UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

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1985

FEDERAL COAL RESOURCE OCCURRENCE AND COAL DEVELOPMENT POTENTIAL MAPS OF THE WHITEHORSE RINCON 7 1/2-MINUTE QUADRANGLE, McKINLEY COUNTY, NEW MEXICO

[Report includes 25 plates]

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WHITEHORSE RINCON QUADRANGLE
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INTRODUCTION

Purpose

This text complements the Coal Resource Occurrence (CRO) and Coal Development Potential (CDP) maps of the Whitehorse Rincon 7½ minute quadrangle, McKinley County, New Mexico. These maps and 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 Published and unpublished public information was used as the data base for this study.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
PROJECT AREA
AREA OF THIS REPORT
COLORADO
ARIZONA
FARMINGTON
ALBUQUERQUE

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
1	Cuba	79- 623
2	San Pablo	79- 624
3	La Ventana	79-1038
4	Headcut Reservoir	79-1043
5	San Luis	79-1044
6	Arroyo Empedrado	79-1045
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8	Tinian	79- 625
9	Canada Calladita	79- 626
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11	El Dado Mesa	79- 628
12	Mesa Cortada	79- 629
13	Mesita del Gavilan	79- 630
14	Rincon Marquez	79- 631
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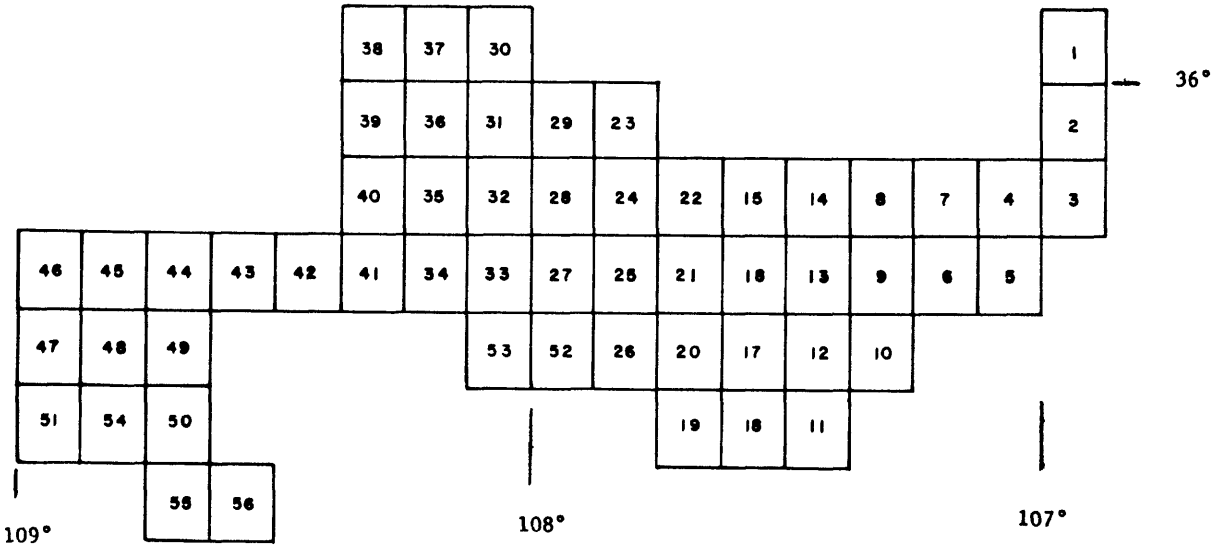
16	Mesita Americana	79- 633
17	El Dado	79- 634
18	Cerro Alesna	79- 635
19	San Lucas Dam	79- 636
20	Piedra de la Aguila	79-1039
21	Hospah	79- 637
22	Whitehorse	79-1040
23	Seven Lakes NE	79- 638
24	Kin Nahzin Ruins	79- 639
25	Orphan Annie Rock	79-1041
26	Mesa de los Toros	79-1122
27	Laguna Castillo	79- 640
28	Seven Lakes	79-1042
29	Seven Lakes NW	79-1123
30	Kin Klizhin Ruins	79-1047

