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COAL RESOURCE OCCURRENCE MAPS AND COAL DEVELOPMENT POTENTIAL MAP OF THE LYBROOK QUADRANGLE, SANDOVAL, RIO ARRIBA, AND SAN JUAN COUNTIES, NEW MEXICO

[Report includes 11 plates]

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LYBROOK 7 1/2-MINUTE QUADRANGLE

INTRODUCTION

Purpose

This text is to be used in conjunction with the Coal Resource Occurrence (CRO) Maps and Coal Development Potential (CDP) Map of the Lybrook quadrangle, Sandoval, Rio Arriba, and San Juan Counties, New Mexico. These reports were compiled to provide a systematic coal resource inventory of Federal coal lands in Known Recoverable Coal Resource Areas (KRCRA's) in the western United States. The work has been performed under contract with the Conservation Division of the U.S. Geological Survey (Contract No. 14-08-0001-17172).

The resource information gathered in this program is in response to the Federal Coal Leasing Amendments Act of 1976 and is a part of the U.S. Geological Survey's coal program. The information provides basic data on coal resources for land-use planning purposes by the Bureau of Land Management, state and local governments, and the public.

Location

The Lybrook 7 1/2-minute quadrangle is in southwestern Rio Arriba County, northwestern Sandoval County, and southeastern San Juan County, New Mexico. The area is approximately 48 miles (77 km) southeast of Farmington and 76 miles (122 km) northeast of Gallup, New Mexico.

Accessibility

The Lybrook quadrangle is accessible by State Route 44 which crosses the northern portion of the area. Numerous unimproved dirt roads provide access to remote parts of the area. The Atchison, Topeka, and Santa Fe Railway operates a route which passes through Gallup, New Mexico, 76 miles (122 km) to the southwest.

Physiography

This quadrangle is in the southern portion of the Central Basin area (Kelley, 1950) of the larger structural depression known as the San Juan Basin. Elevations range from 6,680 ft (2,036 m) in the channel of Escavada Wash to 7,571 ft (2,308 m) in the north. In the northern portion of the quadrangle, intermittent, northward-draining streams have partially dissected the broad plains and carved a topography of low mesas separated by broad stream valleys. The topography in the south is characterized by partially dissected, gently sloping plains. Drainage is provided by many intermittent streams, of which Escavada Wash, Escrito Canyon, and Betonnie Tsosie Wash are the most prominent.

Climate

The climate of the San Juan Basin is arid to semi-arid. Annual precipitation is usually less than 10 inches (25 cm), but varies across the basin due to elevational differences. Rainfall is rare in the early summer and winter; most precipitation is received in July and August as intense afternoon thundershowers. Annual temperatures in the basin range from below 0°F (-18°C) to over 100°F (38°C). Snowfall may occur from November to April with an average of 18 inches (46 cm) in the southern part of the basin.

Land Status

The quadrangle is in the southeastern quarter of the San Juan Basin Known Recoverable Coal Resource Area. The Federal Government owns the coal rights for approximately 90 percent of the quadrangle as shown on Plate 2 of the Coal Resource Occurrence maps. No Federal coal leases occur within the quadrangle.

GENERAL GEOLOGY

Previous Work

Dane (1936) has mapped the Tertiary and Upper Cretaceous strata in the southern part of the quadrangle. A more recent publication by Fassett and Hinds (1971) includes subsurface interpretations of the Fruitland Formation coal deposits throughout the San Juan Basin.

Geologic History

The San Juan Basin, an area of classic transgressive and regressive sedimentation, provided the ideal environment for formation of coals during

Late Cretaceous time. At that time a shallow epeiric sea, which trended northwest-southeast, was northeast of the basin. The sea transgressed southwesterly into the basin area and regressed northeasterly numerous times; consequently, sediments from varying environments were deposited across the basin. Noncarbonaceous terrestrial deposition predominated during Paleocene and Eocene time.

