate, and low development potential for surface mining methods are defined as areas underlain by coal beds having respective mining ratio values of 0 to 10, 10 to 15, and greater than 15. These mining ratio values for each development potential category are based on economic and technological criteria and were provided by the U.S. Geological Survey.

Coal development potential for surface mining is only known to occur in the SE1/4 NE 1/4, NE1/4 SE1/4, and SE1/4 SE1/4 sec. 28, T. 19 N., R. 99 W., where overburden thicknesses of the Fort Union [9] coal bed are less than 200 feet (61 m) (plate 17). The development potential for this area has been rated low. Remaining Federal lands within the quadrangle are classified as having unknown development potential for surface mining methods.

Development Potential for Subsurface and In-Situ Mining Methods

Areas considered to have a development potential for conventional subsurface mining methods are those areas where the coal beds of Reserve

Base thickness are between 200 and 3,000 feet (61 and 914 m) below the ground surface and have dips of 15° or less. Coal beds lying between 200 and 3,000 feet (61 and 914 m) below the ground surface, dipping greater than 15°, are considered to have a development potential for in-situ mining methods.

Areas of high, moderate, and low development potential for conventional subsurface mining methods are defined as areas underlain by coal beds at depths ranging from 200 to 1,000 feet (61 to 305 m), 1,000 to 2,000 feet (305 to 610 m), and 2,000 to 3,000 feet (610 to 914 m), respectively.

Areas where the coal data is absent or extremely limited between 200 and 3,000 feet (61 and 914 m) below the ground surface are assigned unknown development potentials. This applies to the areas influenced by isolated data points and to those areas where no coal beds of Reserve Base thickness are known, but may occur. The areas influenced by isolated data points in this quadrangle contain approximately 23.07 million short tons (20.93 million metric tons) of coal available for conventional subsurface mining.

The coal development potential for subsurface mining methods is shown on plate 19. Of the Federal land areas having a development potential for subsurface mining methods, 46 percent are rated high, and 45 percent are rated moderate, and 1 percent are rated low. The remaining 8 percent of the Federal land is classified as having unknown development potential for conventional subsurface mining methods.

Because the coal beds in this quadrangle have dips less than 15°, the development potential for in-situ mining methods is rated as unknown for all Federal lands within the quadrangle.

Table 1. -- Chemical analyses of coals in the Bitter Creek quadrangle, Sweetwater County, Wyoming.

Location	COAL BED NAME	Form of Analysis	Proximate				Ultimate					Heating Value	
			Moisture	Volatile Matter	Fixed Carbon	Ash	Sulfur	Hydrogen	Carbon	Nitrogen	Oxygen	Calories	Btu/Lb
Representative analysis from Bridger Coal Company, Jim Bridger Mine (Glass, 1975)	Deadman (upper and lower benches combined)	A	20.52	29.09	40.71	9.68	0.47	-	-	-	-	-	9,350
		C	0.0	36.60	51.22	12.18	0.59	-	-	-	-	-	11,759
Average analysis from Black Buttes area (Glass, 1975)	Fort Union Formation, undifferentiated	A	17.69	30.93	43.85	8.48	0.41	-	-	-	-	-	9,728
SW¼, sec. 16, T. 18 N., R. 100 W., Rock Springs - Gibraltar Mine (Yourston, 1955)	Lance Formation, undifferentiated	A	20.8	28.4	47.1	3.7	0.4	-	-	-	-	-	9,910
		C	0.0	32.6	42.0	5.9	0.5	-	-	-	-	-	12,510

Form of Analysis: A, as received
B, air dried
C, moisture free

Note: To convert Btu/pound to kilojoules/kilogram, multiply by 2.326

Table 2. -- Coal Reserve Base data for subsurface mining methods for Federal coal lands (in short tons) in the Bitter Creek quadrangle, Sweetwater County, Wyoming.

Coal Bed or Zone	High Development Potential	Moderate Development Potential	Low Development Potential	Unknown Development Potential	Total
Fu {9}	53,350,000	34,840,000			88,190,000
Fu {5}	25,280,000	90,030,000	24,680,000		139,990,000
Fu {4}		7,450,000			7,450,000
Fu {3U}		12,240,000	1,140,000		13,380,000
Fu {3L}	10,000	48,140,000	17,230,000		65,380,000
Fu {2A}	3,890,000	3,350,000			7,240,000
Fu {1}		17,340,000	1,410,000		18,750,000
Gibralter		1,570,000			1,570,000
IDP				23,070,000	23,070,000
Total	82,530,000	214,960,000	44,460,000	23,070,000	365,020,000

Note: To convert short tons to metric tons, multiply by 0.9072.