Map No.	Quadrangle	Open-file report
31	Nose Rock	79- 641
32	Becenti Lake	79-1124
33	Heart Rock	79- 642
34	Crownpoint	79-1125
35	Antelope Lookout Mesa	79-1376
36	Milk Lake	79-1377
37	La Vida Mission	79-1378
38	The Pillar 3 SE	79-1379
39	Red Lake Well	79-1380
40	Standing Rock	79-1381
41	Dalton Pass	80- 026
42	Oak Spring	80- 027
43	Hard Ground Flats	80- 028
44	Big Rock Hill	80- 029
45	Twin Lakes	80- 030
46	Tse Bonita School	80- 031
47	Samson Lake	80- 032
48	Gallup West	80- 033
49	Gallup East	80- 034
50	Bread Springs	80- 035
51	Manuelito	80- 036
52	Borrego Pass	80- 037
53	Casamero Lake	80- 038
54	Twin Buttes	80- 039
55	Pinehaven	80- 040
56	Upper Nutria	80- 041



Location

The Whitehorse Rincon 7½ minute quadrangle includes acreage in Tps. 18 and 19 N., Rs. 6 and 7 W. of the New Mexico Principal Meridian, McKinley County, northwestern New Mexico (see figs. 1 and 2).

Accessibility

No paved roads pass through the Whitehorse Rincon quadrangle. Unimproved dirt roads traverse most parts of the area and provide access to the town of Whitehorse, 7 mi (11 km) west of the quadrangle. The Atchison, Topeka, and Santa Fe Railroad line passes about 35 mi (56 km) SW. of the quadrangle (see fig. 1).

Physiography

The Whitehorse Rincon quadrangle is in the Navajo section of the southernmost part of the Colorado Plateau physiographic province (U. S. Geological Survey, 1965). The topography of the quadrangle is mesa-and-canyon. Chaco Mesa is a prominent landform in the northern part of the quadrangle. The Continental Divide passes through the northern part of the area.

No perennial streams are present in the quadrangle. Local drainage is provided by several intermittent arroyos which include Whitehorse Rincon, North Fork Arroyo Chico, and Arroyo Sand Springs. Elevations within the quadrangle range from less than 6,560 ft (1,999 m) at the southern quadrangle boundary to 7,472 ft (2,277 m) on Chaco Mesa near the northwest corner.

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 Star Lake Station. The Whitehorse Rincon quadrangle is about 4 mi (6 km) SW. of the Star Lake Station. Average total annual precipitation for thirteen of the previous fifteen years is 8.78 in. (22.30 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 thirteen of the previous fifteen years is 46.4°F (8.0°C). The average daily temperatures in January and July are 23.7° F (-4.6° C) and 69.4° F (20.8° C), respectively.

Land status

The Federal Government holds coal rights to approximately 30 percent of the Whitehorse Rincon 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. All but about 360 acres (146 ha) in the southeastern portion of the quadrangle is within the Hospah Known Recoverable Coal Resource Area. As of October 26, 1978, there were no Federal coal leases, coal preference right lease applications of coal exploration licenses within the Whitehorse Rincon quadrangle.

GENERAL GEOLOGY

Previous work

Early reports on the area include that of Dane (1936) who described coal beds in the Cliff House Sandstone and Allison Member of the Menefee Formation. Shomaker, Beaumont, and Kottlowski (1971) noted Allison Member coal outcrops along Chaco Mesa, and measured beds up to 4.1 ft (1.2 m) thick, but made no reserve estimates. Shomaker and Whyte (1977) calculated Menefee Formation coal resources reserves in T. 18 N., R. 7 W., at depths less than 500 ft (152 m) to be 39.7 million short tons (36.0 million t). About 92 percent of T. 18 N., R. 7 W. is within the Whitehorse Rincon quadrangle.

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 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 Whitehorse Rincon quadrangle include some of the sedimentary units of Upper Cretaceous age. There is Quaternary alluvium along drainages in the area.

The Upper Cretaceous 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 the 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 unit which ranges from 90 to 180 ft (27 to 55 m) thick locally. The continental sediments deposited inland from the beach area during 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 the upper Allison Member. A massive channel sandstone sequence defines the boundary between the two members. The Allison Member was defined as the Allison Barren Member (Sears, 1925) as containing only thin, noncommercial coal beds although the upper part of the Allison Member commonly contains locally important coal beds. The Cleary Coal Member is present only in the subsurface in the quadrangle and ranges from 425 to 476 ft (129 to 145 m) thick locally. The Allison Member is present at the surface in most of the quadrangle and averages 1,200 ft (366 m) thick locally.

