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COAL RESOURCE OCCURRENCE MAPS AND COAL DEVELOPMENT POTENTIAL MAP OF THE YOUNGS LAKE QUADRANGLE, SAN JUAN COUNTY, NEW MEXICO

[Report includes 12 plates]

by

Dames & Moore

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YOUNGS LAKE 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 Youngs Lake quadrangle, San Juan County, New Mexico. These maps 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 Youngs Lake 7 1/2-minute quadrangle is located in northwestern San Juan County, New Mexico. The area is approximately 4 miles (6 km) northwest of Farmington, New Mexico. A portion of the Ute Mountain Indian Reservation is in the northern part of the quadrangle.

Accessibility

The Youngs Lake quadrangle is accessible by light-duty roads extending from both New Mexico State Route 550, south of the area, and New Mexico State Route 17, east of the area. The Atchison, Topeka, and Santa Fe Railway operates a route approximately 93 miles (150 km) to the south at Gallup, New Mexico.

Physiography

This quadrangle is in the northwestern portion of the Central Basin area (Kelley, 1950) of the structural depression known as the San Juan Basin. Elevations range from 5,220 ft (1,591 m) in the southwestern corner of the quadrangle to 6,192 ft (1,887 m) on Pinon Mesa. Pinon Mesa is the dominant physiographic feature in this quadrangle, and is surrounded by areas of lower relief. These areas have been dissected by numerous washes and arroyos, particularly in The Badlands. The Meadows and Foxtail Flats, in the north, are also areas of low relief.

Climate

The climate of the San Juan Basin is arid to semi-arid. Annual precipitation is usually less than 10 inches (25 cm) with slight variations 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 above 100°F (38°C). Snowfall may occur from November to April.

Land Status

Approximately 77 percent of the quadrangle is in the northwestern part of the San Juan Basin Known Recoverable Coal Resource Area. The Federal Government owns the coal rights for approximately 88 percent of the KRCRA land within the quadrangle as shown on Plate 2 of the Coal Resource Occurrence Maps. No Federal coal leases occur in the quadrangle.

GENERAL GEOLOGY

Previous Work

Bauer and Reeside (1921) mapped the Fruitland Formation in the quadrangle area with detailed emphasis on the outcrops of Fruitland coal. Later, Reeside (1924) mapped the various formations on a scale of 1:250,000 as part of a study of the Upper Cretaceous and Tertiary formations in the San Juan Basin. Hayes and Zapp (1955) published a geologic map of the Barker Dome-Fruitland Area on a scale of 1:62,500, which includes this quadrangle. In addition to mapping the Upper Cretaceous rocks of the area, they mapped coal bed outcrops and measured various coal-bearing sections. More recently, Fassett and Hinds (1971) made subsurface interpretations of the Fruitland Formation coals in this area as part of a larger San Juan Basin coal study.

The most recent work in the area is Beach and Jentgen (1978) in which shallow drill hole information was used to determine the coal-bearing zones.

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.

The first basin-wide retreat of the Late Cretaceous sea is indicated by the nearshore deposits of the Point Lookout Sandstone. These ancient barrier beaches formed a generally north-south-trending strandline in this part of the basin, behind which swamps developed. Organic material accumulated in the swamps and later became coal in the paludal deposits of the lower Menefee Formation. Deposition of materials which formed the coal beds was influenced by the strandline. This is shown by the more consistent thickness and greater lateral extent of the coals parallel to the strandline and also by the lack of continuity perpendicular to it, to the east, where the Menefee and underlying Point Lookout deposits interfinger. Streams which crossed the swamps also influenced deposition of organic matter; stream deposits may terminate even the most continuous coal beds.

During the continued retreat of the sea, the depositional environments in the quadrangle area became more terrestrial. This is evidenced by the transition within the lower Menefee from carbonaceous to noncoal-bearing deposits, in which there is an upward decrease in the occurrence and lateral continuity of the coals. As the sea retreated, the sediments of the Point Lookout Sandstone and overlying Menefee Formation were deposited in successively higher stratigraphic positions to the northeast.