After its first basin-wide retreat, the Late Cretaceous sea then reversed the direction of movement. As a result, the transgressive sequence of paludal upper Menefee Formation, nearshore Cliff House Sandstone, and marine Lewis Shale was deposited in the quadrangle. Swamps (Menefee) formed southwest (shoreward) of the transgressing beaches (Cliff House). Organic matter deposited in these swamps ultimately formed the coal beds of the Menefee Formation. Subsequently, several hundred feet of beach sands of the La Ventana Tongue (Cliff House Sandstone) were deposited over the Menefee.

Onlap continued as the sea moved southwestward across the basin area. The transgressing northwest-southeast-trending strandline is represented in the lithologic record by the Chacra Tongue (informal name of local usage) of the Cliff House Sandstone. The marine facies which developed northeast of the strandline as it moved to the southwest is the Lewis Shale. This thick sequence, which thins to the southwest, overlies the Cliff House Sandstone, and marks the last advance of the Late Cretaceous sea.

Evidence of the final retreat of the Late Cretaceous sea are the nearshore regressive Pictured Cliffs Sandstone and the overlying paludal Fruitland Formation which were deposited in successively higher stratigraphic positions to the northeast. Southwest (shoreward) of the beach deposits, swamps, which were dissected by streams, accumulated organic matter which became coals of the Fruitland Formation. Deposition of organic material was influenced by the strandline as shown by the continuity of the coal beds parallel to the northwest-southeast strandline and discontinuity perpendicular to it to the northeast.

The brackish-water swamp environment of the Fruitland moved northeast of the quadrangle as the regression continued in that direction. Terrestrial sediments then covered the area as indicated by the lacustrine, channel, and floodplain deposits of the Kirtland Shale. This sequence of events is evidenced by both an upward decrease in occurrence and thickness of Fruitland coals and a gradational change to noncarbonaceous deposits of the Kirtland. Continuous deposition during Late Cretaceous time ended with the Kirtland. The sea then retreated beyond the limits of the quadrangle area, and modern basin structure began to develop. An erosional unconformity developed in a relatively short time as part of the Cretaceous Kirtland Shale was removed.

Terrestrial deposition resumed in the Paleocene as represented by the Ojo Alamo Sandstone and the overlying Nacimiento Formation. Alluvial plain and floodplain deposits of the Ojo Alamo were followed by the thick, lithologically varied deposits of the Nacimiento during continuous nonmarine deposition. The Nacimiento was later exposed to erosion.

The Eocene San Jose Formation was subsequently deposited over the Nacimiento erosional surface, reflecting various nonmarine environments which developed across the basin. Deposition and structural deformation of the basin then ceased, and the warped strata of the San Juan Basin have been exposed to erosional processes to the present time. A significant amount of erosion has occurred, as indicated by the removal of some of the San Jose Formation from the area.

Stratigraphy

The formations studied in this quadrangle range from Late Cretaceous to Eocene in age. They are, in order from oldest to youngest: (two of the three members of the Mesaverde Group), the Menefee Formation and Cliff House Sandstone; Lewis Shale, Pictured Cliffs Sandstone, Fruitland Formation, Kirtland Shale, Ojo Alamo Sandstone, Nacimiento Formation, and San Jose Formation. A composite columnar section on CRO Plate 3 illustrates the stratigraphic relationships of these formations and is accompanied by lithologic descriptions of the individual formations.

The oldest coal-bearing formation in the quadrangle is the Menefee Formation of the Mesaverde Group. In previous studies the Menefee has been divided into the Cleary Coal Member, the barren Allison Member, and an unnamed upper coal-bearing member (Beaumont and others,1956). These members are referred to as the undifferentiated Menefee Formation for the purposes of this report only. The Menefee in this area is about 800 to 1,000 ft (244-305 m) thick and consists of a gray, fissile, slightly carbonaceous shale with thinly-bedded sandstone, and lenticular coal beds. Due to the gentle regional dip of about 1° to the northeast, the uppermost several hundred feet of the Menefee are overlain by less than 3,000 ft (914 m) of overburden (the study limit) in the southwestern part of the quadrangle. However, the top of the formation is more than 3,000 ft (914 m) deep in the remainder of the area in the northeast.