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. Chaco Mesa represents the approximate maximum southern development of the Cliff House Sandstone in this area. Light gray, medium grained locally calcareous sandstone, with interbedded shales, and local coal beds comprise the lithologies of the Cliff House Sandstone which averages 100 ft (30 m) thick locally.

As the advancing seaways deepened, the Lewis Shale formed from the marine sands, silts, and muds. The Lewis Shale is composed of gray to black, silty shale with interbedded light gray to buff, very fine-to fine-grained, calcareous sandstones, and bentonite marker beds. A partial section of about 100 ft (30 m) of the Lewis Shale is present along the northern boundary of the Whitehorse Rincon quadrangle.

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 contin-

ental 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 Whitehorse Rincon quadrangle is in the Chaco Slope structural division in the southern portion of the structural depression known as the San Juan Basin (Kelley, 1950). The rock units dip about 1^{o} E. to NE. Dane (1936) mapped several east-west trending, low displacement faults in the northern part of the quadrangle.

COAL GEOLOGY

In this quadrangle, the authors identified five coal beds and three coal zones in oil and gas well logs and Dane's (1936) surface mapping. These beds and zones are here informally called the Menefee Cleary No. 1, No. 2, No. 3, and No. 4 coal beds, the Menefee Cleary coal zone, the Menefee Allison No. 3 coal bed, the Menefee Allison coal zone, and the Cliff House coal zone.

The Menefee Cleary No. 1 bed is the first persistent coal bed which overlies the Point Lookout Sandstone in this quadrangle, although in

nearby quadrangles it is up to 15 ft (5 m) above the Point Lookout Sandstone. The Menefee Cleary No. 2 coal bed occurs from 12 to 15 ft (4 to 5 m) above the Point Lookout Sandstone in the quadrangle.

The Menefee Cleary No. 3 and No. 4 coal beds are 48 to 76 ft (15 to 23 m) and 135 to 160 ft (41 to 49 m), respectively, above the Point Lookout Sandstone. Up to twelve beds which occur from 26 to 280 ft (8 to 85 m) above the Point Lookout Sandstone comprise the Menefee Cleary coal zone. 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.

The Menefee Allison coal zone contains up to five beds which cover a stratigraphic interval of about 700 ft (213 m) in the middle and upper parts of the member. The Menefee Allison No. 3 coal bed is stratigraphically the highest identified coal bed in the Whitehorse Rincon quadrangle which occurs near the top of the Allison Member. Up to three beds which occur near the base of the Cliff House Sandstone comprise the Cliff House coal zone.

There are no published coal quality analyses for coal beds from the Whitehorse Rincon quadrangle. Analyses of four Allison Member coal samples, one from an outcrop sample and three from a core test hole, 5 and 10 mi (8 and 16 km), respectively, east of the quadrangle have been reported by Dane (1936) and Shomaker and Whyte (1977), and are shown in table 1. The Allison Member beds analyzed are probably similar in quality to the Allison Member and Cleary Coal Member beds in this quadrangle. Rank of the Cleary Coal Member and Allison Member seams is probably high volatile C bituminous in this area. The outcrop sample reported by Dane (1936) was weathered and lower in heating value than other more representative coals of this area.

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

(Samples 1, 2, and 3 from core test hole in NE¼ NE¼ NE¼ Sec. 11, T. 18 N., R. 5 W.; sample 4 from outcrop in Sec. 19, T. 18 N., R. 5 W.)

