UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

TEXT TO ACCOMPANY:

COAL RESOURCE OCCURRENCE

AND

COAL DEVELOPMENT POTENTIAL

MAPS

OF THE

NORTHEAST QUARTER OF SAVAGETON 15' QUADRANGLE,

CAMPBELL COUNTY, WYOMING

BY

INTRASEARCH INC.

DENVER, COLORADO

OPEN FILE REPORT 79-058
1979

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CONVERSION TABLE

TO CONVERT	MULTIPLY BY	TO OBTAIN
inches	2.54	centimeters (cm)
feet	0.3048	meters (m)
miles	1.609	kilometers (km)
acres	0.40469	hectares (ha)
tons (short)	0.9072	metric tons (t)
cubic yards/ton	0.8428	cubic meters per metric tons
acre feet	0.12335	hectare-meters
Btu/lb	2.326	kilojoules/kilogram (kJ/kg)
Btu/lb	0.55556	kilocalories/kilogram (kcal/kg)
Fahrenheit	5/9 (F-32)	Celsius

I. Introduction

This report and accompanying maps set forth the Coal Resource Occurrence (CRO) and Coal Development Potential (CDP) of coal beds within the Northeast Quarter of Savageton 15' Quadrangle, Campbell County, Wyoming. This CRO and CDP map series (U. S. Geological Survey Open-File Report 79-058) includes 30 plates. The project is compiled by Intra-Search Inc., 5351 South Roslyn Street, Englewood, Colorado, under KRCRA Eastern Powder River Basin, Wyoming Contract Number 14-08-0001-17180. This contract is part of a program to provide an inventory of unleased federal coal in Known Recoverable Coal Resource Areas (KRCRAs) in the western United States.

The Northeast Quarter of Savageton 15' Quadrangle is located in Campbell County, in northeastern Wyoming. It encompasses all or parts of Townships 45, 46, and 47 North, Ranges 74 and 75 West, and covers the area: 43°52'30" to 44°00' north latitude; 105°45' to 105°52'30" west longitude.

Main access to the Northeast Quarter of Savageton 15' Quadrangle is provided by Wyoming State Highway 50 which extends northeast to southwest across the southeast quarter of the study area. A maintained gravel road angles southwest to northeast across the central portion of the quadrangle, intersecting Wyoming State Highway 50 approximately 2 miles (3.2 km) to the east. Two maintained gravel roads branch from this road and provide access through the northwest and southwest quarters of the study area. Minor roads and trails that branch from Wyoming State Highway 50 and these gravel roads provide access to the more remote areas. The closest railroad is the Burlington Northern trackage, 17 miles (27 km) to the east near the Cordero coal mine.

Drainage patterns generate from the moderate relief of the Wild Horse Slope region which extends northeast to southwest across the eastern half of the quadrangle. Elevations attain heights of 5200 feet (1585 m) above sealevel in this area, 400 to 500 feet (122 to 152 m) above the valley floors to the west. The significant drainage to the east of the Wild Horse Slope region is provided by the North, Middle and South Prongs of Wild Horse Creek. Wild Horse Creek flows eastward draining into the Belle Fourche River, 8 miles (13 km) to the east. The major drainage to the west of the Wild Horse Slope region is provided by North Prong and Middle Prong of Pumpkin Creek and by Beaver Creek. These creeks drain the northwest, southwest and northeast quarters of the quadrangle. Pumpkin Creek and Beaver Creek join the Powder River to the west.

The 13 to 14 inches (33 to 36 cm) of annual precipitation falling in this semi-arid region accrue principally in the springtime. Summer and fall precipitation usually originates from thunderstorms, and infrequent snowfalls of 6 inches (15 cm) or less generally characterize winter precipitation. Although temperatures ranging from less than -25°F (-32°C) to more than 100°F (38°C) have been recorded near Gillette, Wyoming, average wintertime minimums and summertime maximums range from +5° to +°15F (-15° to -9°C) and 75° to 90°F (24° to 32°C), respectively.

Surface ownership is divided among fee, state, and federal categories with the state and federal surface generally leased to ranchers for grazing purposes. Details of surface ownership are available at the Campbell County Courthouse in Gillette, Wyoming. Details of mineral ownership on federal lands are available from the U. S. Bureau of Land Management in Cheyenne, Wyoming. Federal coal ownership is shown on Plate 2 of the Coal Resource Occurrence maps. The non-federal coal ownership comprises both fee and state coal resources.