Conformably overlying the Menefee Formation are two members of the Cliff House Sandstone. The basal member is the La Ventana Tongue, which is approximately 770 ft (235 m) thick. The lithologic character of the La

Ventana changes across the quadrangle in a southwest-to-northeast (seaward) direction from massive sandstone to a sandy shale and shaly sandstone.

The upper member, the Chacra Tongue (informal name of local usage), overlies the La Ventana Tongue and is about 420 ft (128 m) thick in this area. The Chacra Tongue in the quadrangle area is composed of gray, argillaceous, thinly-bedded silty sandstone, with abundant interbedded shale and sandy shale. This lithology represents a seaward transition from the thickly bedded sandstone of the type section south of the area at Chacra Mesa to the marine shale of the Lewis. The "transition" Chacra extends from the southwest across half of the quadrangle, where it loses its sandy character and merges into the marine Lewis Shale.

The Mesaverde Group is conformably overlain by the marine deposits of the Lewis Shale. The Lewis is thinner in the southwestern and western portions of the quadrangle where it grades into the Chacra; it averages 260 to 300 ft (79-91 m) in thickness. In the northeast (seaward), the lower contact of the Lewis is 400 ft (122 m) stratigraphically lower and is contemporaneous with the Chacra Tongue to the west and southwest; it conformably overlies the basal Menefee (La Ventana). The Lewis Shale primarily consists of gray to brown, locally silty, slightly calcareous shale with limy nodules, plant fossils, and thin interbedded sandstone, which predominates in the upper portion.

The Pictured Cliffs Sandstone conformably overlies the Lewis Shale. Consequently, the basal contact is difficult to establish and possibly accounts for the reported thicknesses which range from 100 to 150 ft (30-46 m). The upper contact is more sharply defined than the basal contact, even though intertonguing of the Fruitland Formation results in minor variations in the formational top and the occurrence of local Fruitland coal beds. The Pictured Cliffs consists of a cream to light gray, friable sandstone with interbedded gray and brown shale. Since the formation is present throughout most of the basin and displays a distinctive character on geophysical logs, the authors have used the top of the unit as a lithologic datum for correlation of the overlying Fruitland coals for reserve and reserve base calculations.

The Fruitland Formation is the major coal-bearing unit in the quadrangle. It has an average thickness of 80 to 180 ft (24-55 m) and consists of gray to brown, carbonaceous shale with thin, interbedded sandstone, and coal beds of varying thicknesses. The coal beds of greatest continuity and thickness occur near the base of the formation, while discontinuous and lenticular coals are characteristic of the upper portion. The upper contact is gradational between the nonmarine, lower coastal plain deposits of the Fruitland and the upper coastal or alluvial plain deposits of the Kirtland Shale (Molenaar, 1977). Many authors have utilized various criteria in determining the upper contact, but, in general, for the purposes of this report the uppermost coal was chosen (after Fassett and Hinds, 1971).

The freshwater deposits of the Kirtland Shale are the youngest Cretaceous strata in the area. These deposits range from 100 to 300 ft (30-91 m) in thickness and consist of medium gray to brown shale with local plant fossils and interbedded siltstone and sandstone near the base of the unit. The formation has previously been divided into several members by various authors; however, for the purposes of this report it was not necessary to distinguish between the individual members.

Approximately 130 ft (40 m) of the Paleocene Ojo Alamo Sandstone unconformably overlie the Upper Cretaceous strata in this area. The Ojo Alamo consists of white to light gray, coarse-grained to conglomeratic, arkosic, friable sandstone with minor interbedded shale lenses.

The Nacimiento Formation gradationally overlies the Ojo Alamo Sandstone. Approximately 1,180 to 1,300 ft (360-396 m) of the Nacimiento are present in the area. They consist predominantly of medium gray to brown, sandy shale with conglomeratic lenses. Surface exposures of the Nacimiento Formation cover the southwestern two-thirds of the quadrangle.

