Text to accompany:

Open-File Report 79-796

1979

COAL RESOURCE OCCURRENCE MAPS AND COAL DEVELOPMENT POTENTIAL MAPS OF THE FARMINGTON SOUTH QUADRANGLE, SAN JUAN COUNTY, NEW MEXICO

[Report includes 12 plates]

by

Dames & Moore

CONTENTS

CONTENTS

PLATES

TABLES

FARMINGTON SOUTH 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 Farmington South 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 Farmington South 7 1/2-minute quadrangle is located in north-central San Juan County, New Mexico. Farmington, New Mexico, is located in the north-central part of the quadrangle, north of the westward-flowing San Juan River.

Accessibility

The Farmington South quadrangle is accessible from New Mexico State Routes 550, 17, and 371 which converge in the town of Farmington. Light-duty roads extending from these state routes provide access to other parts of the area. The Atchison, Topeka, and Santa Fe Railway operates a route approximately 88 miles (142 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 5,240 ft (1,597 m) in the western part of the San Juan River Valley to 6,120 ft (1,865 m) on the plateau area in the southwest. The Animas River flows southwestward across the northern part of the area and joins the San Juan River which flows westward. The confluence of the rivers is immediately south of Farmington. The La Plata River flows southward across the northwest corner and joins the San Juan River just west of the quadrangle boundary. South of the San Juan River the northern edge of the plateau is dissected by steep-walled terraces and tributary canyons.

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

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 70 percent of the KRCRA land within the quadrangle as shown on Plate 2 of the Coal Resource Occurrence Maps. No Federal coal leases occur within this quadrangle.

GENERAL GEOLOGY

Previous Work

Reeside (1924) mapped the various formations within the quadrangle on a scale of 1:250,000 as part of a study of the Upper Cretaceous and Tertiary formations within the San Juan Basin. 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.

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 reversed the direction of movement. As a result the transgressive sequence of paludal 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 coal in the Menefee Formation. A thin Cliff House sand was then 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.

Depositional evidence of the final retreat of the Late Cretaceous sea is the nearshore regressive Pictured Cliffs Sandstone. 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 both the continuity of the coal beds parallel to the north-south strandline and their discontinuity perpendicular to it to the east. The less continuous Fruitland coals appear to be noncorrelative, but are stratigraphically equivalent in terms of their relative position within the Fruitland Formation.

The brackish-water swamp environment of the Fruitland moved farther to the northeast as the regression continued in that direction. Terrestrial freshwater sediments then covered this 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 nonmarine Eocene San Jose Formation was subsequently deposited over the Nacimiento erosional surface.

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 the San Jose Formation and some of the 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: (two of the three formations of the Mesaverde Group) Menefee Formation and Cliff House Sandstone; Lewis Shale, Pictured Cliffs Sandstone, Fruitland Formation, Kirtland Shale, Ojo Alamo Sandstone, and Nacimiento 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 the upper coal-bearing member (Beaumont and others, 1956). These members are grouped together as undifferentiated Menefee Formation for the purposes of this report only.

The Menefee Formation primarily consists of gray, carbonaceous, slightly calcareous shale with traces of pyrite, interbedded sandstone and siltstone, and lenticular coal beds. It has a total thickness of approximately 860 ft (262 m) in this area. Due to the gentle regional dip of 1° to the east, in the eastern part of the quadrangle area the entire formation has more than 3,000 ft (914 m) of overburden (the study limit); to the west (in drill hole 28 in section 30, T. 29 N., R 13 W), 202 ft (62 m) of the Menefee Formation are less than 3,000 ft (914 m) deep.

The Cliff House Sandstone sequence conformably overlies the Menefee Formation. A thin basal sand member referred to as "the Cliff House

Sandstone" by Fassett (1977) correlates with the thin, undifferentiated Cliff House Sandstone to the northeast. It is about 80 ft (24 m) thick and consists of white to gray, kaolinitic, slightly calcareous sandstone. Overlying the basal member is the La Ventana Tongue. Here, this member is a 580-ft (177-m) thick sequence composed primarily of tan to gray, slightly calcareous sandstone, interbedded gray shale with plant fossils, and interbedded gray, micaceous siltstone.

