Text to Accompany:

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COAL RESOURCE OCCURRENCE AND COAL DEVELOPMENT POTENTIAL MAPS OF THE WARFIELD CREEK QUADRANGLE, LINCOLN COUNTY, WYOMING

[Report includes 18 plates]

Prepared for

UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

By

DAMES & MOORE

DENVER, COLORADO

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 Warfield Creek quadrangle, Lincoln County, Wyoming. This report was compiled to support the land planning work of the Bureau of Land Management (BLM) 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 1975 (P.L. 94-377). Published and unpublished public information available through March, 1978, was used as the data base for this study.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 Warfield Creek quadrangle is located in southwestern Lincoln County, Wyoming, approximately 6 miles (10 km) southwest of Kemmerer and 27 miles (43 km) northeast of Evanston, Wyoming. With the exception of the Old Dutch John Ranch, located in the north-central part of the quadrangle, the area is unpopulated.

Accessibility

An improved light-duty road crosses north-south through the northern third of the quadrangle, connecting the Old Dutch John Ranch with U.S. Highway 30N, approximately 7 miles (11 km) north of the ranch. Several unimproved dirt roads and trails provide access for the remainder of the quadrangle.

The Oregon Shortline Railroad, a branch of the Union Pacific Railroad, passes through Kemmerer, Wyoming approximately 5 miles (8 km) north of the quadrangle, connecting Pocatello, Idaho with the Union Pacific main east-west line at Granger, Wyoming.

Physiography

The Warfield Creek quadrangle is located on the southeastern edge of the Wyoming Overthrust Belt. The landscape within the quadrangle is characterized by east-trending draws and ridges in the western third of the quadrangle and a large mesa forming the Bear River Divide which covers the remaining two thirds of the quadrangle. Altitudes in the quadrangle range from 6,760 feet (2,060 m) in the southeastern part of the quadrangle to 7,718 feet (2,352 m) at the top of Cavanaugh Peak in the northeastern part of the quadrangle.

The Bear River Divide crosses the center of the quadrangle, separating the Bear River and the Green River drainages. The South Fork of Twin Creek, a tributary of Twin Creek, flows northerly in the northern part of the quadrangle into the Bear River drainage system. South of the Bear River Divide, Little Muddy Creek and its tributaries, Warfield Creek and Carter Creek, flow southeasterly into the Green River drainage system. All of the streams are intermittent, flowing mainly in response to snowmelt in the spring.

Climate and Vegetation

The climate of southern Wyoming is semiarid, characterized by low precipitation, rapid evaporation, and large daily temperature variations. Summers are usually dry and mild, and winters are cold. Annual precipitation averages approximately 10 inches (25.4 cm) and is fairly evenly distributed throughout the year.

The average annual temperature in the area is 39°F (4°C). The temperature during January averages 17°F (-8°C) and ranges from 4°F (-16°C) to 30°F (-1°C). During July the average temperature is 62°F (17°C), and the temperature ranges from 43°F (6°C) to 82°F (28°C).

Winds are usually from the west and west-southwest with an average velocity of 15 miles per hour (24 km per hr).

Principal types of vegetation in the quadrangle include grasses, sagebrush, greasewood, saltbush, rabbitbrush, serviceberry, and mountain mahogany.

Land Status

The Warfield Creek quadrangle lies in the west-central part of the Kemmerer Known Recoverable Coal Resource Area. Only the eastern half of the quadrangle lies within the KRCRA boundary, with the Federal government owning the coal rights for approximately two thirds of this area. Two active coal leases are present within the KRCRA boundary, as shown on plate 2.

GENERAL GEOLOGY

Previous Work

Veatch (1907) mapped in detail the geology and economic resources of a large part of Lincoln and Uinta counties in southwestern Wyoming. Schultz made a detailed investigation of the geology and coal resources of the northern part of the Kemmerer coal field in 1914. The stratigraphy of the Evanston, Wasatch, and Green River Formations present in the Kemmerer area was described by Oriel and Tracey in 1970. Smith and others described the Kemmerer coal field and calculated reserves in the Adaville coal deposit in 1972. Rubey, Oriel and Tracey (1975) also described the stratigraphy and structure in the Kemmerer and Sage 15-minute quadrangles north of the Warfield Creek quadrangle. Coal analyses and measured sections of Adaville Formation coals from the Elkol and Sorensen mines were reported by Glass in 1975. Roehler, Swanson, and Sanchez (1977) included the Kemmerer coal field, a part of the Hams Fork coal region, in a report on the geology and mineral resources of the Sweetwater-Kemmerer area. Glass also described the coal-bearing formations and coal beds present in the Hams Fork coal region and reported chemical analyses of these coals in 1977. The coal geology of the Skull Point Mine area on the eastern edge of the Warfield Creek quadrangle was described by Bozzuto in 1977. Schroeder mapped the geology and coal resources of the adjacent Elkol SW quadrangle in 1977. A detailed geologic map of the Warfield Creek quadrangle is currently being prepared by John W. M'Gonigle of the Coal Resources Branch, Geologic Division, U.S. Geological Survey. Unpublished data from Rocky Mountain Energy Company (RMEC) also provided coal thickness information.