The sea then reversed the direction of movement. As a result, the transgressive sequence of nearshore Cliff House Sandstone and marine Lewis Shale was deposited in the quadrangle. As the sea transgressed, a thin sand of the Cliff House Sandstone was deposited over the Menefee Formation. Subsequently, several hundred feet of beach sands of the La Ventana Tongue (Cliff House Sandstone) were deposited over the basal sand. 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 later became coals of the Fruitland Formation. Again, deposition of organic material was influenced by the strandline as shown by both the continuity of the coal beds parallel to the north-south strandline and their discontinuity perpendicular to it to the east.

The brackish-water swamp environment of the Fruitland moved northeast of the area as the regression continued in that direction. Terrestrial freshwater sediments then covered the quadrangle 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 both the San Jose Formation and Nacimiento Formation from the area.

Stratigraphy

The formations studied in this quadrangle range from the Late Cretaceous to Paleocene in age. They are, in order from oldest to youngest: (the three formations of the Mesaverde Group) the Point Lookout Sandstone, Menefee Formation, and Cliff House Sandstone; Pictured Cliffs Sandstone, Fruitland Formation, Kirtland Shale, and Ojo Alamo Sandstone. 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 Point Lookout Sandstone, the basal formation of the Mesaverde Group, is composed of light gray, kaolinitic sandstone and interbedded gray shale. It is fairly massive, averages about 325 ft (99 m) in thickness in this area, and possesses a distinctive and consistent character on geophysical logs. This last characteristic was used by the authors to establish the top of the Point Lookout as a lithologic datum for the correlation of the overlying Menefee Formation coals.

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 upper coal-bearing member (Beaumont and others, 1956). These members were grouped together as undifferentiated Menefee Formation for the purposes of this report only. The Menefee Formation consists primarily of gray, carbonaceous to noncarbonaceous shale with plant fossils, light gray, kaolinitic sandstone, and lenticular coal beds. It has a total thickness of approximately 760 ft (232 m).

The Cliff House Sandstone sequence conformably overlies the Menefee Formation. A basal sand referred to as "the Cliff House Sandstone" by Fassett (1977) correlates with the undifferentiated Cliff House Sandstone to the north. It is about 240 ft (73 m) thick and consists of gray, micaceous, calcareous sandstone with a trace of glauconite, and interbedded shale. Overlying the basal member is the La Ventana Tongue. It is a 465-ft (142-m) thick sequence of gray, argillaceous, sandy, calcareous siltstone and interbedded gray shale.

The marine Lewis Shale conformably overlies the Mesaverde Group. In contrast to the underlying Cliff House Sandstone, it is comprised predominantly of gray, micaceous, calcareous shale with local plant fossils, gray-green siltstone, and thin sandstone. The thickness of the Lewis Shale averages 915 ft (279 m) in this area. The upper contact is gradational with the overlying Pictured Cliffs Sandstone, and, therefore, a definite and consistent contact is difficult to establish.

The Pictured Cliffs Sandstone consists of about 125 ft (38 m) of white to light gray, micaceous, slightly calcareous, kaolinitic sandstone commonly interbedded with gray shale near the base where it grades into the Lewis. The upper contact is more sharply defined than the basal contact, even though intertonguing with the overlying Fruitland Formation results in minor variations in the formational top and the occurrence of local Fruitland coal beds in the sandstone. Since the Pictured Cliffs Sandstone is present throughout most of the basin and displays a distinctive character on geophysical logs, the authors have used the top as a lithologic datum for correlation of Fruitland coals.

The Fruitland Formation is the major coal-bearing unit in the quadrangle. It is composed of about 370 ft (113 m) of gray to brown, carbonaceous shale with plant fossils, interbedded sandstone and siltstone, and coal beds of varying thicknesses. The thickest and most continuous coal beds occur near the base of the formation, while discontinuous and lenticular coals are characteristic of the upper portion. The upper contact is gradational from nonmarine, lower coastal plain deposits of the Fruitland to upper coastal or alluvial plain deposits of the Kirtland Shale (Molenaar, 1977).