The marine Lewis Shale conformably overlies the Mesaverde Group. In contrast to the underlying Cliff House Sandstone it is comprised predominantly of gray, slightly calcareous shale with plant fossils, interbedded gray to gray-brown, micaceous siltstone, and interbedded gray to gray-brown, micaceous sandstone. The thickness of the Lewis Shale averages 870 ft (265 m) in this area.

The Pictured Cliffs Sandstone consists of about 170 ft (52 m) of cream to gray, slightly micaceous sandstone with interstitial kaolinite, commonly interbedded with gray-green shale with plant fossils near the base of the formation where it grades into the Lewis. The upper contact is more sharply defined than the basal contact. Although intertonguing with the overlying Fruitland Formation results in minor variations in the formational top and the occurrence of local Fruitland coal beds in the upper portion, the Pictured Cliffs is a consistent formation throughout the basin. The authors have used the consistency and distinctive character of the formation on geophysical logs to establish the top as a lithologic datum for correlation of Fruitland coals.

The major coal-bearing unit in the quadrangle is the Fruitland Formation. It averages 290 ft (88 m) of gray, carbonaceous, micaceous shale with scattered siderite nodules, 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 860 ft (262 m) in thickness and are composed of gray, micaceous shale, interbedded gray-green to gray, micaceous siltstone and claystone, and interbedded cream, slightly calcareous sandstone beds with interstitial kaolinite. 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. It consists of about 120 ft (36 m) of white to gray, coarse-grained to conglomeratic sandstone and interbedded gray shale.

Several hundred feet of the Paleocene Nacimiento have been removed from the quadrangle. In contrast to the conformably underlying Ojo Alamo, the Nacimiento consists primarily of gray-green to brown shale, interbedded tan, micaceous siltstone, and interbedded tan to gray sandstone.

Three formations are exposed within the quadrangle area. The oldest formation, the Kirtland Shale, crops out in the southwestern, northwestern and north-central parts of the quadrangle. The Ojo Alamo is exposed along the eastern and southwestern boundaries and in the central part of the quadrangle. The youngest formation, the Nacimiento Formation, crops out in the south-central part of the area.

Structure

The Farmington South quadrangle is in the Central Basin area (Kelley, 1950) of the major structural depression known as the San Juan Basin. The axis of the basin is about 52 miles (84 km) northeast of the quadrangle area and trends in an arcuate pattern eastward across the northern portion of the Central Basin area (Baltz, 1967). Regional dip measured within the quadrangle is 1° to the east (Reeside, 1924).

COAL GEOLOGY

Two coal zones (Menefee, Fruitland) and two coal beds (Fruitland 1, Fruitland 2) were identified in the subsurface of this quadrangle (CRO Plate 3). The Menefee Formation coal beds are grouped together as the Menefee coal zone (Me zone). These coals are generally noncorrelative and less than reserve base thickness (5 ft [1.5 m]); an exception is a 5-ft (1.5-m) coal in drill hole 25. Due to these characteristics, derivative maps were not constructed.

Menefee Formation coals in the northwestern part of the San Juan Basin are considered high volatile C bituminous in rank, although they vary from borderline subbituminous A-high volatile C bituminous to high volatile B bituminous. 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 one 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. The Fruitland 2 (Fr 2) coal bed is above the Fruitland 1 (when present), separated by a rock interval of 4 to 60 ft (1.2-18.3 m). Although these coal beds have been correlated and mapped as consistent horizons, they may actually be several different coal beds that are lithostratigraphically equivalent but not laterally continuous.