The Eocene San Jose Formation unconformably overlies the Paleocene Nacimiento Formation. It is composed of buff to yellow, fine- to coarse-grained, locally conglomeratic, arkosic sandstone and brown to gray shale. The San Jose is the youngest formation in the quadrangle and crops out in the northeastern corner of the area.

Structure

The axis of the San Juan basin is about 30 miles (48 km) northeast of the Lybrook quadrangle and trends in an arcuate pattern across the northern portion of the Central Basin area (Baltz, 1967). Regional dip is approximately 1° to 2° to the northeast.

COAL GEOLOGY

Individual coal beds are not continuous across the San Juan Basin because the coal related strata are progressively younger from southwest to northeast; the strata rise in steps due to minor transgressions which occurred during the overall retreat of the sea. However, for the exclusive purpose of reserve and reserve base calculations, the Fruitland 1 coal bed has been correlated and mapped as if it were a single bed, continuous throughout the basin.

A lithologic datum was used for correlation of the coals (CRO Plate 3). The primarily marine sandstone units (Point Lookout, Pictured Cliffs) which underlie the coal-bearing formations (Menefee, Fruitland) were used as datums since they represent a more laterally continuous boundary than any of the overlying paludal, fluvial, and lacustrine deposits of the coal-bearing formations. Also, the sandstone units are generally more easily recognized on geophysical logs. As shown on CRO Plate 3, the tops of the sandstone units have been used as datums for each drill hole, and the coals have been plotted in the columns and correlated based upon their position relative to the datum.

A coal bed (Fruitland 1) and two coal zones (Fruitland and Menefee) were identified in the subsurface in this quadrangle. The Menefee Formation over much of the quadrangle is overlain by more than 3,000 ft (914 m) of overburden (the study limit), with only the upper portions less than 3,000 ft (914 m) deep in the southwestern area. The Menefee coals are designated as the Menefee coal zone (Me zone). They are generally noncorrelative and less than reserve base thickness of 5 ft (1.5 m) as set by the U.S. Geological Survey. Due to these characteristics, derivative maps were not constructed.

No published analyses of the quality of Menefee Formation coals are available for this quadrangle. However, information on the quality of coals from surrounding areas is assumed to be similar to that of the coals from this quadrangle. There is no apparent consistent difference between the various Menefee Formation coals (Dane, 1936). The Menefee Formation coals in the southern San Juan Basin vary from subbituminous B to high volatile C bituminous in rank. The rank is determined on a moist, mineral-matter-free basis with calorific values ranging from 9,983 to 11,966 Btu's per pound (23,220-27,833 kj/kg) (Amer. Soc. for Testing Materials, 1977). The coal is hard, brittle, and black with a bright luster. The coal readily slakes with exposure to weather; however, it stocks fairly well when protected. The "as received" analyses indicate moisture content varying from 12.1 to 20.0 percent, sulfur content ranging from 0.6 to 2.8 percent, ash content varying from 4.9 to 10.2 percent, and heating values on the order of 10,269 Btu's per pound (23,886 kj/kg) (Bauer and Reeside, 1921; Dane, 1936; Lease, 1971; Shomaker, 1971). Analyses of several Menefee Formation coals were included in reports by Lease (1971) and Shomaker (1971). The results of these analyses are given in Table 1.

The Fruitland 1 (Fr 1) coal bed is defined by the authors as the lowermost coal of the Fruitland Formation which is generally directly above the Pictured Cliffs Sandstone. The remaining Fruitland coals are designated as the Fruitland coal zone (Fr zone). Many of the coals in the Fruitland coal zone are correlative over short distances; however, none of the Fruitland zone coal beds extend over the entire quadrangle, and they are less than reserve base thickness (5 ft [1.5 m]). Therefore, derivative maps were not constructed.

