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FEDERAL COAL RESOURCE OCCURRENCE AND COAL DEVELOPMENT POTENTIAL MAPS  
OF THE PILLAR 3 SE 7 1/2-MINUTE QUADRANGLE,  
SAN JUAN AND MCKINLEY COUNTIES, NEW MEXICO

[Report includes 22 plates]

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This report was prepared under contract to the U.S. Geological Survey, and has not been edited for conformity with Geological Survey editorial standards or stratigraphic nomenclature. Opinions expressed herein do not necessarily represent those of the Geological Survey.

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## INTRODUCTION

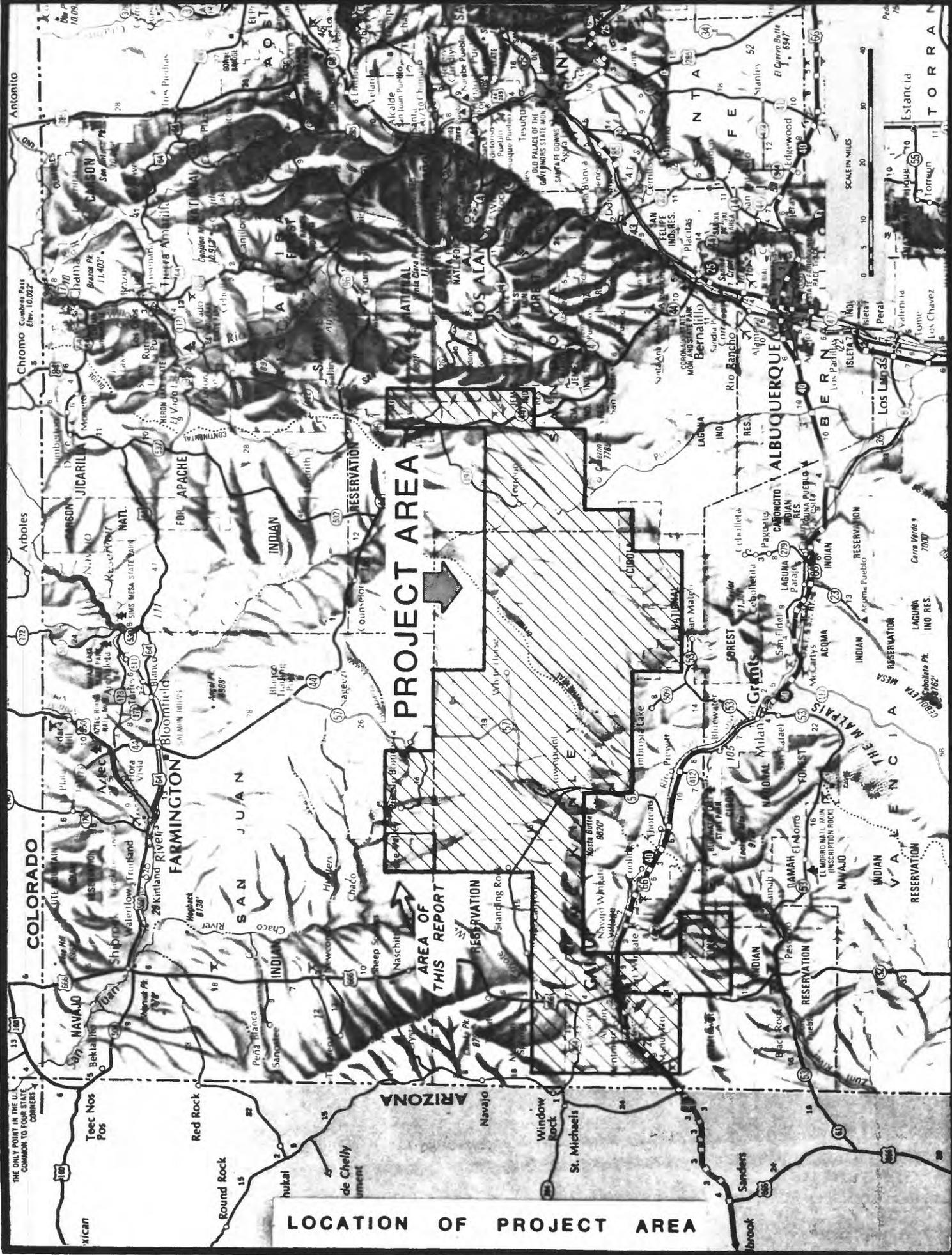
### Purpose

This text complements the Coal Resource Occurrence (CRO) and Coal Development Potential (CDP) maps of The Pillar 3 SE 7½ minute quadrangle, San Juan and McKinley Counties, New Mexico. These maps and the report are part of an evaluation of fifty-six 7½ minute quadrangles in northwestern New Mexico which were completed under U. S. Geological Survey Contract No. 14-08-0001-17459 (see figs. 1 and 2).