The freshwater deposits of the Kirtland Shale average 640 ft (195 m) in thickness and are composed of gray-green to gray-brown siltstone and interbedded white, friable, sandstone beds with local interstitial pyrite. The formation has previously been divided into several members by various authors; however, for the purpose of this report it was not necessary to distinguish between the individual members.

Unconformably overlying the Upper Cretaceous rocks is the Paleocene Ojo Alamo Sandstone, the youngest formation in the quadrangle. The lower beds are present in the quadrangle area and consist of white to gray, very coarse-grained to conglomeratic, arkosic, calcareous sandstone with interstitial kaolinite, and thin interbedded siltstone near the base.

Surface exposures in this quadrangle are influenced by the structural feature, the Hogback Monocline. Successively younger strata are exposed in the direction of dip, to the south and southeast. The oldest unit exposed is the Pictured Cliffs Sandstone which crops out with the Fruitland Formation in the extreme northwestern corner, on the flank of the Hogback Monocline. The Kirtland Shale crops out across the majority of the quadrangle and is younger to the east and southeast. The youngest formation in the quadrangle, the Ojo Alamo Sandstone, is exposed on Pinon Mesa, in the east-central part of the area.

Structure

The western end of the axis of the San Juan Basin is about 7 miles (11 km) east of the Youngs Lake quadrangle area and trends eastward in an arcuate pattern across the northern portion of the Central Basin area (Baltz, 1967). The Hogback Monocline trends north and east across the northern part of the area, dipping to the east and south. The coal-bearing Fruitland Formation is exposed on its flank and, therefore, has a steep dip at the surface. Toward the south the dip angle decreases in a relatively short distance. Reeside (1924) and Hayes and Zapp (1955) made several measurements of the strata in this quadrangle and measured dips ranging from 26° to 2°.

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. For the exclusive purpose of reserve and reserve base calculations, the Fruitland 1, 2, and 3 coal beds have been correlated and in the case of the Fruitland 1 and 3, mapped, as if they are single beds, continuous throughout the basin.

A lithologic datum was used for correlation of the coals (CRO Plate 3). The Menefee Formation-Cliff House Sandstone contact was used as the datum for plotting the coals of the Menefee in this quadrangle. The primarily marine sandstone unit, the Pictured Cliffs, which underlies the coal-bearing Fruitland was used as a datum since it represents a more laterally continuous boundary than any of the overlying paludal, fluvial, and lacustrine deposits of the coal-bearing formation. Also, the sandstone unit is more easily recognized on geophysical logs. As shown on CRO Plate 3, the sandstone units have been used as datums for each drill hole and the coals have been plotted in the column and correlated based upon their position relative to the datum. Correlation of coals in measured sections are based upon geologic maps (Bauer and Reeside, 1921; Hayes and Zapp, 1955).

Two coal zones (Menefee, Fruitland) and three coal beds (Fruitland 1, Fruitland 2, Fruitland 3) were identified in the subsurface or on the surface of this quadrangle (CRO Plate 1). The coals of the Menefee Formation have been designated as the Menefee coal zone (Me zone). These coals are generally noncorrelative, discontinuous, and less than reserve base thickness (5 ft [1.5 m]) as established by the U.S. Geological Survey; exceptions are a 6-ft (1.8-m) coal bed in drill holes 5 and 11. Due to these characteristics, derivative maps were not constructed.

Menefee Formation coals in the northwestern part of the San Juan Basin vary from borderline subbituminous A - high volatile C bituminous to high volatile B bituminous in rank. The rank has been determined on a moist, mineral-matter-free basis with calorific values averaging 12,563 Btu's per pound (29,222 kj/kg) (Amer. Soc. for Testing and 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 5.6 to 11.3 percent, ash content ranging from 3.1 to 6.3 percent, sulfur content less than 1 percent, and heating values on the order of 11,993 Btu's per pound (27,896 kj/kg). Analyses of several Menefee coals are given in Table 1 (Bauer and Reeside, 1921; Hayes and Zapp, 1955; Shomaker and Whyte, 1977).