Stratigraphy

The areal extent of the formations cropping out in the quadrangle is not accurately known at this time. Projection of formation outcrops from adjacent quadrangles indicate that the formations cropping out within the Warfield Creek quadrangle probably range in age from Mississippian to Recent. The Adaville Formation of Late Cretaceous age, cropping out along the eastern edge of the quadrangle, is the only major coal-bearing formation in the Warfield Creek quadrangle.

The Hilliard Shale of early Late Cretaceous age, approximately 6,600 feet (2,012 m) thick, is present in the subsurface in this quadrangle. It is composed of a thick sequence of dark-gray, gray and tan fissile marine claystone; light- to medium-gray, partly argillaceous and partly lignitic sandy siltstone; white to dark-gray, thin-bedded, very fine grained to gritty sandstone; and white to gray bentonite (Rubey and others, 1975).

The Adaville Formation of Late Cretaceous age conformably overlies the Hilliard Shale and crops out along the eastern edge of the quadrangle. At the base of the Adaville Formation is the Lazeart Sandstone Member which is approximately 200 to 300 feet (61 to 91 m) thick and composed of light-gray to white, fine- to coarse-grained sandstone. The Adaville Formation consists of interbedded gray sandstone, siltstone, carbonaceous clay, and numerous thick coal beds. The sandstone is calcareous, fine- to coarse-grained, thin-bedded to massive, and is partly conglomeratic in the upper part of the formation (Rubey and others, 1975). Numerous coal beds, including the 30-foot- (9.1-m-) thick Adaville No. 1 coal bed, are located in the lower part of the formation. The Adaville Formation is approximately 2,300 feet (701 m) thick in the Warfield Creek quadrangle (Oriel and Tracey, 1970).

The Evanston Formation lies unconformably on the Adaville Formation, cropping out in the eastern part of the quadrangle. At the base of the formation is the Hams Fork Conglomerate Member of latest Cretaceous age. This member may consist of up to 1,000 feet (305 m) of boulder-conglomerate beds with gray to brown cross-bedded sandstone, and gray mudstone. The main body of the Evanston Formation, which is Paleocene in age, consists of over 200 feet (61 m) of gray siltstone, red mudstone, carbonaceous claystone, occasional thin coal beds, and dark brown concretionary ironstone. Composition of the Evanston Formation varies both laterally and vertically (Oriel and Tracey, 1970, and Rubey and others, 1975).

Unconformably overlying the Evanston Formation, the Wasatch Formation of Eocene age crops out in the western part of the quadrangle. This formation is composed of red, maroon, yellow, and gray variegated mudstone; yellow, brown, and gray, fine- to coarse-grained sandstone; and stream-channel conglomerate beds containing pebbles and boulders of quartzite, chert, and limestone. The Wasatch Formation may range in thickness from 1,600 to 2,000 feet (488 to 610 m) in the Warfield Creek quadrangle (Oriel and Tracey, 1970).

The Green River Formation of Eocene age intertongues with and overlies the Wasatch Formation with a sharp and conformable contact. The Green River Formation consists of buff laminated limestone and marlstone, gray calcareous siltstone, claystone, brown to black oil shale, thin beds of tuffaceous ash, and abundant fossils. This formation is approximately 200 to 400 feet (61 to 122 m) thick in the Warfield Creek quadrangle (Oriel and Tracey, 1970).

Recent deposits of alluvium cover the stream valleys of Little Muddy Creek, Twin Creek and their tributaries; recent deposits of gravel derived from the Hams Fork Conglomerate Member of the Evanston Formation are found in the southeastern part of the quadrangle (Schroeder, 1977).