TABLE 1

Analyses of coal samples from the Menefee Formation

(Form of analysis: A, as received; B, moisture free; C, moisture and ash free)

U.S. Bureau Mines Lab No.	Well or Other Source	Location			Approx. Depth Interval of Sample (ft.)	Form of Analysis	Proximate, percent					Heating Value (Btu)	Remarks
		Section	T.N.	R.W.			Moisture	Volatile matter	Fixed Carbon	Ash	Sulfur		
A47085	Mine Sample	SW¼ 31	19	1	——	A	15.8	34.5	43.8	5.9	0.6	10,900	Cleary Member
	San Juan Mine					B	——	41.0	52.0	7.0	0.7	12,950	
A46366	Mine Sample	SW¼ 31	19	1	——	A	15.7	32.0	45.1	7.2	0.6	10,790	Cleary Member
	San Juan Mine					B	——	38.0	53.5	8.5	0.7	12,800	
						C	——	41.5	58.5	——	0.8	13,990	
A47084	Prospect Pit	SW¼ 26	19	1	——	A	18.2	34.4	40.8	6.6	0.9	10,280	Cleary Member
	Wilkins No. 2 Prospect					B	——	42.0	49.9	8.1	1.0	12,570	
A60026	Mine Sample	SE¼ 19	19	1	——	A	12.1	35.8	44.5	7.6	2.8	10,940	Allison Member
	Rio Puerco Mine					B	——	40.7	50.6	8.7	3.2	12,460	
						C	——	44.6	55.4	——	3.5	13,640	
A64268	Mine Sample	SE¼ 35	19	2	——	A	20.0	32.5	42.6	4.9	0.7	10,240	Allison Member
	Anderson Mine					B	——	40.7	53.2	6.1	0.8	12,790	
						C	——	43.3	56.7	——	0.9	13,630	
A46367	Prospect Drift	35	19	2	——	A	14.8	33.9	41.4	9.9	1.2	8,910	Allison Member;
						B	——	39.8	48.6	11.6	1.4	10,460	sample may have
						C	——	45.1	54.9	——	1.6	11,840	been somewhat weathered
3823	Mine Sample	14	20	11	——	A	17.5	32.9	41.2	8.4	2.2	——	
23004	Outcrop Sample	14	20	11	——	A	14.4	34.8	42.3	7.5	1.5	10,220	
						B	——	40.7	50.5	8.8	1.8	11,940	
J-57562	Pit Sample	SW¼ 11	22	13	——	A	14.4	32.6	42.8	10.2	0.9	9,870	
						B	——	38.1	50.0	11.9	1.0	11,530	
						C	——	43.3	56.7	——	1.2	13,090	

To convert Btu's/lb. to kj/kg, multiply Btu's/lb. by 2.326.

The Pictured Cliffs Sandstone occasionally contains random Fruitland coal beds within its upper portion, where the formations interfinger. These coals are designated as local (L) beds because they are random, discontinuous, and generally below the reserve base thickness of 5 ft (1.5 m).

Fruitland Formation coal beds in the southern part of the San Juan Basin are considered high volatile C bituminous in rank, varying from subbituminous A to high volatile A bituminous. The rank is determined on a moist, mineral-matter-free basis with calorific values ranging from 11,207 to 14,097 Btu's per pound (26,067-32,790 kj/kg) (Amer. Soc. for Testing Materials, 1977). The coal is hard, brittle, and black with a bright luster. The coal readily slakes with exposure to weather, however, it stocks fairly well when protected. The "as received" analyses indicate moisture content varying from 3.6 to 13.6 percent, ash content ranging from 13.5 to 30.5 percent but averaging 18.1 percent, sulfur content less than 1 percent, and heating values on the order of 10,332 Btu's per pound (24,032 kj/kg) (Dane, 1936; Fassett and Hinds, 1971; Shomaker and Lease, 1971).

Fruitland 1 Coal Bed

As illustrated by the structure contour map (CRO Plate 5) the Fruitland 1 coal bed dips approximately 1° to the northeast. Due to topography and dip, overburden (CRO Plate 6) varies from less than 1,000 ft (305 m) in the southwest to greater than 2,200 ft (671 m) on Sisnathyel Mesa. The isopach map (CRO Plate 4) shows the coal bed is greater than 5 ft (1.5 m) thick in the southwest and north-central portions of the quadrangle. The thickness decreases from these areas, and the coal is absent in several small areas.