The Fruitland 1 (Fr 1) coal bed is defined by the authors as the lowermost coal of the Fruitland Formation; it is generally directly above the Pictured Cliffs Sandstone (CRO Plate 3). The Fruitland 2 (Fr 2) is above the Fruitland 1 separated by a rock interval of 10 to 69 ft (3.0-21.0 m); the Fruitland 3 (Fr 3) coal bed is above the Fruitland 2 separated by a rock interval of 20.6 to 88 ft (6.3-26.8 m). In this quadrangle the Fruitland 2 is generally less than reserve base thickness (5 ft [1.5 m]); exceptions are a 6-ft (1.8-m) coal in measured section 24 (located in the Ute Mountain Indian Reservation) and a 5-ft (1.5-m) coal in drill hole 19 (CRO Plate 1). As a result, derivative maps were not required by the U.S. Geological Survey.

The remaining coals in the upper portion of the Fruitland Formation are grouped together as the Fruitland coal zone (Fr zone). These coals are generally noncorrelative, discontinuous, and less than reserve base thickness (5 ft [1.5 m]). Therefore, derivative maps were not constructed.

All of these coal beds crop out in the northern part of the quadrangle. The traces of the outcrop have been modified from the original data source to conform with modern topographic maps.

Fruitland Formation coals in the northwestern part of the San Juan Basin vary from high volatile C to high volatile B bituminous in rank.

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		
J-58561	Merrion & Bayless #1, Union	9	29	15	2,494-2,500	A	5.6	40.4	47.7	6.3	0.8	12,740	
						B	----	42.7	50.7	6.6	0.9	13,490	
						C	----	45.8	54.2	---	1.0	14,450	
17750	Shiprock School Mine(?) (100 ft from entry) (Government Mine)	SW¼ 21	30	16	----------	A	10.6	36.7	49.6	3.1	0.64	11,010	
						B	----	41.1	55.4	3.5	0.72	12,310	
						C	----	42.6	57.4	---	0.75	12,750	
A-46364	Shiprock School Mine (250 ft from entry)	21	30	16	----------	A	9.8	38.7	46.5	5.0	----	11,870	
						B	----	42.9	51.5	5.6	----	13,170	
						C	----	45.4	54.6	---	1.5	13,940	
29006	Shiprock School Mine (350 ft from entry) (Government Mine)	SW¼ 21	30	16	----------	A	10.1	39.9	45.8	4.2	0.85	12,010	
						B	----	44.4	50.9	4.7	0.95	13,370	
						C	----	46.6	53.4	---	1.00	14,020	
A-46365	Joe Duncan Mine (150 ft from entry)	21	30	16	----------	A	10.5	39.1	47.2	3.2	----	12,240	
						B	----	43.7	52.7	3.6	----	13,670	
						C	----	45.3	54.7	---	1.0	14,180	
C-31312	Davidson Mine (tipple)	22	30	16	----------	A	11.3	39.3	46.0	3.4	----	12,090	
						B	----	44.3	51.9	3.8	----	13,630	
						C	----	46.1	53.9	---	0.8	14,170	

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.

The rank has been determined on a moist, mineral-matter-free basis with calorific values averaging 12,900 Btu's per pound (30,005 kj/kg) (Amer. Soc. for Testing and 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 4.1 to 11.6 percent, ash content ranging from 8.3 to 15.3 percent, sulfur content varying from 0.60 to 2.36 percent, and heating values on the order of 10,530 to 12,056 Btu's per pound (24,493-28,042 kj/kg). Analyses of several Fruitland Formation coals are given in Table 2 (Bauer and Reeside, 1921; Beach and Jentgen, 1978; Fassett and Hinds, 1971; Hayes and Zapp, 1955).