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

The marine shale, claystone and sandstone of the Hilliard Shale indicate another transgression of the Cretaceous sea with minor fluctuations of the shoreline (Roehler and others, 1977).

The Lazeart Sandstone Member, at the base of the Adaville Formation, is a beach deposit marking a transition from the marine deposition of the Hilliard Shale to the continental coastal plain deposition of the Adaville Formation. The sandstone, siltstone, and coals of the Adaville Formation were deposited in flood plains and swamps along the coastal plain (Roehler and others, 1977).

After the final withdrawal of the Cretaceous sea, thick sections of detrital material, eroded from older deposits to the west, were deposited by large streams as the conglomerates of the Hams Fork Conglomerate Member of the Evanston Formation. Environments of deposition for the main body of the Evanston Formation include streams, marshes, and, probably, ponds (Oriel and Tracey, 1970).

The main body of the Wasatch Formation is composed of continental sediments. The bright-colored mudstones were probably deposited on a flood plain and then cut by stream channels now filled with well-sorted conglomerate (Oriel and Tracey, 1970).

The Green River Formation was deposited in a lacustrine environment. Fluctuations in the lake size are recorded in the intertonguing of Green River Formation beds with Wasatch Formation strata (Oriel and Tracey, 1970).

Structure

The Warfield Creek quadrangle lies on the southeastern edge of the structurally complex Wyoming Overthrust Belt. Folded Paleozoic and Mesozoic rocks are thrust eastward over folded Cretaceous-age rocks with younger rocks, Cretaceous and Tertiary in age, resting unconformably on top of the older rocks. Coal-bearing strata crop out in eroded limbs of folds as long narrow belts bounded on the west by major thrust faults (Roehler and others, 1977).

The axial trace of the asymmetric Lazeart syncline trends north-south along the eastern edge of the quadrangle. Cretaceous-age beds dip about 30° on the eastern limb of the syncline and are vertical or overturned on the western limb. Much of the western limb of the syncline is covered by thick Tertiary-age sediments (Rubey and others, 1977).

Three major thrust faults, the Absaroka fault, the Commissary fault, and the Beaver Creek fault, lie west of the Lazeart syncline and parallel the trace of the synclinal axis.

The Absaroka fault, an extensive thrust fault mapped for a linear distance of 205 miles (330 km) in Wyoming and Idaho, brings Paleozoic strata in contact with the Upper Cretaceous-age Hilliard Shale in the Warfield Creek quadrangle. At and near the surface, the fault dips steeply to the west (approximately 70°). According to Rubey and others (1975), the dip of the fault probably becomes much less with an increase in depth to the west. Stratigraphic displacement of the Absaroka fault is approximately 10,000 to 15,000 feet (3,048 to 4,572 m) and its lateral displacement is approximately 3 miles (4.8 km). Major movement along the fault occurred in very late Cretaceous time with probable minor movement in the Paleocene (Rubey and others, 1975).

The Commissary fault, crossing the northwestern corner of the quadrangle, and the Beaver Creek fault, just west of the Commissary fault, are believed to be upward slices or branches of the Absaroka fault at depth (Rubey and others, 1975).

COAL GEOLOGY

Coal beds of the Adaville Formation were mapped in outcrop and identified in drill holes by RMEC in this quadrangle (plate 1). The

Adaville Coal Zone is approximately 1,750 feet (533 m) thick with the lowest coal bed directly overlying the Lazeart Sandstone Member (Glass, 1975).

It is probable that the outcrop locations shown on plate 1 will change based on the detailed geologic map currently being prepared by John W. M'Gonigle of the U.S. Geological Survey. However, changes in outcrop locations resulting from M'Gonigle's work will not affect the coal tonnages available for leasing or the coal development potential of Federal land in the Warfield Creek quadrangle since all land areas where coal bed outcrops occur are either already leased or are non-Federal lands.

Chemical analyses of coal.--One analysis from the Warfield Creek quadrangle and two other analyses from the adjacent southeast quarter of the Kemmerer 15-minute quadrangle are included in table 1 (Glass, 1975). The coals in the Adaville Formation are low in sulfur and rank as subbituminous A, B, or C on a moist, mineral-matter-free basis according to ASTM Standard Specification D 388-77 (American Society for Testing and Materials, 1977).