Chemical Analyses of the Fruitland 1 Coal Bed - Several analyses of Fruitland Formation coal beds from the Lybrook quadrangle and the surrounding area have been published by Fassett and Hinds (1971) and Shomaker and Lease (1971). The results of these analyses are given in Table 2.

Fruitland Coal Zone

The Fruitland zone extends from the top of the Fruitland Formation to the base of the lowermost coal designated as a Fruitland zone coal bed on CRO Plate 3. Consequently, the structure contour map (CRO Plate 9) was constructed using the top of the Fruitland Formation. The Fruitland Formation dips approximately 1° to the northeast. Due to topography and dip, overburden (CRO Plate 10) varies from less than 800 ft (244 m) in the southwest to greater than 2,000 ft (610 m) on the mesas. Also shown on CRO Plate 10 is the total amount of interburden which is the noncoal portion of the coal zone. The interburden thickness ranges from zero to greater than 200 ft (61 m). This thickness variation is the result of the number of coal beds and their stratigraphic positions within the Fruitland zone. The isopach map (CRO Plate 8) illustrates the total thickness of the individual coal beds of the Fruitland zone. The greatest thickness occurs in the northwest where the coals total more than 15 ft (4.6 m). The thickness decreases from this area, and there is no coal in a portion of the southwest.

TABLE 2

Analyses of coal samples from the Fruitland Formation

(Form of analysis: A, as received; B, moisture free; C, moisture and ash free)

U.S. Bureau Mines Lab No.	Well or Other Source	Location			Approx. Depth Interval of Sample (ft.)	Form of Analysis	Proximate, percent					Heating Value (Btu)	Remarks
		Section	T.N.	R.W.			Mois-ture	Volatile matter	Fixed Carbon	Ash	Sulfur		
H-31101	Val Reese & Assoc Lybrook No. 7-27.	NE¼ 27	24	7	2,140-2,150	A	4.4	40.9	41.2	13.5	0.6	11,790	
						B	----	42.8	43.1	14.1	0.6	12,340	
						C	----	49.9	50.1	----	0.7	14,370	
H-22075	Val Reese & Assoc Bobby "B" No. 2-31.	NE¼ 31	24	6	2,070-2,090	A	3.6	41.1	40.6	14.7	0.7	11,840	
						B	----	42.6	42.2	15.2	0.7	12,280	
						C	----	50.2	49.8	----	0.9	14,480	
H-16309	Val Reese & Assoc Betty "B" No. 1-15.	NW¼ 15	23	7	2,180-2,195	A	5.7	39.3	40.8	14.2	0.6	11,410	
						B	----	41.7	43.3	15.0	0.7	12,100	
						C	----	49.1	50.9	----	0.8	14,240	
J-62557	Core Sample	SW¼ 26	21	8	----	A	13.6	33.4	35.4	17.6	0.53	9,110	
						B	----	38.6	41.0	20.4	0.62	10,540	
						C	----	48.5	51.5	----	0.77	13,240	
J-62604	Core Sample	SW¼ 26	21	8	----	A	12.6	28.7	28.2	30.5	0.49	7,510	
						B	----	32.8	32.4	34.8	0.56	8,590	
						C	----	50.3	49.7	----	0.86	13,180	

To convert Btu's/lb. to kj/kg, multiply Btu's/lb. by 2.326.
To convert feet to meters, multiply feet by 0.3048.

Chemical Analyses of the Fruitland Coal Zone - Several analyses of Fruitland Formation coal beds from the Lybrook quadrangle and the surrounding area have been published by Fassett and Hinds (1971) and Shomaker and Lease (1971). The results of these analyses are given in Table 2.

COAL RESOURCES

Coal resource data from oil and gas wells (El Paso Natural Gas Co., 1978, unpublished data in well log library in Farmington, New Mexico) were utilized in the construction of isopach and structure contour maps of the coals in this quadrangle. All the coal beds in the Lybrook quadrangle are more than 200 ft (61 m) below the ground surface and, thus, have no outcrop or surface development potential.

