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COAL RESOURCE OCCURRENCE MAPS AND COAL DEVELOPMENT POTENTIAL MAPS OF THE ADOBE DOWNS RANCH QUADRANGLE, SAN JUAN COUNTY, NEW MEXICO, AND LA PLATA COUNTY, COLORADO

[Report includes 23 plates]

by

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

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INTRODUCTION

Purpose

This text is to be used in conjunction with the Coal Resource Occurrence (CRO) Maps and Coal Development Potential (CDP) Map of the Adobe Downs Ranch quadrangle, San Juan County, New Mexico, and La Plata County, Colorado. These maps were compiled to provide a systematic coal resource inventory of Federal coal lands in Known Recoverable Coal Resource Areas (KRCRA's) of the western United States. The work was 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 Adobe Downs Ranch 7 1/2-minute quadrangle is located in northern San Juan County, New Mexico, and southern La Plata County, Colorado. The area is approximately 14 miles (23 km) northeast of Farmington, New Mexico.

Accessibility

The Adobe Downs Ranch quadrangle is accessible from New Mexico State Route 550 to the east, southeast, and south of the area. A light-duty road, State Route 173, extends northward into the area from State Route 550. Numerous unimproved dirt roads intersecting State Route 173 provide access to remote parts of the area. The Atchison, Topeka, and Santa Fe Railway operates a route 103 miles (166 km) south of the area 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 5,860 ft (1,786 m) in Hartley Wash to 6,940 ft (2,115 m) in the northeast. The major drainage of the area is Farmington Glade Arroyo, which drains to the southwest through the center of the quadrangle. Several other washes and arroyos drain the areas at the perimeter of the quadrangle. The drainage areas of these arroyos have low relief; however, higher relief is common along the divides between arroyos. In particular, steep-walled canyons have been cut by washes in the eastern part of the area.

Climate

The climate of the San Juan Basin is arid to semi-arid. Annual precipitation is usually less than about 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 afternoon thundershowers. Annual temperatures range from below 0°F (-18°C) to over 100°F (38°C) in the basin. Snowfall may occur from November to April.

Land Status

Approximately 82 percent of the quadrangle is within the northwestern part of the San Juan Basin Known Recoverable Coal Resource Area. The Federal Government owns the coal rights for approximately 74 percent of the KRCRA land within the quadrangle as shown on Plate 2 of the Coal Resource Occurrence Maps. Coal lease (NM 0315559) covers approximately 1 percent of the quadrangle.

GENERAL GEOLOGY

Previous Work

Reeside (1924) mapped the surficial geology of the area on a scale of 1:250,000 as part of a study of the Upper Cretaceous and Tertiary formations of the San Juan Basin. More recently, Fassett and Hinds (1971) made subsurface interpretations of Fruitland Formation coal occurrences 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.

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 later 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 in this part of the basin 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 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.

Stratigraphy

The formations studied in this quadrangle range from Late Cretaceous to Eocene in age. They are, in order from oldest to youngest: the 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 Pictured Cliffs Sandstone averages 150 ft (46 m) thick. Because the unit is present throughout most of the San Juan Basin and easily recognized on geophysical logs, the top was picked as the datum (CRO Plate 3) for Fruitland coal correlations. The formation consists of a gray, fine-grained, micaceous, glauconitic, calcareous sandstone interbedded with gray to green shale near the base of the unit. Intertonguing with the overlying Fruitland Formation occurs throughout the entire basin, and, consequently, minor Fruitland coal beds commonly are present in the upper portion of the Pictured Cliffs.

The major coal-bearing unit in the quadrangle is the Fruitland Formation. Wide variations in reported thickness of the Fruitland are common due to an indistinct upper contact with the Kirtland Shale, but the average is about 450 ft (137 m) in this quadrangle. Many authors have utilized various criteria for establishing the upper contact, but, in general, for this study the uppermost coal in the Fruitland was chosen (after Fassett and Hinds, 1971). The formation consists primarily of gray, carbonaceous shale, interbedded buff to gray to brown, calcareous, slightly glauconitic sandstone, and lenticular coal beds.