Adaville Coal Zone

Eight coal beds of Reserve Base thickness (5 feet or 1.5 meters) were identified in the Adaville Formation in the Warfield Creek quadrangle. They occur in the southeastern part of the quadrangle and in the Sorensen mine in the northeastern part of the quadrangle. The coal beds were named according to the alpha-numeric system (e.g., AV-4C) used by RMEC. Data projected from the Elkol quadrangle to the east was used to map two of the beds in this quadrangle.

The dotted line shown on all isopach and structure contour maps represents a limit of confidence beyond which isopach and structure contours are not drawn due to insufficient data. Dips measured by Veatch (1907) range from 18° to 32° in a west-northwest direction. Overburden thickness increases in the same direction.

Adaville No. 1 Coal Bed

The Adaville No. 1 coal bed is stratigraphically the lowest coal bed in the Adaville Coal Zone. It is found immediately overlying the Lazeart Sandstone Member of the Adaville Formation. The Adaville No. 1 coal bed does not crop out within this quadrangle, but is identified in a drill hole located in sec. 3, T. 19 N., R. 117 W., where it measures 10 feet (3.0 m) in thickness. To the east in the Elkol quadrangle, the Adaville No. 1 coal bed is 43 feet (13.1 m) thick. In the Cumberland Gap quadrangle to the southeast, the Adaville No. 1 coal bed thins to 10 feet (3.0 m) and the outcrop appears to pinch out. The dip of the coal bed, as derived from plate 7, ranges from 16° to 24° in a southwest to northwest direction. An areal distribution and identified resources map of the Adaville No. 1 coal bed was not prepared because, in this quadrangle, its occurrence is limited to non-Federal lands or Federal lands already leased for coal mining.

Adaville No. 2 Coal Bed

The Adaville No. 2 coal bed is located 180 feet (55 m) stratigraphically above the Adaville No. 1 coal bed. Geologic data was not available to verify the existence of the Adaville No. 2 coal bed in this quadrangle. However, the coal bed does crop out to the east in the Elkol quadrangle, with one drill hole measurement indicating a thickness of 12 feet (3.7 m). Isopach, structure contour, and overburden isopach maps of the Adaville No. 2 coal bed were prepared from geologic data extrapolated from the Elkol quadrangle into this quadrangle. An areal distribution and identified resources map of this coal bed was not prepared because the bed is limited to either non-Federal lands or Federal lands already leased for coal mining in this quadrangle.

Adaville No. 4C Coal Bed

The Adaville No. 4C coal bed lies 620 feet (189 m) stratigraphically above the Adaville No. 1 coal bed. It crops out in the southeastern part of the Warfield Creek quadrangle. A maximum measured thickness of 15.5 feet (4.7 m) is recorded in a drill hole located in sec. 3, T. 19 N., R. 117 W. The Adaville No. 4C coal bed is also found in the Elkol quadrangle to the east, where it is 6 to 10 feet (1.8 to 3.0 m) thick. The dip of the coal bed, calculated from plate 14, ranges from 12° to 25° to the west.

Adaville No. 5 Coal Bed

The Adaville No. 5 coal bed is located approximately 80 feet (24.4 m) above the Adaville No. 4C coal bed. This coal bed is not represented in any drill hole or measured section in this quadrangle, but data from the Elkol quadrangle to the east indicates that the Adaville No. 5 coal bed may exist in the Warfield Creek quadrangle at depth. In the Elkol quadrangle this coal bed is named the Adaville No. 5 coal bed by Glass (1977) and the Adaville No. 4E coal bed by RMEC. To avoid confusion it is designated the Adaville No. 5 coal bed in this quadrangle. Its average thickness in the Elkol quadrangle is 6 feet (1.8 m) and the dip, derived from plate 4, is approximately 11° to the west.

Adaville No. 4G Coal Bed

The Adaville No. 4G coal bed is found approximately 110 feet (34 m) above the Adaville No. 4C coal bed. A thickness of 5.5 feet (1.7 m) was measured in a drill hole located in sec. 3, T. 19 N., R. 117 W. To the east in the Elkol quadrangle, this coal bed is 6 feet (1.8 m) thick; in the Elkol SW quadrangle to the south it averages 10 feet (3.0 m) in thickness. The dip of the Adaville No. 4G coal bed, calculated from plate 12, ranges from 13° to 24° to the west.