The purpose of this Coal Resource Occurrence-Coal Development Potential program, which was conceived by Congress as part of its Federal Coal Leasing Amendments Act of 1976, is to obtain coal resource information and to determine the geographical extent of Federal coal deposits. In addition, the program is intended to provide information on the amount of coal recoverable by various mining methods and to serve as a guide for land-use planning.

The U. S. Geological Survey initiated the program by identifying areas underlain by coal resources. These areas were designated Known Recoverable Coal Resource Areas based on the presence of minable coal thicknesses, adequate areal extent of these coal deposits, and the potential for developing commercial quantities of coal at minable depths.

This report is limited to coal resources which are 3,000 ft (914 m) or less below ground surface. Published and unpublished public information was used as the data base for this study. No new drilling or field mapping was performed as part of this study, nor were any confidential data used.

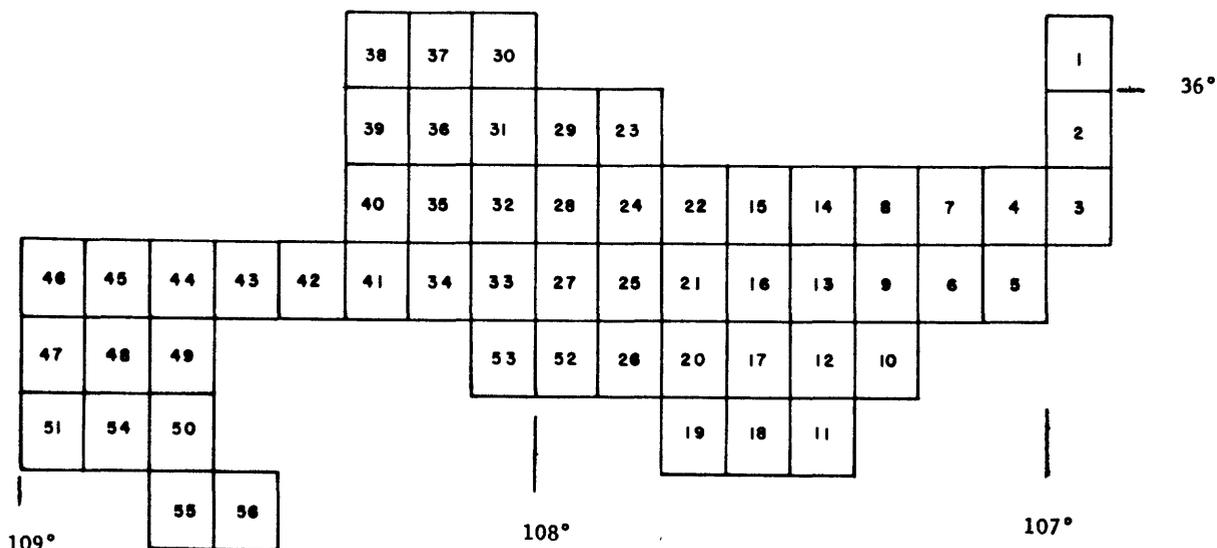


LOCATION OF PROJECT AREA

FIGURE 1

FIGURE 2.--Index to USGS 7 1/2-minute quadrangles and coal resource occurrence/  
coal development potential maps for the southern San Juan Basin area, New Mexico