The Upper Cretaceous Kirtland Shale conformably overlies the Fruitland Formation and averages 1,200 ft (366 m) in thickness in this area. It consists predominantly of gray to gray-green shale with sandy stringers, thin interbedded white to gray, fine-grained, micaceous sandstone, and minor beds of various lithologies between shale and sandstone. 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.

The Ojo Alamo Sandstone conformably overlies the Kirtland Shale. It is gray, medium- to very coarse-grained, locally conglomeratic, micaceous sandstone, and averages 75 ft (23 m) in thickness.

Approximately 1,100 to 1,200 ft (335-366 m) of the Paleocene Nacimiento Formation overlie the Ojo Alamo Sandstone. These rocks consist of white to buff to gray, fine- to coarse-grained, micaceous, locally calcareous sandstone, and interbedded gray to gray-green, micaceous, silty shale.

The San Jose Formation of Eocene age unconformably overlies the Nacimiento Formation. It predominantly consists of buff to brown, coarse-grained to conglomeratic sandstone with abundant volcanic grains, brown to gray shale, and many lithologies gradational between the two.

A total of four formations crop out within the quadrangle. The outcrop pattern trends in a northeast-southwest direction, with the formations becoming successively younger to the southeast. The oldest formation exposed is the Kirtland Shale which crops out along the flank of the Hogback Monocline in the northwestern corner of the area. The entire sections of the Ojo Alamo Sandstone and the Nacimiento Formation are present and crop out consecutively across the quadrangle in an easterly and southeasterly direction. The lowermost beds of the San Jose Formation, the youngest formation in the area, are exposed in the northeastern corner of the quadrangle.

Structure

The Adobe Downs Ranch quadrangle is located in the Central Basin area (Kelley, 1950) of the major structural depression known as the San Juan Basin. The axis of the basin extends across the southeastern edge of the quadrangle area and trends in an arcuate pattern across the northern portion of the Central Basin area (Baltz, 1967). A structural feature known as the Hogback Monocline trends across the northwestern edge of the area in a northeast-southwest direction. Reeside (1924) measured dips in the Hogback Monocline area of 8° to 16° to the southeast. The dip angle decreases to the southeast where Reeside measured dips of 1° to 2°.

COAL GEOLOGY

Five coal beds (Fruitland 1, Fruitland 2, Fruitland 3, Fruitland 4, Fruitland 5) and a coal zone (Fruitland) were identiifed in the subsurface of this quadrangle (CRO Plate 1). 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; they are separated by a rock interval of 19 to 73 ft (5.8-22.3 m). The Fruitland 3 (Fr 3) coal bed is above the Fruitland 2 separated by a rock interval of 23 to 100 ft (7.0-30.5 m); the Fruitland 4 (Fr 4) coal bed is above the Fruitland 3 separated by a rock interval of 28 to 90 ft (8.5-27.4 m); the Fruitland 5 (Fr 5) coal bed is above the Fruitland 4 separated by a rock interval averaging 42 ft (12.8 m). Local (L) coals which are discontinuous and noncorrelative occur between these Fruitland coal beds. Although these coal beds have been correlated and mapped as consistent horizons, they may actually be several different coal beds that are litho-stratigraphically equivalent but not laterally continuous.

The remaining coals in the upper portion of the Fruitland Formation are designated as Fruitland zone (Fr zone) coals. These coals are generally noncorrelative, discontinuous, and less than reserve base thickness (5 ft [1.5 m]); an exception is a 5-ft (1.5-m) coal in drill hole 21 (CRO Plate 3). As a result of these characteristics, derivative maps were not constructed.