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

Samples 1, 2, and 3 from Shomaker and Whyte, 1977

Sample 4 from Dane, 1936

Sample	Form of Analysis	Proximate analysis (percent)				Sulfur	Heating Value (Btu/lb)
		Moisture	Volatile matter	Fixed Carbon	Ash		
1	A	12.0	34.1	39.9	14.0	0.3	10,410
	B	----	38.7	45.4	15.9	0.4	11,830
	C	----	46.1	53.9	----	0.5	14,070
2	A	13.0	34.7	33.8	18.5	0.3	9,550
	B	----	39.8	39.0	21.2	0.4	10,980
	C	----	50.6	49.4	----	0.5	13,940
3	A	11.0	34.4	35.1	19.5	0.4	9,800
	B	----	38.7	39.4	21.9	0.5	11,020
	C	----	49.5	50.5	----	0.6	14,100
4	A	13.6	36.2	42.6	7.6	1.1	8,660
	B	----	41.9	49.3	8.8	1.3	10,030
	C	----	45.9	54.1	----	1.4	10,990

Remarks:
A moist, mineral-matter-free (MMMF) calculation using the Parr formula (American Society for Testing and Materials, 1973), yields heating values of 12,270 Btu/lb (28,540 kJ/kg; sample 1), 11,940 Btu/lb (27,772 kJ/kg; sample 2), 12,432 Btu/lb (28,917 kJ/kg; sample 3) and 9,437 Btu/lb (21,950 kJ/kg; sample 4). No agglomerating characteristics were included with the analyses.

Menefee Allison No. 3 coal bed

The Menefee Allison No. 3 coal bed was identified in one oil and gas well log and four outcrop measured sections. Thickness of the bed ranges from 1.2 to 5.5 ft (0.4 to 1.7 m). Menefee Allison No. 3 coal data from a drill hole immediately north of the Whitehorse Rincon quadrangle were used to infer the bed to thicken to 5.0 ft (1.5 m) along the northern quadrangle boundary. The bed is inferred to pinch out between a 1.2 ft (0.4 m) outcrop measurement and the 5.0 ft (1.5 m) thickness in the oil and gas well (see plate 4). Existence and character of the Menefee Allison No. 3 coal bed are unknown in the southern part of the quadrangle because of insufficient data.

Menefee Cleary No. 4 coal bed

The Menefee Cleary No. 4 coal bed was identified only in the subsurface in this quadrangle, and ranges in thickness from 5.0 to 6.0 ft (1.5 to 1.8 m). The bed is inferred to thicken to 7.0 ft (2.1 m) in the central part of the quadrangle (see plate 7). Existence and character of the Menefee Cleary No. 4 coal bed are unknown in the northwest and southeast parts of the quadrangle because of insufficient data.

Menefee Cleary No. 3 coal bed

The Menefee Cleary No. 3 coal bed was identified in all three of the drill holes in this quadrangle, and is shown to be split into two separate benches. The isopach map (plate 10) is based on the lower bench, and the

upper bench was disregarded for map construction. In data point #4 (see plate 3), the lower bench is absent and the bed is inferred to pinch out in the southwestern part of the quadrangle (plate 10). Existence and character of the Menefee Cleary No. 3 coal bed are unknown in the northwest and southeast parts of the quadrangle because of insufficient data.

Menefee Cleary No. 2 coal bed

The Menefee Cleary No. 2 coal bed was identified in all three of the drill holes in this quadrangle. Thickness of the bed ranges from 2.0 to 5.0 ft (0.8 to 1.5 m). The bed is inferred to pinch out in the southwest corner of the quadrangle (see plate 13). Existence and character of the Menefee Cleary No. 2 coal bed are unknown in the northwest and southeast parts of the quadrangle because of insufficient data.

Menefee Cleary No. 1 coal bed

The Menefee Cleary No. 1 was identified in all three of the drill holes in this quadrangle, and ranges in thickness from 2.0 to 7.0 ft (0.6 to 2.1 m). The bed is inferred to thicken to 4.0 ft (1.2 m) in the northeast corner of the quadrangle based on Menefee Cleary No. 1 coal data from the eastern adjacent Rincon Marquez quadrangle. Existence and character of the Menefee Cleary No. 1 coal bed are unknown in the northwest and southeast parts of the quadrangle because of insufficient data.

COAL RESOURCES

The U. S. Geological Survey requested resource evaluations of the Menefee Cleary No. 1, No. 2, No. 3, and No. 4 coal beds, and the Menefee Allison No. 3 coal bed, 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 and hypothetical resource categories. Reserve base was calculated for each category, by section, using data from the isopach (plates 4, 7, 10, 13, and 16) and overburden (plates 6, 9, 12, 15, and 18) maps. 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 that category. Coal beds with 3.0 ft (0.9 m) 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 recovery factors of 85 percent and 50 percent for coal beds 0 to 200 ft (0 to 61 m) and 200 to 3,000 ft (61 to 914 m) deep, respectively. All reserve base and reserve values are rounded to the nearest 10,000 short tons (9,072 t).