Map No.	Quadrangle	Open-file report	Map No.	Quadrangle	Open-file report
1	Cuba	79- 623	31	Nose Rock	79- 641
2	San Pablo	79- 624	32	Becenti Lake	79-1124
3	La Ventana	79-1038	33	Heart Rock	79- 642
4	Headcut Reservoir	79-1043	34	Crownpoint	79-1125
5	San Luis	79-1044	35	Antelope Lookout Mesa	79-1376
6	Arroyo Empedrado	79-1045	36	Milk Lake	79-1377
7	Wolf Stand	79-1046	37	La Vida Mission	79-1378
8	Tinian	79- 625	38	The Pillar 3 SE	79-1379
9	Canada Calladita	79- 626	39	Red Lake Well	79-1380
10	Cerro Parido	79- 627	40	Standing Rock	79-1381
11	El Dado Mesa	79- 628	41	Dalton Pass	80- 026
12	Mesa Cortada	79- 629	42	Oak Spring	80- 027
13	Mesita del Gavilan	79- 630	43	Hard Ground Flats	80- 028
14	Rincon Marquez	79- 631	44	Big Rock Hill	80- 029
15	Whitehorse Rincon	79- 632	45	Twin Lakes	80- 030
16	Mesita Americana	79- 633	46	Tse Bonita School	80- 031
17	El Dado	79- 634	47	Samson Lake	80- 032
18	Cerro Alesna	79- 635	48	Gallup West	80- 033
19	San Lucas Dam	79- 636	49	Gallup East	80- 034
20	Piedra de la Aguila	79-1039	50	Bread Springs	80- 035
21	Hospah	79- 637	51	Manuelito	80- 036
22	Whitehorse	79-1040	52	Borrogo Pass	80- 037
23	Seven Lakes NE	79- 638	53	Casamero Lake	80- 038
24	Kin Nahzin Ruins	79- 639	54	Twin Buttes	80- 039
25	Orphan Annie Rock	79-1041	55	Pinehaven	80- 040
26	Mesa de los Toros	79-1122	56	Upper Nutria	80- 041
27	Laguna Castillo	79- 640			
28	Seven Lakes	79-1042			
29	Seven Lakes NW	79-1123			
30	Kin Klizhin Ruins	79-1047			



## Location

The Pillar 3 SE 7½ minute quadrangle includes acreage in Tps. 20, 21, and 22 N., Rs. 13 and 14 W. of the New Mexico Principal Meridian, San Juan and McKinley Counties, northwestern New Mexico (see figs. 1 and 2).

## Accessibility

No paved roads pass through The Pillar 3 SE quadrangle. A light-duty maintained road provides access to the town of White Rock in the northeast part of the quadrangle. Unimproved dirt roads traverse most parts of the area. The Atchison, Topeka, and Santa Fe Railroad line passes about 34 mi (55 km) SSW of the quadrangle (see fig. 1).

## Physiography

The Pillar 3 SE quadrangle is in the Navajo section of the southernmost part of the Colorado Plateau physiographic province (U. S. Geological Survey, 1965). Hilly badlands characterize the topography of the northeast, while most of the quadrangle is relatively flat land.

No perennial streams are present in the area. Indian Creek and other intermittent arroyos provide drainage locally. Elevations within the quadrangle range from 5,717 ft (1,743 m) in the northwest along Indian Creek to 6,531 ft (1,991 m) at Stony Butte in the northeast.

## Climate

The climate of this area is semiarid to arid. The following temperature and precipitation data were reported by the National Oceanic and Atmospheric Administration for the Chaco Canyon National Monument Station. The Pillar 3 SE quadrangle is about 16 mi (26 km) W of the Chaco Canyon National Monument Station. Average total annual precipitation for thirteen of the previous fifteen years is 8.75 in. (22.23 cm). Intense thunderstorms in July, August, and September account for the majority of precipitation. The area is susceptible to flash flooding associated with these thunderstorms. Mean annual temperature for eleven of the previous fifteen years is 48.4<sup>0</sup>F (9.1<sup>0</sup>C). The average daily temperatures in January and July are 26.3<sup>0</sup>F (-3.2<sup>0</sup>C) and 72.5<sup>0</sup>F (22.5<sup>0</sup>C), respectively.

## Land status

The Federal Government holds coal rights to approximately 12 percent of The Pillar 3 SE quadrangle. For the specific coal ownership boundaries, see plate 2. It is not within the scope of this report to provide detailed land-surface ownership. About 4,200 acres (1,700 ha) along the eastern edge of the quadrangle are within the Tsaya Known Recoverable Coal Resource Area. Coal mineral rights are held by the Navajo Indians in the remainder of the quadrangle. As of October 26, 1978, there were no Federal coal leases, coal preference right lease applications or coal exploration licenses within The Pillar 3 SE quadrangle.

## GENERAL GEOLOGY

### Previous work

Early reports on the area include that of Bauer and Reeside (1921) who identified upper Menefee Formation coals in the area. Dobbin (1932) mapped areas of clinkered coal and two coal beds in sec. 31, T. 22 N., R. 13 W. O'Sullivan (1955) mapped the surface geology of the quadrangle and measured upper Allison Member coal outcrops. Shomaker, Beaumont, and Kottowski (1971) report "Section 31 (of T. 22 N., R. 13 W.) and the surrounding terrain are hilly badlands incised in the strata at the base of the Cliff House Sandstone." They also report a coal bed 9.7 ft (3.0 m) thick is present in the northwestern part of sec. 31. No reserves were estimated because of the coals lenticular nature and sparse outcrops. O'Sullivan, et.al., (1972) discuss the stratigraphic relationships of the Cretaceous rock units in the area. Beaumont, Shomaker, Stone, and others (1976) discuss coals and environments of deposition in the Tsaya Canyon area of their road log.