Fruitland 1 Coal Bed

The coal bed has been mapped only in areas outside the Ute Mountain Indian Reservation. The structure contour map (CRO Plate 5) shows that in the mapped area the coal bed dips to the east and varies from approximately 3° in the northwest and southwest to less than 1° in the south and east. Due to topography and dip, the overburden thickness (CRO Plate 6) varies from less than 400 ft (122 m) in the extreme southwestern corner of the map to more than 1,700 ft (518 m) on Pinon Mesa. The coal bed thickness is more than 25 ft (7.6 m) in the west and decreases in all directions as illustrated by the isopach map (CRO Plate 4).

Chemical Analyses of the Fruitland 1 Coal Bed - Analyses of several coals of the Fruitland Formation from this quadrangle and the surrounding area are given in Table 2 (Bauer and Reeside, 1921; Fassett and Hinds, 1971;

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 Section	Location T.N.	Location R.W.	Approx. Depth Interval of Sample (ft.)	Form of Analysis	Proximate, percent Moisture	Proximate, percent Volatile matter	Proximate, percent Fixed Carbon	Proximate, percent Ash	Sulfur	Heating Value (Btu)	Remarks
H-4051	Humble Oil & Gas Humble No. L-9	SE¼ 36	29	14	1,490-1,495	A	4.1	40.0	40.6	15.3	0.7	11,600	
						B	—	41.7	42.3	16.0	0.7	12,100	
						C	—	49.7	50.3	—	0.9	14,400	
22509	L.W. Henderickson (Smous) mine	SW¼ 3	29	15	—	A	10.5	38.6	41.7	9.2	0.60	11,210	
						B	—	43.1	46.6	10.3	0.67	12,530	
						C	—	48.0	52.0	—	0.75	13,970	
2464	Black Diamond Mine	SW¼ 4	29	15	—	A	9.9	38.4	41.5	10.2	0.64	11,300	
						B	—	42.7	46.0	11.3	0.71	12,540	
						C	—	48.1	51.9	—	0.80	14,140	
22508	Black Diamond Mine	SW¼ 4	29	15	—	A	11.6	38.6	39.9	9.9	0.60	10,990	
						B	—	43.6	45.2	11.2	0.68	12,430	
						C	—	49.2	50.8	—	0.77	14,000	
B-61218	Stalling mine (tipple)	4	29	15	—	A	10.1	39.1	41.7	9.1	—	11,460	
						B	—	43.5	46.3	10.2	—	12,750	
						C	—	48.4	51.6	—	—	14,200	
29026	Prospect Drift	NW¼ 16	30	15	—	A	9.6	37.2	40.5	12.7	2.36	10,530	
						B	—	41.2	44.8	14.0	2.61	11,660	
						C	—	47.9	52.1	—	3.04	13,560	
H-78945	N.M.P.S.C.C. Core Hole No. 7	21	30	15	69-70	A	5.6	39.7	43.3	11.4	0.7	11,850	Sample from core - not floated in CCl_4. A is air dried analysis
						B	—	42.0	46.0	12.0	0.7	12,540	
						C	—	47.8	52.2	—	0.8	14,260	
Number not available	Open File Report 78-960 drill hole SJ 23-4	23	30	15	589-590	A	4.6	42.6	41.1	11.7	0.6	12,056	
						B	—	44.7	43.1	12.2	0.6	12,639	
						C	—	50.9	49.1	—	0.7	14,402	
29025	Marcelius Mine	SW¼ 28	30	15	—	A	8.8	41.7	41.2	8.3	0.62	11,660	
						B	—	45.7	45.2	9.1	0.68	12,770	
						C	—	50.3	49.7	—	0.75	14,060	

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.

Fruitland 3 Coal Bed

The Fruitland 3 coal bed has been mapped only in areas outside the Ute Mountain Indian Reservation. As indicated by the structure contour map (CRO Plate 9) the coal bed dips to the east and varies in magnitude from about 3° in the northwestern and southwestern corners to less than 1° in the east and south. As a result of topography and dip, the overburden thickness (CRO Plate 10) varies from less than 400 ft (122 m) in the northwest within Shumway Arroyo and in the southwest corner of the mapped area to more than 1,600 ft (488 m) on Pinon Mesa. The isopach map (CRO Plate 8) shows that the coal bed is more than 5 ft (1.5 m) thick over much of the north and west portions of the mapped area. The coal thins from these areas and is absent in the west-central and southeastern corner of the map.