Fruitland Formation coals in the northwestern part of the San Juan Basin are considered high volatile B to high volatile A bituminous in rank. The rank has been determined on a moist, mineral-matter-free basis with calorific values averaging 14,196 Btu's per pound (33,020 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 1.7 to 6.9 percent, ash content ranging from 8.4 to 16.2 percent, sulfur content varying from 0.5 to 1.32 percent, and heating values on the order of 11,490 to 13,350 Btu's per pound (26,726-31,052 kj/kg). Analyses of several Fruitland Formation coals are given in Table 1 (Bauer and Reeside, 1921; Fassett and Hinds, 1971; Hayes and Zapp, 1955).

Fruitland 1 Coal Bed

The coal bed has been mapped only in areas of less than 3,000 ft (914 m) of overburden (the study limit). As indicated by the structure contour map (CRO Plate 5), the coal bed dips less than 1° to the east, except in the extreme northwest corner where the dip is approximately 14° to the southeast. As a result of topography and dip, overburden (CRO Plate 6) varies from less than 200 ft (61 m) in the extreme northwest corner to greater than 3,000 ft (914 m) in the northeast. The isopach map (CRO Plate

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 Moisture	Volatile matter	Fixed Carbon	Ash	Sulfur	Heating Value (Btu)	Remarks
H-15777	El Paso Nat Gas Case No. 9	SW¼ 8	31	11	2,710-2,740	A	1.7	40.3	47.0	11.0	0.7	13,350	
						B	—	41.0	47.9	11.1	0.7	13,580	
						C	—	46.1	53.9	—	0.8	13,280	
H-19884	Consolidated Oil & Gas Mitchell No. 1-5	SW¼ 5	31	12	2,215-3,000	A	2.4	39.4	47.3	10.9	0.5	13,090	
						B	—	40.4	48.5	11.1	0.5	13,410	
						C	—	45.5	54.5	—	0.6	15,100	
H-15141	Consolidated Oil & Gas Freeman No. 1-11	NE¼ 11	31	13	1,776-1,782	A	2.3	37.9	43.6	16.2	1.3	12,040	
						B	—	38.8	44.7	16.5	1.3	12,320	
						C	—	46.5	53.5	—	1.6	14,760	
17749	New Mexico Mine	7	32	12	—	A	6.6	35.4	44.9	13.1	0.66	11,490	
						B	—	37.9	48.0	14.1	0.71	12,300	
						C	—	44.1	55.9	—	0.83	14,310	
B-61247	Morgen Mine (tipple)	15	32	13	—	A	5.4	38.6	46.0	10.0	—	12,320	
						B	—	40.9	48.6	10.5	—	13,030	
						C	—	45.7	54.3	—	—	14,560	
B-61248	W.H. Thomas Mine (tipple)	15	32	13	—	A	5.4	40.0	46.2	8.4	—	12,650	
						B	—	42.2	48.9	8.9	—	13,380	
						C	—	46.4	53.6	—	—	14,680	
29249	W.H. Thomas Mine (500 ft from entry)	22	32	13	—	A	5.9	39.1	44.0	11.0	0.63	12,050	
						B	—	41.5	46.8	11.7	0.67	12,810	
						C	—	47.0	53.0	—	0.76	14,510	
29250	Jones Mine (500 ft from entry)	SE¼ 21	32	13	—	A	6.9	38.1	43.1	11.9	1.32	11,630	
						B	—	41.0	46.2	12.8	1.42	12,490	
						C	—	47.0	53.0	—	1.63	14,330	

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.

4) shows the coal bed is greater than 20 ft (6.1 m) thick in the northwest and a part of the southeast. The thickness decreases in all directions, and the coal is absent in small areas in the center and the southwest corner of 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 1 (Bauer and Reeside, 1921; Fassett and Hinds, 1971; Hayes and Zapp, 1955).