### Stratigraphy

Within the San Juan Basin, the shoreline positions of the Cretaceous seaways changed innumerable times. The overall regional alignment of the shorelines trended N. 60° W. - S. 60° E. (Sears, Hunt, and Hendricks, 1941). The transgressive and regressive shoreline migrations are evidenced by the intertonguing relationships of the continental and marine facies. Rates of trough (geosynclinal) subsidence and the availability of sediment supplies are the major factors that controlled the transgressive-regressive shoreline sequences.

Exposed rock units in The Pillar 3 SE quadrangle include some of the sedimentary units of Upper Cretaceous age. There is Quaternary alluvium, terrace, and pediment gravels along drainages in the area. The Menefee Formation is exposed at the surface over most of the quadrangle.

The Point Lookout Sandstone is a prominent sandstone marker in most of the San Juan Basin and represents nearshore or littoral deposits which formed during the most extensive northeastward retreat prior to final withdrawal of the Cretaceous seaways in the San Juan Basin (Sears, Hunt, and Hendricks, 1941). Light gray to reddish-brown, fine-to medium-grained sandstone with interbedded shales comprises the lithologies of the Point Lookout Sandstone which ranges from 100 to 140 ft (30 to 43 m) thick locally. The continental sediments deposited inland from the beach area during the deposition of the Point Lookout Sandstone compose the overlying Menefee Formation.

The Menefee Formation consists of dark gray to brown, carbonaceous to noncarbonaceous shales, light gray sandstones, and coal beds, and is divisible into the basal Cleary Coal Member and upper Allison Member. A massive channel sandstone sequence defines the boundary between the two members. The Cleary Coal Member contains many coal beds in this area, and is 380 to 450 ft (116 to 137 m) thick locally. The Allison Member represents continued continental sedimentation. Erosion has reduced the Allison Member to about 870 ft (265 m) thick in some areas, although the full thickness of the member is about 1,450 ft (442 m). Intertonguing of the Allison Member with the overlying Cliff House Sandstone indicates the instability of the Cretaceous shorelines during transition from regressive to transgressive depositional conditions in this area.

The Cliff House Sandstone formed in a nearshore marine environment as the Cretaceous seaways advanced southwestward during the final transgression in the San Juan Basin. The Cliff House Sandstone caps White Rock in the northeast corner of the quadrangle, and consists of light gray, medium-grained, locally calcareous sandstone with interbedded shales, and local coal beds. Erosion has reduced the unit to about 90 ft (27 m) thick locally.

#### Depositional environments

The Cretaceous System sedimentary units in the quadrangle represent transgressive and regressive depositional conditions. There were innumerable minor cycles of widely varying duration and extent within the major sedimentary sequences. The paucity of data in this quadrangle and the intended scope of this report permit only general interpretations of the depositional environments.

The Cretaceous coal deposits of the San Juan Basin are products of former coastal swamps and marshes. These swamps and marshes were supported by heavy precipitation and a climate conducive to rapid vegetal growth in moderately fresh water. Due to the relatively low sulfur contents of the San Juan Basin coals, Shomaker and Whyte (1977) suggest the coals formed in fresh water environments.

Most of the coal-bearing units were deposited in coastal plain environments. The majority of the peat deposits formed in a transition zone

between lower and upper deltaic sediments during periods of relative shoreline stability. Coals also formed in lake margin swamps inland from the coastal area. Shoreline oscillations and the subsequent influx of continental or marine debris upon the peat accumulations produced the vertical buildup or "stacking" of peat deposits. This sediment debris is represented by variable ash contents, rock partings, and splits within the coal seams.

The peat accumulated in lenses or pods which were generally parallel to the ancient shorelines. The coals in the lower portions of the coal-bearing units represent regressive depositional conditions (Sears, Hunt, and Hendricks, 1941). The coals in the upper portions of these units are relatively sporadic in occurrence.

### Structure

The Pillar 3 SE quadrangle is in the Chaco Slope and Central Basin structural divisions in the southern portion of the structural depression known as the San Juan Basin (Kelley, 1950). Dips of the rock units range from  $1^{\circ}$  to  $3^{\circ}$  N to NE. Neither Dobbin (1932) nor O'Sullivan (1955) mapped any faults in this quadrangle.