Adaville No. 7C Coal Bed

The Adaville No. 7C coal bed is stratigraphically above and separated from the Adaville No. 4G coal bed by approximately 460 feet (140 m) of sandstone, siltstone, carbonaceous shale, and several thin coal beds. The maximum thickness (corrected for dip) of the Adaville No. 7C coal bed is 9.9 feet (3.0 m) where measured in a drill hole in sec. 33, T. 20 N., R. 117 W. To the south in the Elkol SW quadrangle, this coal bed averages 10.4 feet (3.2 m) thick, with the outcrop restricted to the northeastern part of the quadrangle due to the influence of the Lazeart syncline. The coal bed dips toward the west at an average of 30° as calculated from plate 10. No areal distribution and identified resources map of the Adaville No. 7C coal bed was prepared because its occurrence in this quadrangle is limited to non-Federal lands or Federal lands already leased for coal mining.

Adaville No. 10A Coal Bed

The Adaville No. 10A coal bed overlies the Adaville No. 7C coal bed and is separated from it by approximately 250 feet (76 m) of carbonaceous shale, siltstone, and thin coal beds. Drill holes located in sec. 9, T. 19 N., R. 117 W., indicate that, after correcting for dip, the coal bed averages 5 feet (1.5 m) in thickness. In the Sorensen mine to the north, in sec. 3, T. 20 N., R 117 W., the bed was measured as being 8 feet (2.4 m) thick. It is believed that the coal bed exists between the drill hole and outcrop measurements. Therefore, the outcrop of the coal bed was projected as shown on plates 7 and 8. In the Elkol SW quadrangle to the south, the Adaville No. 10A coal bed was not encountered in any drill hole or measured section. However, the coal bed has been projected to extend to the north into the southwest quarter of the Kemmerer 15-minute quadrangle based on outcrop data in this quadrangle. The dip of the coal bed, as calculated from plate 7, averages 24° to the west.

Adaville No. 11A Coal Bed

The Adaville No. 11A coal bed is located 200 feet (61 m) stratigraphically above the Adaville No. 10A coal bed. Two measurements, one drill hole located in sec. 9, T. 19 N., R. 117 W., and a measured section in the Sorensen mine in sec. 10, T. 20 N., R. 117 W., were used to map the coal bed. After correction for dip, the thickness of the coal bed in the drill hole is 5.3 feet (1.6 m). In the measured section to the north, the recorded thickness is 13.0 feet (4.0 m). A projected outcrop is shown on plates 4 and 5. The Adaville No. 11A coal bed was not encountered in drill holes or measured sections either to the south in the Elkol SW quadrangle, or to the north in the southwest quarter of the Kemmerer 15-minute quadrangle. The coal bed was, however, projected northward into the southwest quarter of the Kemmerer 15-minute quadrangle because of the significant thickness measured in the Sorensen mine. This coal bed dips at an average of 24° to the west as calculated from plate 4.

COAL RESOURCES

Information from coal test holes drilled by RMEC, as well as measured sections by Glass (1977) and surface mapping by RMEC, was used to construct outcrop, isopach, and structure contour maps of the coal beds in this quadrangle. At the request of RMEC, coal-rock data for some of their drill holes have not been shown on plate 1 or on the derivative maps. However, data from these holes have been used to construct the derivative maps. These data may be obtained by contacting RMEC. The source of each indexed data point shown on plate 1 is listed in table 3.

Coal resources were calculated using data obtained from the coal isopach maps (plates 4, 7, 10, 12, 14, 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 of coal 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 tonnages for the Adaville No. 11A and Adaville No. 10A coal beds are shown on plates 6 and 9, 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 12.53 million short tons (11.37 million metric tons) for the entire quadrangle.

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 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 and Subsurface Mining Methods

Areas where the coal beds of Reserve Base thickness are overlain by 200 feet (61 m) or less of overburden are ordinarily 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 per ton of recoverable coal (to convert mining ratio to cubic meters of overburden per metric ton of recoverable coal, multiply mining ratio by 0.8428). The areas of high, moderate, and low development potential 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.

Areas ordinarily considered to have a development potential for conventional subsurface mining methods include those areas where the coal beds are between 200 feet (61 m) and 3,000 feet (914 m) below the ground surface and have dips less than 15°. Areas of high, moderate, and low development potential for conventional subsurface mining are defined by the U.S. Geological Survey as areas underlain by coal beds of Reserve

Base thickness at depths ranging from 200 to 1,000 feet (61 to 305 m), 1,000 feet to 2,000 feet (305 to 610 m), and 2,000 to 3,000 feet (610 to 914 m), respectively.