Table 3. -- Sources of data used on plate 1

Plate 1 Index Number	Source	Data Base
1	El Paso Natural Gas Products Co.	Oil/gas well No. 114 Monell Unit
2	↓	Oil/gas well No. 1 Patrick Draw Unit
3	↓	Oil/gas well No. 112 Monell Unit
4	↓	Oil/gas well No. 117 Monell Unit
5	↓	Oil/gas well No. 104 Monell Unit
6	↓	Oil/gas well No. 118 Monell Unit
7	↓	Oil/gas well No. 103 Monell Unit
8	El Paso Natural Gas Products Co. and U.P.R.R. Co.	Oil/gas well No. 34 Patrick Draw Unit
9	Clark Oil and Refining Co.	Oil/gas well No. 1 Government
10	El Paso Natural Gas Products Co.	Oil/gas well No. 102 Monell Unit
11	↓	Oil/gas well No. 173 Monell Unit
12	↓	Oil/gas well No. 92 Monell Unit
13	↓	Oil/gas well No. 110 Monell Unit

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Table 3. -- Continued

Plate 1 Index Number	Source	Data Base
14	El Paso Natural Gas Products Co. and U.P.R.R. Co.	Oil/gas well No. 12 Patrick Draw Unit
15	El Paso Natural Gas Products Co.	Oil/gas well No. 88 Monell Unit
16	↓	Oil/gas well No. 97 Monell Unit
17	↓	Oil/gas well No. 4 Patrick Draw Unit
18	El Paso Natural Gas Products Co. and U.P.R.R. Co.	Oil/gas well No. 14 Patrick Draw Unit
19	↓	Oil/gas well No. 30 Patrick Draw Unit
20	Chandler & Simpson, Inc.	Oil/gas well No. 1 Rosen-State
21	Schultz, 1909, U.S. Geological Survey Bulletin 341-B, p. 265	Measured Section
22		Measured Section
23	Odessa Natural Crop.	Oil/gas well No. 2 Wallace-Federal
24	Davis Oil Co. and Golden Oil Co.	Oil/gas well No. 16 Wallace-Federal
25	Odessa Natural Corp.	Oil/gas well No. 16 Stage Stop Unit
26	↓	Oil/gas well No. 12 Stage Stop Unit

Table 3. -- Continued

Plate 1 Index Number	Source	Data Base
27	El Paso Natural Gas Products Co.	Oil/gas well No. 7 Stage Stop Unit
28	Kenneth D. Luff, Inc.	Oil/gas well No. 1-25 Champlin
29	Odessa Natural Corp.	Oil/gas well No. 13 Stage Stop Unit
30	El Paso Natural Gas Products Co.	Oil/gas well No. 4 Stage Stop Unit
31	Lion Oil Co.-Monsanto Co.	Oil/gas well No. 1 Verbrugge
32	Forest Oil Corp. and U.P.R.R. Co.	Oil/gas well No. 7 Arch Unit-18-1
33	El Paso Natural Gas Products Co.	Oil/gas well No. 138 Monell Unit
34	Forest Oil Corp.	Oil/gas well No. 79 Arch Unit-13-8
35	Forest Exploration Corp.	Oil/gas well No. 39 Arch Unit-13-7
36	Forest Oil Corp. and U.P.R.R. Co.	Oil/gas well No. 6 Arch Unit-13-1
37	Forest Exploration Corp.	Oil/gas well No. 22 Arch Unit-14-1
38	Forest Oil Corp. and U.P.R.R. Co.	Oil/gas well No. 62 Arch Unit-15-1
39	Colorado Oil and Gas Co.	Oil/gas well No. 1-16 State

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Table 3. -- Continued

Plate 1 Index Number	Source	Data Base
40	Reserve Oil Co.	Oil/gas well No. 1-17 McFarland-Amoco-Champlin
41	Gulf Oil Corp.	Oil/gas well No. 1 Leon-Government
42	Buttes Gas and Oil Co.	Oil/gas well No. 1-20 Federal
43	Champlin Petroleum Co.	Oil/gas well No. 3-21 Champlin-U.P.R.R.
44	Forest Oil Corp.	Oil/gas well No. 58 Arch Unit-22-1
45	↓	Oil/gas well No. 74 Arch Unit-22-2
46	↓	Oil/gas well No. 87 Arch Unit-22-3
47	Forest Exploration Corp.	Oil/gas well No. 19 Arch Unit-23-3
48	Forest Exploration Corp. and U.P.R.R. Co.	Oil/gas well No. 15 Arch Unit-23-1
49	↓	Oil/gas well No. 12 Arch Unit-24-2-Gov't
50	Forest Oil Corp.	Oil/gas well No. 73 Arch Unit-24-7
51	Texaco, Inc.	Oil/gas well No. 18 Beacon Ridge Unit
52	El Paso Natural Gas Products Co.	Oil/gas well No. 157 Monell Unit

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Table 3. -- Continued

Plate 1 Index Number	Source	Data Base
53	El Paso Natural Gas Products Co.	Oil/gas well No. 149 Monell Unit
54	Colorado Oil and Gas Corp.	Oil/gas well No. 4-26 Government
55	Texaco, Inc.	Oil/gas well No. 7
56	↓	Oil/gas well No. 1-E Texaco-U.P.R.R.
57	↓	Oil/gas well No. 26 Beacon Ridge Unit
58	↓	Oil/gas well No. 1-B Texaco-U.P.R.R.
59	El Paso Natural Gas Products Co.	Oil/gas well No. 129 Monell Unit
60	↓	Oil/gas well No. 140 Monell Unit
61	↓	Oil/gas well No. 127 Monell Unit

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