## COAL GEOLOGY

In this quadrangle, the authors identified three coal beds and two coal zones in oil and gas well logs and Dobbin's (1932) and O'Sullivan's (1955) surface mapping. These beds and zones are here informally called the Menefee Cleary No. 1, No. 2, and No. 3 coal beds, and the Menefee Cleary and Menefee Allison coal zones. Two additional local coal beds occur between the Menefee Cleary No. 1 and No. 2 coal beds.

The Menefee Cleary No. 1 bed is the first persistent coal bed above the Point Lookout Sandstone. It occurs from 0 to 6 ft (0 to 2 m) above the Point Lookout Sandstone in this quadrangle. The Menefee Cleary No. 2 and No. 3 coal beds are 13 to 23 ft (4 to 7 m) and 78 to 87 ft (24 to 27 m), respectively, above the Point Lookout Sandstone. These beds are inferred to be continuous although they may be several individual beds that are stratigraphically equivalent.

Up to six coal beds which occur from 37 to 198 ft (11 to 60 m) above the Point Lookout Sandstone comprise the Menefee Cleary coal zone. The youngest coals in this quadrangle are within the Menefee Allison coal zone. These coals crop out in the northeastern part of the quadrangle and are relatively thick though very erratic and lenticular. These zone coals may be correlated for limited distances in portions of the area, but they lack sufficient continuity with poorly defined stratigraphic position and cannot be designated as persistent coal beds.

There are no known published coal quality analyses for coal beds from The Pillar 3 SE quadrangle. An abandoned coal mine in NW $\frac{1}{4}$  sec. 31,

T. 22 N., R. 13 W., probably provided coal for local usage. Several coal quality analyses of upper Allison Member coals from 3.5 to 4.5 mi (5.6 to 7.2 km) E to NE of the quadrangle are available and are shown in table 1. The Allison Member coals analyzed are probably similar in quality to the Cleary Coal Member and Allison Member coals in this quadrangle. Rank of the Allison Member and Cleary Coal Member seams is subbituminous A to high volatile C bituminous in this area.

Because the Navajo Indians own the coal mineral rights to about 80 percent of the quadrangle, no isopachs, structure contours or overburden (and interburden) isopachs were constructed on Indian lands. Therefore, all bed and zone maps terminate at the Navajo Indian Reservation boundary.

#### Menefee Allison coal zone

The Menefee Allison coal zone was identified in two oil and gas well logs and measured sections by Dobbin (1932) and O'Sullivan (1955). Individual coal thicknesses range from 2.3 to 8.0 ft (0.7 to 2.4 m). The maximum zone coal thickness is 12.0 ft (3.7 m) at data point #7 (see plate 3). Structure contours (plate 5) are drawn on the base of the Allison Member. Overburden isopachs were based on the vertical distance from the surface to the base of the Allison Member, and the interburden consists of the rock interval between the lowest and highest Menefee Allison zone coal, less intervening coal thicknesses. Existence and character of the Menefee Allison coal zone are unknown in the southern part of the mapped area because of insufficient data.

Table 1. - Analyses of coal samples from the Allison Member of the Menefee Formation.

[Form of analysis: A, as received; B, moisture free; C, moisture and ash free].

Sample 1 from Shomaker, Beaumont, and Kottlowski, 1971

Sample 2 from Bauer and Reeside, 1921

Sample 3 and 4 from U. S. Bureau of Mines, 1971

Sample	Type of sample	Location Sec. T. N. R. W.	Form of analysis	Proximate analysis (percent)				Sulfur	Ash	Heating Value (Btu/lb)
				Moisture	Volatile matter	Fixed carbon				
1	pit sample	SW $\frac{1}{4}$ SW $\frac{1}{4}$ 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	
2	mine sample (Blakes mine)	13 22 13	A	19.0	32.4	43.2	5.4	0.92	10,190	
			B	-----	40.0	53.3	6.7	1.14	12,590	
			C	-----	42.9	57.1	-----	1.22	13,490	
3	mine sample (unnamed)	NE $\frac{1}{4}$ SE $\frac{1}{4}$ 23 22 13	A	16.0	38.4	41.4	4.2	1.0	11,100	
			B	-----	45.7	49.3	5.0	1.1	13,210	
			C	-----	48.1	51.9	-----	1.2	13,900	
4	mine sample (unnamed)	SW $\frac{1}{4}$ NW $\frac{1}{4}$ 24 22 13	A	9.5	38.9	48.0	3.6	1.1	11,300	
			B	-----	42.9	53.1	4.0	1.2	12,490	
			C	-----	44.7	55.3	-----	1.3	13,010	

Remarks:

A moist, mineral-matter-free (MMMF) calculation using the Parr formula (American Society for Testing and Materials, 1973) yields heating values of 11,103 Btu/lb (25,826 kJ/kg; sample 1), 10,830 Btu/lb (25,191 kJ/kg; sample 2), 11,642 Btu/lb (27,079 kJ/kg; sample 3), and 11,774 Btu/lb (27,386 kJ/kg; sample 4). Sample 1 is nonagglomerating, but no agglomerating characteristics are available for samples 2, 3 or 4.