Unknown development potentials are assigned to those areas where coal data is absent or extremely limited. Even though these areas may contain coal thicker than 5 feet (1.5 m), limited knowledge pertaining to the areal distribution, thickness, depth, and attitude of the coal beds in this quadrangle prevents accurate evaluation of the development potential in the high, moderate, or low categories.

All Federal lands within the KRCRA boundary in this quadrangle were classified as having an unknown development potential for surface and conventional subsurface mining methods because of the high dips of the coal beds and extremely low tonnages available for mining.

Development Potential for In-Situ Mining Methods

Coal beds lying between 200 feet (61 m) and 3,000 feet (914 m) below the ground surface, dipping greater than 15°, are considered to have a development potential for in-situ mining methods. Based on criteria provided by the U.S. Geological Survey, coal beds of Reserve Base thickness dipping between 35° and 90° with a minimum Reserve Base of 70 million short tons (63.5 million metric tons) for subbituminous coal have a moderate potential for in-situ development; coal beds dipping from 15° to 35°, regardless of tonnage, and coal beds dipping from 35° to 90° with less than 50 million short tons (45.4 million metric tons) of coal have a low development potential for in-situ mining methods. Coals lying between the 200-foot (61-m) overburden line and the outcrop are not included in the total coal tonnages available because they are needed for cover and containment in the in-situ process.

Areas classified as having development potential for in-situ mining methods are shown on plate 18. Since the dips of the coal beds in these areas exceed 15° and the total Reserve Base tonnage is only 12.53 million short tons (11.37 million metric tons), all of the Federal land areas having a known development potential have been rated low for in-situ mining methods. The remaining Federal land areas that have not already been leased for coal mining are classified as having unknown development potential.

Table 1. Chemical analyses of coals in the Warfield Creek quadrangle, Lincoln County, Wyoming.

LOCATION	COAL BED NAME	Form of analysis	Proximate				Ultimate					Heating value	
			Moisture	Volatile matter	Fixed carbon	Ash	Sulfur	Hydrocarbon	Carbon	Nitrogen	Oxygen	Calories	Btu/lb
NW¼, SW¼, sec. 3, T. 20 N., R. 117 W., (Sorensen Mine - Glass, 1975)	Adaville No. 10	A	20.5	33.0	39.6	6.9	0.9	-	-	-	-	-	9,410
		C	0.0	41.5	49.8	8.7	1.2	-	-	-	-	-	11,840
SE¼, NE¼, sec. 19, T. 21 N., R. 116 W., (Sorensen Mine - Glass, 1975)	Adaville No. 5	A	17.5	35.1	43.7	3.7	0.4	-	-	-	-	-	10,180
		C	0.0	42.5	53.0	4.5	0.4	-	-	-	-	-	12,330
SE¼, NW¼, sec. 20, T. 21 N., R. 116 W., (Elkol Mine - Glass, 1975)	Adaville No. 1	A	16.7	36.5	42.8	4.0	1.3	-	-	-	-	-	10,530
		C	0.0	43.8	51.4	4.8	1.5	-	-	-	-	-	12,640
Form of Analysis: A, as received; C, moisture free													

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

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

Coal Bed or Zone	Moderate Development Potential	Low Development Potential	Total
Adaville No. 10A	-	3,970,000	3,970,000
Adaville No. 11A	-	8,560,000	8,560,000
Total	-	12,530,000	12,530,000

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	Rocky Mountain Energy Co., (no date), unpublished data	Drill hole No. 4, line A
2		Drill hole No. 5, line A
3		Drill hole No. 7, line A
4		Drill hole No. 8, line A
5		Drill hole No. 1, line B
6		Drill hole No. 6, line A
7		Drill hole No. 5, line A
8		Drill hole No. 4, line A
9		Drill hole No. 3, line A
10		Drill hole No. 2, line A
11		Drill hole No. 1, line A
12		Drill hole No. P, line A
13		Drill hole No. Q, line A

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Table 3. -- Continued

Plate 1 Index Number	Source	Data Base
14	Rocky Mountain Energy Co., (no date), unpublished data	Drill hole No. R, line A
15	↓	Drill hole No. S, line A
16	↓	Drill hole No. T, line A
17	Glass, 1975, Wyoming Geological Survey Report of Investigations No. 11	Measured Section No. 74-2, 74-3
18	↓	Measured Section No. 74-1
19	Rocky Mountain Energy Co., (no date), unpublished data	Drill hole No. 2, line A
20	↓	Drill hole No. 3, line A
21	↓	Drill hole No. 1, line A

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