Total reserve base data, which include all reserve base categories, are shown by section on plate 2. Reserve base and reserve data in the various categories are shown on plates 19-23.

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 stripping 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 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. Areas which have a correlative coal bed 3.0 ft (0.9 m) or more thick with surface mining potential are assigned a high, moderate or low development potential based on the mining ratio (cubic yards of overburden per short ton of recoverable coal). The formula used to calculate mining ratios is:

$$MR = \frac{t_o\ (C)}{t_c\ (Rf)}$$

Where MR = Mining ratio

t_o = Thickness of overburden in feet

t_c = Thickness of coal in feet

Rf = Recovery factor

C = Volume-weight conversion factor

(.896 yd^3/short ton for bituminous coal)

(.911 yd^3/short ton for subbituminous coal)

High, moderate, and low development potential areas have respective surface mining ratio values of 0 to 10, 10 to 15, and greater than 15.

Any area underlain by a potentially coal-bearing formation with 200 to 3,000 ft (61 to 914 m) of overburden has 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).

The no and unknown development potential boundaries for surface mining methods (plate 24) are defined at the contact of the coal-bearing Menefee Formation and Cliff House Sandstone with the underlying noncoal-bearing Point Lookout Sandstone and overlying noncoal-bearing Lewis Shale. These contacts are approximated due to the inaccuracies of adjusting old geologic maps to modern topographic bases.

Boundaries of coal development potential areas coincide with the boundaries of the smallest legal land division (40 acre 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) in the various development potential categories for surface and subsurface mining methods are shown in tables 2 and 3, respectively.

The coal development potential maps are 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

The coal development potential for surface mining methods in the Whitehorse Rincon quadrangle is shown on plate 24. Based on coal development criteria, all Federal coal lands in the quadrangle have moderate, low, unknown or no development potential for surface mining methods. Refer to table 4 for reserves and planimetered acreage, by section, for Federal coal lands with surface mining potential.

Development potential for subsurface mining methods and in situ gasification

The coal development potential for subsurface mining methods in the Whitehorse Rincon quadrangle is shown on plate 25. Based on coal development criteria, all Federal coal lands have high, moderate, low or unknown development potential for subsurface mining methods. Refer to table 5 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 surface mining methods for Federal coal lands in the Whitehorse Rincon quadrangle, McKinley County, New Mexico.

[Development potentials are based on mining ratios (cubic yards of overburden per ton of underlying coal). To convert short tons to metric tonnes, multiply by 0.9072; to convert mining ratios in yds^3/ton coal to m^3/ton, multiply by 0.842].

Coal Bed	High Development Potential (0-10 mining ratio)	Moderate Development Potential (10-15 mining ratio)	Low Development Potential (greater than 15 mining ratio)	Total
Menefee Allison No. 3	---	40,000	20,000	60,000
Total	---	40,000	20,000	60,000

Table 3. - Reserve base data (in short tons) including hypothetical resources for subsurface mining methods for Federal coal lands in the Whitehorse Rincon quadrangle, McKinley County, 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 Allison No. 3	1,480,000	---	---	1,480,000
Menefee Cleary No. 4	----	63,820,000	200,000	64,020,000
Menefee Cleary No. 3	----	32,210,000	4,710,000	36,920,000
Menefee Cleary No. 2	----	31,920,000	310,000	32,230,000
Menefee Cleary No. 1	----	47,400,000	4,530,000	51,930,000
Total	1,480,000	175,350,000	9,750,000	186,580,000
Hypothetical Resources				
Menefee Cleary No. 4	----	8,930,000	---	8,930,000
Menefee Cleary No. 3	----	1,200,000	1,440,000	2,640,000
Menefee Cleary No. 2	----	4,580,000	70,000	4,650,000
Menefee Cleary No. 1	----	6,720,000	1,110,000	7,830,000
Total	----	21,430,000	2,620,000	24,050,000

Table 4. - Reserves and planimetered acreage, by section, for Federal coal lands in the Whitehorse Rincon quadrangle with surface mining potential.