### Menefee Cleary coal zone

The Menefee Cleary coal zone was identified in four oil and gas well logs in this quadrangle. Total coal thickness is as much as 17.0 ft (5.2 m) at data point #3 (see plate 3). Individual bed thicknesses range from 2.0 to 5.0 ft (0.6 to 1.5 m). The structural datum used to map the zone was the top of the Cleary Coal Member. Based on Menefee Cleary zone data in adjacent quadrangles, the zone was inferred to pinch out in the central eastern part of the quadrangle (see plate 7).

### Menefee Cleary No. 3 coal bed

The Menefee Cleary No. 3 coal bed was identified in three oil and gas well logs and ranges from 2.0 to 4.0 ft (0.6 to 1.2 m) thick. The bed is interpreted as a lenticular pod in the northeast corner of the quadrangle. Because the Menefee Cleary No. 3 was not identified in drill holes #5 and #6 (see plate 3), the bed was inferred to pinch out to the north, east, and south (plate 10).

### Menefee Cleary No. 2 coal bed

The Menefee Cleary No. 2 coal bed was identified in three oil and gas well logs and ranges from 3.0 to 6.0 ft (0.9 to 1.8 m) thick. The configuration of the bed is similar to that of the Menefee Cleary No. 3 bed. Because the Menefee Cleary No. 2 coal bed was not identified in drill holes #6 and #7 (see plate 3), the bed was inferred to pinch out to the north, east, and south (plate 13).

## Menefee Cleary No. 1 coal bed

The Menefee Cleary No. 1 coal bed is the most persistent coal bed identified in The Pillar 3 SE quadrangle, and is present in all five oil and gas well logs. Thickness of the bed ranges from 4.0 ft (1.2 m) to 7.0 ft (2.1 m), with a 3.0 ft (0.9 m) rock parting (see plate 3). The 2.0 ft (0.6 m) isopach line (see plate 16) was inferred to be present in the southern part of the quadrangle based on Menefee Cleary No. 1 coal data from the southern adjacent Red Lake Well quadrangle.

## COAL RESOURCES

The U. S. Geological Survey requested resource evaluations of the Menefee Cleary No. 1, No. 2, and No. 3 coal beds, where the beds are 3.0 ft (0.9 m) or more thick. The evaluation is restricted to Federal coal lands.

The following procedures were prescribed by the U. S. Geological Survey for the calculation of reserve base. Criteria established in U. S. Geological Survey Bulletin 1450-B were used to areally divide the bed into measured, indicated, and inferred reserve base categories. Reserve base was calculated for each category, by section, using data from the isopach and overburden maps (plates 10, 12, 13, 15, 16, and 18). The acreage in each category (measured by planimeter) multiplied by the average coal bed thickness and a bituminous coal conversion factor (1,800 tons of coal per acre-ft) yields the reserve base for the category. Coal beds with a 3.0 ft minimum thickness are included in reserve base and reserve data rather than the 28 in. (71 cm) minimum thickness prescribed in U. S. Geological Survey Bulletin 1450-B. Reserve figures are derived from reserve base totals by applying a recovery factor of 50 percent for coal beds 200 to 3,000 ft (61

to 914 m) deep. All reserve base and reserve values are rounded to the nearest 10,000 short tons (9,072 t).

Total reserve base data for the Menefee Cleary No. 1, No. 2, and No. 3 coal beds, which include all reserve base categories, are shown by section on plate 2. Reserve base and reserve data in the various categories for the Menefee Cleary No. 1, No. 2, and No. 3 coal beds are shown on plates 21, 20, and 19, respectively.

The U. S. Geological Survey also requested resource evaluations of the Menefee Allison and Menefee Cleary coal zones, where the total coal thickness is 5.0 ft (1.5 m) or greater. The Menefee Allison and Menefee Cleary coal zones have total identified resources of 32.75 and 28.75 million short tons (29.71 and 26.08 million t), respectively, in The Pillar 3 SE quadrangle.