The remaining coals of the Fruitland Formation are grouped together as the Fruitland coal zone (Fr zone). These coals are generally noncorrelative and less than reserve base thickness (5 ft [1.5 m]); an exception is an 8-ft (2.4-m) coal in drill hole 13 (CRO Plate 3). Due to these characteristics, derivative maps were not constructed.

Fruitland Formation coals in the northwest part of the San Juan Basin are considered high volatile A to high volatile B bituminous in rank. The rank has been determined on a moist, mineral-matter-free basis with calorific values averaging 14,258 Btu's per pound (33,164 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 1.4 to 5.7 percent, ash content averaging 13.7 percent, sulfur content less than one percent, and heating values on the

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 Section	T.N.	R.W.	Approx. Depth Interval of Sample (ft.)	Form of Analysis	Proximate, percent Mois- ture	Volatile matter	Fixed Carbon	Ash	Sulfur	Heating Value (Btu)	Remarks
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.

order of 12,131 Btu's per pound (28,217 kj/kg). Analyses of several Fruitland coals are given in Table 2 (Bauer and Reeside, 1921; Dane, 1936; Fassett and Hinds, 1971).

Fruitland 1 Coal Bed

As shown by the structure contour map (CRO Plate 5) the coal bed dips less than 1° to the northeast. Due to topography and dip, overburden (CRO Plate 6) varies from less than 1,000 ft (305 m) in the San Juan River and La Plata River Valleys to greater than 1,700 ft (518 m) in the southwest near The Dunes. The isopach map (CRO Plate 4) shows that the coal bed has a thickness of greater than 10 ft (3.0 m) in the northeast part of the quadrangle. In general, the thickness decreases in all directions, and the coal is absent in several areas throughout the quadrangle.

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 (Fassett and Hinds, 1971).

Fruitland 2 Coal Bed

The structure contour map (CRO Plate 9) illustrates that the coal bed dips less than 1° to the northeast. As a result of topography and dip, overburden (CRO Plate 10) ranges from less than 1,000 ft (305 m) in the San Juan River and La Plata River Valleys to greater than 1,600 ft (488 m) in the south. The isopach map (CRO Plate 11) illustrates that the coal bed is greater than 10 ft (3.0 m) thick in several areas in the east. It thins in all directions from these areas and is absent in several locations in the west.