Chemical Analyses of the Fruitland 3 Coal Bed - Analyses of several coals of the Fruitland Formation from this quadrangle and the surrounding area are given in Table 2 (Bauer and Reeside, 1921; Fassett and Hinds, 1971; Hayes and Zapp, 1955).

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), coal test holes (Beach and Jentgen, 1978), and geologic maps (Bauer and Reeside, 1921; Hayes and Zapp, 1955) were used in the construction of isopach and structure contour maps of coals in this quadrangle. Within the KRCRA, all of the coals studied in the Youngs Lake 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 and Fruitland 3 coal beds for the determination of coal resources in this quadrangle. Coals of the Menefee and Fruitland zones were not evaluated because they are discontinuous and noncorrelative. The Fruitland 2 coal bed was not evaluated because it is generally less than the reserve base thickness of 5 ft (1.5 m).

For Reserve Base and Reserve calculations, each coal bed was areally divided into measured, indicated, and inferred resource categories (CRO Plates 7 and 11) 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 Plates 4 and 8) and areal distribution maps (CRO Plates 7 and 11) for each coal bed. The surface area of each isopached 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. However, in areas of underground coal exceeding 12 ft (3.7 m) in thickness, the Reserves (mineable coal) were calculated on the basis of a maximum coal bed thickness of 12 ft (3.7 m), which represents the maximum economically mineable thickness for a single coal bed in this area by current underground mining technology.

Reserve Base and Reserve values for measured, indicated, and inferred categories of coal for the Fruitland 1 and Fruitland 3 beds are shown on CRO Plates 7 and 11, respectively, 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 572 million short tons (519 million metric tons).

The coal development potential for each bed was 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 Youngs Lake quadrangle has development potential for subsurface mining methods only (CDP Plate 12).

COAL DEVELOPMENT POTENTIAL

Coal beds of 5 ft (1.5 m) or more in thickness which are overlain by 200 ft (61 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 and Fruitland 3 coal beds.

Development Potential for Surface Mining Methods

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

TABLE 3

COAL RESOURCE DATA FOR UNDERGROUND MINING METHODS FOR FEDERAL COAL LANDS
(in short tons) IN THE YOUNGS LAKE QUADRANGLE,
SAN JUAN COUNTY, 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 3	93,080,000	52,120,000	0	145,200,000
Fruitland 1	198,590,000	228,220,000	0	426,810,000
TOTAL	291,670,000	280,340,000	0	572,010,000

Development Potential for Subsurface Mining Methods

The western half of the quadrangle has high development potential for the Fruitland 1 and Fruitland 3 coal beds (CDP Plate 12). Coal bed thickness ranges from 5 to 25 ft (1.5-7.6 m) for the Fruitland 1 (CRO Plate 4) and 5 to 7 ft (1.5-2.1 m) for the Fruitland 3 (CRO Plate 8), and overburden thickness for both coal beds increases from 400 ft (122 m) in the southwest to 1,000 ft (305 m) in the center. The eastern half of the quadrangle has moderate potential due to the Fruitland 3 coal bed in the northeast and the Fruitland 1 bed in the northeast and southeast. The Fruitland 1 coal bed here has a thickness of 5 to 13 ft (1.5-4.0 m), and the Fruitland 3 bed is 5 to 7 ft (1.5-2.1 m) in thickness. Overburden thickness increases from 1,000 ft (305 m) in the center of the quadrangle to approximately 1,700 ft (518 m) in the northeast. Small areas of unknown development potential in the northeast, southeast, and southwest parts of the quadrangle occur where the Fruitland 1 and Fruitland 3 coal beds are less than the Reserve Base thickness of 5 ft (1.5 m).

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