The U.S. Geological Survey designated the Fruitland 1 coal bed for the determination of coal resources in this quadrangle. Coals of the Fruitland and Menefee zones were not evaluated because the thickness of the coal beds is less than the reserve base thickness (5 ft [1.5 m]).

For Reserve Base and Reserve calculations, the Fruitland 1 coal bed was areally divided into measured, indicated, and inferred resource categories (CRO Plate 7) according to criteria established in U.S. Geological Survey Bulletin 1450-B. Data for calculation of Reserve Base and Reserves for each category were obtained from the respective coal isopach (CRO Plate 4) and areal distribution (CRO Plate 7) maps. The surface area of the isopached Fruitland 1 bed was measured by planimeter, in acres, for each category, then multiplied by both the average isopached thickness of the coal bed and 1,800 short tons of coal per acre-foot (13,239 tons/hectare-meter), the conversion factor for bituminous coal. This yields the Reserve Base coal, in short tons, for each coal bed. In order to calculate Reserves, a recovery factor of 50 percent was applied to the Reserve Base tonnages for underground coal.

Reserve Base and Reserve values for measured, indicated, and inferred categories of coal for the Fruitland 1 coal bed are shown on CRO Plate 7 and are rounded to the nearest hundredth of a million short tons. The total coal Reserve Base, by section, is shown on CRO Plate 2 and totals approximately 30 million short tons (27 million metric tons).

The coal development potential for the Fruitland 1 bed is calculated in a manner similar to the Reserve Base, from planimetered measurements, in acres, for areas of high, moderate, and low potential for subsurface mining methods. The Lybrook quadrangle has development potential for subsurface mining methods only (CDP Plate 11).

COAL DEVELOPMENT POTENTIAL

Coal beds of 5 ft (1.5 m) or more in thickness which are overlain by 200 ft to 3,000 ft (61-914 m) or more of overburden are considered to have potential for underground mining and are designated as having high, moderate, or low development potential according to the overburden thickness: 200 to 1,000 ft (61-305 m), high; 1,000 to 2,000 ft (305-610 m), moderate; and 2,000 to 3,000 ft (610-914 m), low. Table 3 summarizes the coal development potential, in short tons, for underground coal of the Fruitland 1 coal bed.

Development Potential For Surface Mining Methods

All coals studied in the Lybrook quadrangle occur more than 200 ft (61 m) below the ground surface and, thus, have no coal development potential for surface mining methods.

Development Potential For Subsurface Mining Methods

Underground coal of the Fruitland 1 coal bed has high development potential in the extreme southwest corner only. Here the coal bed thickness is 5 ft (1.5 m) (CRO Plate 4) and the overburden is slightly less than 1,000 ft (305 m) in thickness (CRO Plate 6). North of this area, as the overburden thickness increases and the coal thickness varies from 5 to 6 ft (1.5-1.8 m), the Fruitland 1 bed has moderate development potential in a lobate area at the center of the western quadrangle boundary. Moderate development potential also occurs in a small section in the extreme northwest corner of the quadrangle. The Fruitland 1 coal bed has low development potential along the north-central quadrangle boundary where the overburden thickness exceeds 2,000 ft (610 m).

Most of the remaining area in the quadrangle has unknown development potential where the Fruitland 1 coal bed is less than the reserve base thickness of 5 ft (1.5 m). Small areas in the northeast, north-central, and northwest parts of the quadrangle have no Fruitland 1 coal and, thus, have no development potential for subsurface mining methods.

TABLE 3

COAL RESOURCE DATA FOR UNDERGROUND MINING METHODS FOR FEDERAL COAL LANDS
(in short tons) IN THE LYBROOK QUADRANGLE
SANDOVAL, RIO ARRIBA, AND SAN JUAN COUNTIES, NEW MEXICO

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

Coal Bed	High Development Potential	Moderate Development Potential	Low Development Potential	Total
Fruitland 1	1,020,000	27,250,000	1,770,000	30,040,000
TOTAL	1,020,000	27,250,000	1,770,000	30,040,000

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