#### COAL DEVELOPMENT POTENTIAL

The factors used to determine the development potential are the presence of a potentially coal-bearing formation, and the thickness and overburden of correlative coal beds. The U. S. Geological Survey supplied the criteria to evaluate the coal development potential for Federal lands in this quadrangle. These criteria are based on current industry practice, U. S. Geological Survey Bulletin 1450-B, and anticipated technological advances. All available data were utilized for the surface and subsurface coal development potential evaluations.

Any area underlain by a potentially coal-bearing formation with 200 ft (61 m) or less of overburden has potential for surface mining. The U. S. Geological Survey designated the 200 ft (61 m) maximum depth as the stippling limit. Areas where a potentially coal-bearing formation is overlain

by more than 200 ft (61 m) of overburden have no potential for surface mining. Areas with no correlative coal bed or a correlative coal bed less than 3.0 ft (0.9 m) in thickness and overlain by 200 ft (61 m) or less of overburden have unknown surface mining potential.

Any area underlain by a potentially coal-bearing formation with 200 to 3,000 ft (61 to 914 m) of overburden have potential for subsurface mining. Areas where a potentially coal-bearing formation is overlain by more than 3,000 ft (914 m) of overburden have no subsurface mining potential. Development potential for subsurface mining is unknown where a potentially coal-bearing formation within 200 to 3,000 ft (61 to 914 m) of the surface contains no identified correlative coal bed or a correlative coal bed less than 3.0 ft (0.9 m) thick. High, moderate, and low development potential areas have respective overburden values of 200 to 1,000 ft (61 to 305 m), 1,000 to 2,000 ft (305 to 610 m), and 2,000 to 3,000 ft (610 to 914 m).

Boundaries of coal development potential areas coincide with the boundaries of the smallest legal land subdivision (40 acres or lot). When a land subdivision contains areas with different development potentials, the potential shown on the map is that of the areally largest component area. When an area is underlain by more than one bed, the potential shown on the map is that of the bed with the highest potential.

Reserve base (in short tons) for the moderate and low development potential categories for subsurface mining methods is shown in table 2.

The coal development potential map is subject to revision. Map boundary lines and reserve base values are based on coal resource occurrence map isopachs, overburden isopachs, and coal bed correlations that are interpretive and subject to change as additional coal information becomes available.

## Development potential for surface mining methods

Based on coal development potential criteria, all Federal coal land has unknown development potential for surface mining methods in The Pillar 3 SE quadrangle.

## Development potential for subsurface mining methods and in situ gasification

The coal development potential for subsurface mining methods in The Pillar 3 SE quadrangle is shown on plate 22. Based on coal development criteria, all Federal coal lands have subsurface mining potentials of moderate, low or unknown. Refer to table 3 for reserves and planimetered acreage, by section, for Federal coal lands with subsurface mining potential.

In situ gasification of coal has not been done on a commercial scale in the United States and criteria for rating the development potential of this method are unknown.

Table 2. - Reserve base data (in short tons) for subsurface mining methods for Federal coal lands in The Pillar 3 SE quadrangle, San Juan and McKinley Counties, New Mexico.

[Development potentials are based on thickness of overburden. To convert short tons to metric tonnes, multiply by 0.9072].

Coal Bed	High Development Potential (200'-1,000' overburden)	Moderate Development Potential (1,000'-2,000' overburden)	Low Development Potential (2,000'-3,000' overburden)	Total
Menefee Cleary No. 1	-----	15,520,000	3,890,000	19,410,000
Menefee Cleary No. 2	-----	2,120,000	450,000	2,570,000
Menefee Cleary No. 3	-----	2,910,000	-----	2,910,000
Total	-----	20,550,000	4,340,000	24,890,000

Table 3. - Reserves and planimetered acreage, by section, for Federal coal lands in The Pillar 3 SE quadrangle with subsurface mining potential.

[To convert acres to hectares, divide acres by 2.471; to convert short tons to metric tonnes, multiply short tons by 0.9072].

Potential category	Coal bed	Sec. T. N. R. W.	Acres (planimetered)	Reserves (in short tons)		
Moderate	Menefee Cleary No. 1	5 21 13	150.5	760,000		
		6	570.2	3,160,000		
		8	188.5	800,000		
		17	95.8	310,000		
		18	168.7	530,000		
		31 22 13	387.7	2,190,000		
Low	Menefee Cleary No. 2	6 21 13	36.5	100,000		
		31 22 13	258.4	940,000		
		Menefee Cleary No. 3	6 21 13	326.9	1,100,000	
			31 22 13	95.8	340,000	
			Menefee Cleary No. 1	5 21 13	44.1	220,000
				29 22 13	76.0	240,000
30	293.4			1,010,000		
31	101.9			460,000		
Menefee Cleary No. 2	30 22 13	45.6		140,000		
	31	25.8		80,000		