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

Potential category	Coal bed	Sec.	T.	N.	R.	W.	Acres (planimetered)	Reserves (in short tons)
Moderate	Menefee Allison No. 3	6	18		7		5.4	30,000
Low	Menefee Allison No. 3	6	18		7		2.7	10,000

Table 5. - Reserves and planimetered acreage, by section, for Federal coal lands in the Whitehorse Rincon quadrangle with subsurface mining potential.

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

Potential category	Coal bed	Sec.	T. N.	R. W.	Acres (planimetered)	Reserves (in short tons)
High	Menefee Allison No. 3	20	19	6	28.4	80,000
		15	19	7	124.4	470,000
		22			25.7	80,000
		24			14.9	40,000
		26			24.4	70,000
Moderate	Menefee Cleary No. 4	7	18	6	384.3	2,210,000
		18			515.5	2,830,000
		17			54.1	270,000
		13	18	7	487.1	2,970,000
		12			160.0	980,000
		14			261.1	1,690,000
		6			136.7	790,000
		7			419.4	2,150,000
		8			318.0	1,830,000
		9			477.6	3,040,000
		17			639.9	3,310,000
		18			516.8	2,280,000
		22	19	7	13.5	70,000
		24			631.9	2,240,000
		26			631.9	3,130,000
		27			385.6	1,980,000
		28			16.2	90,000
		20	19	6	20.3	60,000

Table 5. - Reserves and planimetered acreage, by section, for Federal coal lands in the Whitehorse Rincon quadrangle with subsurface mining potential (continued).

Potential category	Coal bed	Sec.	T. N.	R. W.	Acres (planimetered)	Reserves (in short tons)
Moderate	Menefee Cleary No. 3	7	18	6	351.8	1,930,000
		17			54.1	240,000
		18			515.5	2,140,000
		12	18	7	158.3	880,000
		13			484.4	1,670,000
		14			181.3	530,000
		9			58.2	160,000
		20	19	6	4.1	10,000
		24	19	7	392.4	1,840,000
		26			619.7	5,050,000
		22			13.5	90,000
		27			223.2	1,480,000
		28			12.2	80,000
	Menefee Cleary No. 2	7	18	6	323.4	920,000
		17			54.1	150,000
		18			515.5	1,600,000
		12	18	7	160.0	470,000
		13			487.1	1,680,000
		14			261.1	1,040,000
		6			136.7	470,000
		7			419.4	1,710,000
		8			318.0	1,430,000
		9			477.6	2,030,000
		17			639.9	3,000,000
		18			369.3	1,470,000
	Menefee Cleary No. 1	7	18	6	323.4	1,570,000
		17			54.1	260,000
		18			515.5	2,550,000
		12	18	7	160.0	790,000
		13			487.1	2,540,000
		14			261.1	1,480,000

Table 5. - Reserves and planimetered acreage, by section, for Federal coal lands in the Whitehorse Rincon quadrangle with subsurface mining potential (continued).

Potential category	Coal bed	Sec.	T. N.	R. W.	Acres (planimetered)	Reserves (in short tons)
Moderate	Menefee Cleary No. 1	6	18	7	136.7	580,000
		7			419.4	1,860,000
		8			318.0	1,830,000
		9			477.6	2,750,000
		17			639.9	4,010,000
		18			516.8	2,300,000
		24	19	7	3.1	10,000
		22			12.0	30,000
		26			200.2	660,000
		27			124.5	420,000
		28			10.8	40,000
		20	19	6	2.7	10,000
Low	Menefee Cleary No. 4	7	18	6	9.5	50,000
		26	19	7	9.5	50,000
	Menefee Cleary No. 3	7	18	6	43.3	250,000
		24	19	7	178.6	840,000
		26			21.6	160,000
		27			162.4	1,080,000
		28			4.1	30,000
	Menefee Cleary No. 2	7	18	6	54.1	150,000
	Menefee Cleary No. 1	7	18	6	54.1	260,000
		24	19	7	281.4	820,000
		22			3.0	10,000
		27			211.1	690,000
		28			5.4	20,000
		20	19	6	148.8	460,000

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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 forseeable 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.