Fruitland 2 Coal Bed

The coal bed has been mapped only in areas with less than 3,000 ft (914 m) of overburden (the study limit). As indicated by the structure contour map (CRO Plate 9), the coal bed dips less than 1° to the east, except in the extreme northwest corner where the dip is nearly 14° to the southeast. As a result of topography and dip, overburden (CRO Plate 10) varies from less than 200 ft (61 m) in the extreme northwest corner to greater than 3,000 ft (914 m) in the northeast. The isopach map (CRO Plate 8) shows that the coal bed has a thickness of greater than 5 ft (1.5 m) in an area extending from the northeast to the west-central parts of the quadrangle. The thickness decreases in all directions from these areas, and the coal is absent in several areas throughout the quadrangle.

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 1 (Bauer and Reeside, 1921; Fassett and Hinds, 1971; Hayes and Zapp, 1955).

Fruitland 3 Coal Bed

The coal bed has been mapped only in areas with less than 3,000 ft (914 m) of overburden (the study limit). As indicated by the structure contour map (CRO Plate 13), the coal bed dips less than 1° to the east, except in the extreme northwest corner where it dips approximately 14° to the southeast. As a result of topography and dip, overburden varies from less than 1,200 ft (366 m) in the northwest part of the mapped area to greater than 3,000 ft (914 m) in the northeast. The isopach map (CRO Plate 12) illustrates that the coal bed is greater than 5 ft (1.5 m) thick in the north and in a portion of the south. The coal is absent in the north and several locations in the south.

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 1 (Bauer and Reeside, 1921; Fassett and Hinds, 1971; Hayes and Zapp, 1955).

Fruitland 4 Coal Bed

The coal bed has been mapped only in areas with less than 3,000 ft (914 m) of overburden (the study limit). As indicated by the structure contour map (CRO Plate 17), the coal bed dips less than 1° to the east, except in the northwest corner where the dip is approximately 14° to the southeast. As a result of topography and dip, overburden varies from less than 200 ft (61 m) in the northwest corner to greater than 3,000 ft (914 m) in the northeast. The isopach map (CRO Plate 16) shows the coal bed has a thickness of greater than 10 ft (3.0 m) in the northeast and the thickness decreases away from this area. The coal is absent in several areas throughout the quadrangle.

Chemical Analyses of the Fruitland 4 Coal Bed - Analyses of several coals of the Fruitland Formation from this quadrangle and the surrounding area are given in Table 1 (Bauer and Reeside, 1921; Fassett and Hinds, 1971; Hayes and Zapp, 1955).

Fruitland 5 Coal Bed

As indicated by the structure contour map (CRO Plate 21), the coal bed dips less than 1° to the northeast. As a result of topography and dip, overburden (CRO Plate 22) varies from less than 2,400 ft (732 m) in the south to greater than 2,800 ft (853 m) in the northeast part of the mapped area. The isopach map (CRO Plate 20) illustrates that the coal bed has a thickness of greater than 5 ft (1.5 m) in the central part of the southeast. The thickness decreases from this area. The coal is present only in the southeast part of the quadrangle.

Chemical Analyses of the Fruitland 5 Coal Bed - Analyses of several coals of the Fruitland Formation from this quadrangle and the surrounding area are given in Table 1 (Bauer and Reeside, 1921; Fassett and Hinds, 1971; Hayes and Zapp, 1955).

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 within Federal lands in the Adobe Downs Ranch 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, Fruitland 2, Fruitland 3, Fruitland 4, and Fruitland 5 coal beds for the determination of coal resources in this quadrangle. Coals of the Fruitland zone were not evaluated because they are discontinuous, limited in extent, 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, 11, 15, and 19) 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, 8, 12, 16, and 20) and areal distribution maps (CRO Plates 7, 11, 15, and 19) 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, Fruitland 2, Fruitland 3, and Fruitland 4 and Fruitland 5 beds are shown on CRO Plates 7, 11, 15, and 19, 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 401 million short tons (364 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 Adobe Downs Ranch quadrangle has development potential for subsurface mining methods only (CDP Plate 23).

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 2 summarizes the coal development potential, in short tons, for underground coal of the Fruitland 1, Fruitland 2, Fruitland 3, Fruitland 4, and Fruitland 5 coal beds.