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## GLOSSARY

- coal bed--A stratified sequence of coal, composed of relatively homogeneous material, exhibiting some degree of lithologic unity and separated from the rocks above and below by physically rather well defined boundary planes.
- coal bed separation line--A line on a map plate separating areas where different coal beds or zones are mapped.
- coal bench--One of two or more divisions of a coal bed separated by rock.
- coal conversion factor--A factor used to convert acre-feet of coal into short tons of coal; bituminous coal is 1800 tons/acre-ft; subbituminous coal is 1770 tons/acre-ft.
- coal development potential--A subjective determination of the comparative potential of Federal coal lands for development of a commercially viable coal mining operation.
- coal exploration license--An area of Federal coal lands in which the licensee is granted the right, after outlining the area and the probable methods of exploration, to investigate the coal resources. An exploration license has a term not to exceed 2 years and does not confer rights to a lease.
- coal lease--An area of Federal coal lands in which the Federal Government has entered into a contractual agreement for development of the coal deposits.
- coal split--A coal bed resulting from the occurrence of a noncoal parting within the parent coal bed which divides the single coal bed into two or more coal beds.
- coal zone--A distinctive stratigraphic interval containing a sequence of alternating coal and noncoal layers in which the coal beds may so lack lateral persistence that correlating individual beds in the zone is not feasible.
- Federal coal land--Land for which the Federal Government holds title to the coal mineral rights, without regard to surface ownership.
- hypothetical resources--Undiscovered coal resources in beds that may reasonably be expected to exist in known mining districts under known geologic conditions. In general, hypothetical resources are in broad areas of coal fields where points of observation are absent and evidence is from distant outcrops, drill holes or wells. Exploration that confirms their presence and reveals quantity and quality will permit their reclassification as a Reserve or Identified Subeconomic Resource.
- identified resources--Specific bodies of coal whose location, rank, quality, and quantity are known from geologic evidence supported by engineering measurements.
- indicated--Coal for which estimates for the rank, quality, and quantity have been computed partly from sample analyses and measurements and partly from reasonable geologic projections.
- inferred--Coal in unexplored extensions of demonstrated resources for which estimates of the quality and quantity are based on geologic evidence and projections.
- isopach--A line joining points of equal bed thickness.
- Known Recoverable Coal Resource Area (KRCRA)--Formerly called Known Coal Leasing Area (KCLA). Area in which the Federal coal land is classified (1) as subject to the coal leasing provisions of the Mineral Leasing Act of 1920, as amended, and (2) by virtue of the available data being sufficient to permit evaluation as to extent, location, and potential for developing commercial quantities of coal.
- measured--Coal for which estimates for rank, quality, and quantity can be computed, within a margin of error of less than 20 percent, from sample analyses and measurements from closely spaced and geologically well known sample sites.
- mining ratio--A numerical ratio equating the in-place volumes, in cubic yards, of rocks that must be removed in order to recover 1 short ton of coal by surface mining.
- overburden--A stratigraphic interval (composed of noncoal beds and coal beds) lying between the ground surface and the top of a coal bed. For coal zones, overburden is the stratigraphic interval lying between the ground surface and the structural datum used to map the zone.
- parting--A noncoal layer occurring along a bedding plane within a coal bed.
- Preference Right Lease Application (PRLA)--An area of Federal coal lands for which an application for a noncompetitive coal lease has been made as a result of exploration done under a coal prospecting permit. PRLA's are no longer obtainable.
- quality or grade--Refers to measurements such as heat value; fixed carbon; moisture; ash; sulfur; phosphorus; major, minor, and trace elements; coking properties; petrologic properties; and particular organic constituents.
- rank--The classification of coal relative to other coals, according to degree of metamorphism, or progressive alteration, in the natural series from lignite to anthracite (Classification of coals by rank, 1973, American Society for Testing and Materials, ASTM Designation D-388-66).
- recovery factor--The percentage of total tons of coal estimated to be recoverable from a given area in relation to the total tonnage estimated to be in the Reserve Base in the ground.
- reserve--That part of identified coal resource that can be economically mined at the time of determination. The reserve is derived by applying a recovery factor to that component of the identified coal resource designated as the reserve base.
- reserve base--That part of identified coal resource from which Reserves are calculated.
- stripping limit--A vertical depth, in feet, measured from the surface, reflecting the probable maximum, practical depth to which surface mining may be technologically feasible in the foreseeable future. The rock interval, expressed in feet, above the stripping limit is the "strippable interval."
- structure contour--A line joining points of equal elevation on a stratum or bed.