TABLE 1

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	T.N.	R.W.	Approx. Depth Interval of Sample (ft.)	Form of Analysis	Proximate, percent Mois-ture	Volatile matter	Fixed Carbon	Ash	Sulfur	Heating Value (Btu)	Remarks
H-12704	Redfern & Herd Redfern & Herd No. 5	SW¼ 10	28	11	1,490-1,500	A	2.1	39.8	43.4	14.7	0.6	12,190	
						B	---	40.7	44.3	15.0	0.6	12,460	
						C	---	47.9	52.1	---	0.7	14,670	
H-24567	Sunray Mid-continent Gallegos No. 122	NW¼ 18	28	12	1,305-1,315	A	3.0	38.9	44.4	13.7	0.6	12,010	
						B	---	40.1	45.8	14.1	0.6	12,390	
						C	---	46.8	53.2	---	0.7	14,430	
H-7225	Pan American Holder No. 7	NW¼ 16	28	13	1,705-1,715	A	4.1	39.4	42.8	13.7	0.6	11,740	
						B	---	41.1	44.6	14.3	0.6	12,240	
						C	---	47.9	52.1	---	0.7	14,290	
H-3028	International Oil Fogelson No. 1-9	NW¼ 9	29	11	1,905-1,910	A	1.8	39.9	43.9	14.4	0.7	12,360	
						B	---	40.6	44.8	14.6	0.7	12,590	
						C	---	47.6	52.4	---	0.8	14,750	
H-13060	Tidewater N.M.-Fed. No. 12-E	SE¼ 12	29	11	2,065-2,070	A	2.1	38.7	47.9	11.3	0.6	12,830	
						B	---	39.5	48.9	11.6	0.6	13,100	
						C	---	44.7	55.3	---	0.7	14,820	
H-3030	Tennessee Oil & Gas Cornell Gas Unit A No. 1	NW¼ 10	29	12	1,740-1,750	A	2.1	40.0	44.8	13.1	0.5	12,340	
						B	---	40.9	45.7	13.4	0.5	12,600	
						C	---	47.2	52.8	---	0.6	14,560	
H-8360	Aztec Oil & Gas Hagood No. 21-C	SW¼ 20	29	13	1,125-1,140	A	5.6	39.0	41.3	14.1	0.6	11,580	
						B	---	41.3	43.8	14.9	0.6	12,260	
						C	---	48.5	51.5	---	0.7	14,420	
H-4052	Aztec Oil & Gas Hagood No. 13-G	SE¼ 34	29	13	1,635-1,640	A	3.5	39.6	43.2	13.7	0.5	11,910	
						B	---	41.0	44.8	14.2	0.6	12,330	
						C	---	47.8	52.2	---	0.6	14,370	
H-13062	Aztec Oil & Gas Ruby Jones No. 1	NE¼ 7	30	11	2,020-2,030	A	1.4	37.2	44.1	17.3	0.6	12,010	
						B	---	37.7	44.8	17.5	0.6	12,180	
						C	---	45.7	54.3	---	0.7	14,770	
H-15140	Southwest Production Sullivan No. 1	NE¼ 22	30	12	1,713-1,742	A	2.2	38.8	45.3	13.7	0.6	12,370	
						B	---	39.7	48.3	14.0	0.6	12,640	
						C	---	46.1	53.9	---	0.7	14,700	
H-16308	R&G Drilling Lunt No. 62	NW¼ 18	30	13	1,425-1,440	A	2.8	40.4	44.7	12.1	0.6	12,390	
						B	---	41.6	45.9	12.5	0.6	12,750	
						C	---	47.5	52.5	---	0.7	14,570	
H-19399	Compass Exploration Federal No. 1-31A	NE¼ 31	30	13	1,070-1,080	A	5.7	38.8	43.0	12.5	0.6	11,840	
						B	--	41.2	45.5	13.3	0.6	12,540	
						C	---	47.4	52.6	---	0.7	14,460	

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 2 Coal Bed - Analyses of several coals of the Fruitland Formation from this quadrangle and the surrounding area are given in Table 2 (Fassett and Hinds, 1971).

COAL RESOURCES

Coal resource data from oil and gas wells and pertinent publications were utilized in the construction of isopach and structure contour maps of coals in this quadrangle. All of the coals studied in the Farmington South 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 2 coal beds for the determination of coal resources in this quadrangle. Coals of the Fruitland zone and Menefee zone were not evaluated because they are discontinuous, noncorrelative, and generally less than the reserve base thickness (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 2 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 203 million short tons (184 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 Farmington South 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 to 3,000 ft (61-914 m) 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 2 coal beds.

Development Potential for Surface Mining Methods

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

Development Potential for Subsurface Mining Methods

The quadrangle has moderate development potential for the Fruitland 1 coal bed in the south and northeast and for the Fruitland 2 coal bed in the west-central and the eastern half of the quadrangle (CDP Plate 12). Coal bed thickness for the Fruitland 1 varies from 5 to 10 ft (1.5-3.0 m) (CRO Plate 4), and the Fruitland 2 ranges from 5 to 13 ft (1.5-4.0 m) (CRO Plate 8). Overburden thickness ranges from 1,200 ft (366 m) in the southeast to 1,600 ft (488 m) in the northeast for the Fruitland 1 (CRO Plate 6) and from 1,200 ft (366 m) in the southeast to 1,600 ft (488 m) in the west for the Fruitland 2 (CRO Plate 10). The Fruitland 1 and Fruitland 2 coal beds have unknown development potential in the western half of the quadrangle where the individual coal beds are less than the reserve base thickness of 5 ft (1.5 m). Several small areas in the western half of the quadrangle have no Fruitland 1 or Fruitland 2 coal and, thus, have no development potential.