TABLE 2

COAL RESOURCE DATA FOR UNDERGROUND MINING METHODS FOR FEDERAL COAL LANDS (in short tons) IN THE ADOBE DOWNS RANCH QUADRANGLE, SAN JUAN COUNTY, NEW MEXICO, AND LA PLATA COUNTY, COLORADO

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

Coal Bed	High Development Potential	Moderate Development Potential	Low Development Potential	Total
Fruitland 5	--	--	19,500,000	19,500,000
Fruitland 4	--	790,000	14,810,000	15,600,000
Fruitland 3	--	--	48,420,000	48,420,000
Fruitland 2	--	--	49,630,000	49,630,000
Fruitland 1	--	34,000,000	233,900,000	267,900,000
TOTAL	--	34,790,000	366,260,000	401,050,000

Development Potential for Surface Mining Methods

All coals studied within Federal lands in the Adobe Downs Ranch 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

Underground coal of the Fruitland 1 and Fruitland 4 coal beds has moderate development potential in the northwest corner of the quadrangle (CDP Plate 23) where coal bed thicknesses are approximately 20 to 25 ft (6.1-7.6 m) for the Fruitland 1 (CRO Plate 4) and 5 ft (1.5 m) for the Fruitland 4 (CRO Plate 16), and the overburden thicknesses range from 1,000 to 2,000 ft (305-610 m) for the Fruitland 1 (CRO Plate 6) and 1,600 to 1,800 ft (488-549 m) for the Fruitland 4 (CRO Plate 18).

The five Fruitland coal beds in this quadrangle for which derivative maps were constructed have low coal development potential. The Fruitland 1 coal with low potential for development is in the northwest quadrant and the southern half of the quadrangle, where the coal is 5 to 20 ft (1.5-6.2 m) thick (CRO Plate 4), and the overburden thickness increases from 2,400 ft (732 m) in the west to 3,000 ft (914 m) in the east (CRO Plate 6). Low potential coal of the Fruitland 2 occurs in the north-northwest and in the west-central part of the area. The coal is 5 to 8 ft (1.5-2.4 m) thick (CRO Plate 8), and the overburden thickness ranges from 2,200 ft (671 m) in the west to 3,000 ft (914 m) in the north (CRO Plate 10). The Fruitland 3 coal bed has low development potential in the north-central, east-central, and south-central areas (as shown on the areal distribution map [CRO Plate 15]), where the coal bed thickness varies from 5 to 8 ft (1.5-2.4 m) (CRO Plate 12), and the overburden ranges from 2,400 to 3,000 ft (732-914 m) thick (CRO Plate 14). The Fruitland 4 and Fruitland 5 coal beds have low development potential in several isolated areas shown on the areal distribution map (CRO Plate 19). Thickness of the coal varies from 5 to 8 ft (1.5-2.4 m) for the Fruitland 4 (CRO Plate 16) to 5 to 9 ft (1.5-2.7 m) for the Fruitland 5 (CRO Plate 20), and the overburden is 2,260 to 2,600 ft (669-792 m) thick for the Fruitland 4 (CRO Plate 18) and 2,400 to 2,800 ft (732-853 m) thick for the Fruitland 5 (CRO Plate 22).

The central and southwestern parts of the quadrangle have unknown development potential and include areas where the individual coal bed thicknesses are less than 5 ft (1.5 m) and areas outside the 3,000-foot (914-m) overburden study limits. A small area with no coal development potential occurs in the extreme southwest corner where there is no Fruitland 1, Fruitland 2, Fruitland 4, or Fruitland 5 coal. Although the Fruitland 3 is present in this area (less than 5 ft [1.5 m] thick, CRO Plate 12), it was necessary to disregard it in order to tie the coal development potential map of Adobe Downs Ranch (CDP Plate 23) to the map for La Plata, the adjoining quadrangle.

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