TABLE 3

COAL RESOURCE DATA FOR UNDERGROUND MINING METHODS FOR FEDERAL COAL LANDS (in short tons) IN THE FARMINGTON SOUTH 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 2	--	176,940,000	--	176,940,000
Fruitland 1	--	26,270,000	--	26,270,000
TOTAL	--	203,210,000	--	203,210,000

REFERENCES

American Soc. for Testing and Materials, 1977, Gaseous fuels; coal and coke; atmospheric analysis, in Annual book of ASTM standards, part 26: p. 214-218.

Baltz, E.H., Jr., 1967, Stratigraphy and regional tectonic implications of part of Upper Cretaceous and Tertiary rocks, east-central San Juan Basin, New Mexico: U.S. Geol. Survey Prof. Paper 552, p. 12.

Bauer, C.M., and Reeside, J.B., Jr., 1921, Coal in the middle and eastern parts of San Juan County, New Mexico: U.S. Geol. Survey Bull. 716-G, p. 177-178.

Beaumont, E.C., Dane, C.H., and Sears, J.D., 1956, Revised nomenclature of Mesaverde Group in San Juan Basin, New Mexico: Amer. Assoc. of Petroleum Geologists Bull., v. 40, no. 9, p. 2161.

Dane, C.H., 1936, The La Ventana - Chacra Mesa coal field, pt. 3 of Geology and fuel resources of the southern part of the San Juan Basin, New Mexico: U.S. Geol. Survey Bull. 860-C, p. 137-138, [1937].

El Paso Natural Gas Co., Well log library, Farmington, New Mexico.

Fassett, J.E., 1977, Geology of the Point Lookout, Cliff House and Pictured Cliffs Sandstones of the San Juan Basin, New Mexico and Colorado in New Mexico Geol. Soc. Guidebook of the San Juan Basin III, Northwestern New Mexico, 28th Field Conf., p. 193-197.

Fassett, J.E., and Hinds, J.S., 1971, Geology and fuel resources of the Fruitland Formation and Kirtland Shale of the San Juan Basin, New Mexico and Colorado: U.S. Geol. Survey Prof. Paper 676, 76 p.

Hayes, P.T., and Zapp, A.D., 1955, Geology and fuel resources of the Upper Cretaceous rocks of the Barker Dome-Fruitland area, San Juan County, New Mexico. U.S.G.S. Oil and Gas Invest. Map OM-144, scale 1:62,500.

Kelley, V.C., 1950, Regional structure of the San Juan Basin in New Mexico Geol. Soc. Guidebook of the San Juan Basin, New Mexico and Colorado, 1st Field Conf., p. 102.

Molenaar, C.M., 1977, Stratigraphy and depositional history of Upper Cretaceous rocks of the San Juan Basin area, New Mexico and Colorado, with a note on economic resources in New Mexico Geol. Soc. Guidebook of the San Juan Basin III, Northwestern New Mexico, 28th Field Conf., p. 165.

Reeside, J.B., Jr., 1924, Upper Cretaceous and Tertiary formations of the western part of the San Juan Basin of Colorado and New Mexico: U.S. Geol. Survey Prof. Paper 134, p. 1-70.

Shomaker, J.W., and Whyte, M.R., 1977, Geologic appraisal of deep coals in San Juan Basin, New Mexico: New Mexico Bureau of Mines and Mineral Resources, Circular 155, 5 p.

U.S. Bureau of Mines and U.S. Geological Survey, 1976, Coal resource classification system of the U.S. Bureau of Mines and U.S. Geological Survey: U.S. Geol. Survey Bull. 1450-B, 7 p.

U.S. Department of the Interior, 1940, Fulcher Basin-Kutz Canyon Areas, San Juan County, New Mexico: U.S. Geol. Survey Oil and Gas Operations Map Roswell 60, revised 1972, 1:31,680.