The Coal Resource Occurrence and Coal Development Potential program pertains to unleased federal coal and focuses upon the delineation of lignite, subbituminous coal, bituminous coal, and anthracite at the surface, and in the subsurface. In addition, the program identifies total tons of coal in place, as well as recoverable tons. These coal tonnages are then categorized into units of measured, indicated, and inferred reserves and resources, and hypothetical resources. Finally, recommendations are made regarding the potential for surface mining, underground mining, and in-situ gasification of the coal beds. This report evaluates the coal resources of all unleased federal coal beds in the quadrangle which are 5 feet (1.5 m) or greater in thickness and occur at depths down to 3000 feet (914 m). No resources or reserves are computed for leased federal coal, state coal, fee coal, or lands encompassed by coal prospecting permits and preference-right lease applications.

Surface and subsurface geological and engineering extrapolations drawn from the current data base suggest the occurrence of approximately 8.6 billion tons (7.8 billion metric tons) of unleased federal coal resources in the Northeast Quarter of Savageton 15' Quadrangle.

The suite of maps that accompany this report sets forth and portrays the coal resource and reserve occurrence in considerable detail. For the most part, this report supplements the cartographically displayed information with minimum verbal duplication of the CRO-CDP map data.

II. Geology

Regional. The thick, economic coal deposits of the Powder River Basin in northeastern Wyoming occur mostly in the Tongue River Member of the Fort Union Formation, and in the lower part of the Wasatch Formation. Approximately 3000 feet (914 m) of the Fort Union Formation,

including the Tongue River, Lebo, and Tullock Members of Paleocene age, are unconformably overlain by approximately 700 feet (213 m) of the Wasatch Formation of Eocene age. These Tertiary formations lie in a structural basin flanked on the east by the Black Hills uplift, on the south by the Hartville and Casper Mountain uplifts, and on the west by the Casper Arch and the Big Horn Mountain uplift. The structural configuration of the Powder River Basin originated in Late Cretaceous time, with episodic uplift thereafter. The Cretaceous Cordillera was the dominant positive land form throughout the Rocky Mountain area at the close of Mesozoic time.

Outcrops of the Wasatch Formation and the Tongue River Member of the Fort Union Formation cover most of the areas of major coal resource occurrence in the Powder River Basin. The Tongue River Member is composed of very fine-grained sandstones, siltstones, claystones, shales, carbonaceous shales, and numerous coal beds. The Lebo Member of the Fort Union Formation consists of light- to dark-gray very fine-grained to conglomeratic sandstone with interbedded siltstone, claystone, carbonaceous shale and thin coal beds. Thin bedded calcareous ironstone concretions interbedded with massive white sandstone and slightly bentonitic shale occur throughout the unit. The Lebo Member is mapped at the surface northeast of Recluse, Wyoming. Here, the Lebo Member is east of the principal coal outcrops and associated clinkers (McKay, 1974), and it presumably projects into the subsurface beneath much of the basin. One of the principal characteristics for separating the Lebo and Tullock Members (collectively referred to as the Ludlow Member east of Miles City, Montana) from the overlying Tongue River Member is the color differential between the lighter-colored upper

portion and the somewhat darker lower portion (Brown, 1958). Although geologists are trying to develop criteria for subsurface recognition of the Lebo-Tullock and Tongue River-Lebo contacts through the use of subsurface data from geophysical logs, no definitive guidelines are known to have been published. Hence, for subsurface mapping purposes, the Fort Union Formation is not divided into its members for this study.

During the Paleocene epoch, the Powder River Basin tropical to subtropical depositional environment included broad, inland flood basins with extensive swamps, marshes, freshwater lakes, and a sluggish, but active, northeastward-discharging drainage system. These features were superimposed on an emerging sea floor, near base level. Much of the vast area where organic debris collected was within a reducing depositional environment. Localized uplifts began to disturb the near sea-level terrain of northeastern Wyoming following retreat of the Cretaceous seas. However, the extremely fine-grained characteristics of the Tongue River Member clastics suggest that areas of recurring uplift peripheral to the Powder River Basin were subdued during major coal deposit formation.

The uplift of areas surrounding the Powder River Basin created a structural basin of asymmetric character, with the steep west flank located on the eastern edge of the Big Horn Mountains. The axis of the Powder River Basin is difficult to specifically define, but it is thought to be located in the western part of the Basin and to display a north-south configuration some 15 to 20 miles (24 to 32 km) east of Sheridan, Wyoming. Thus, the sedimentary section described in this report lies on the east flank of the Powder River Basin, with gentle dips of two degrees or less disrupted by surface structure thought to

relate to tectonic adjustment and differential compaction.

Some coal beds in the Powder River Basin exceed 200 feet (61 m) in thickness. Deposition of these thick, in-situ coal beds requires a delicate balance between subsidence of the earth's crust and in-filling by trememdous volumes of organic debris. These conditions in concert with a favorable ground water table, non-oxidizing clear water, and a climate amenable to the luxuriant growth of vegetation produce a stabilized swamp critical to the deposition of coal beds.

Deposition of the unusually thick coal beds of the Powder River Basin may be partially attributable to short-distance water transportation of organic detritus into areas of crustal subsidence. Variations in coal bed thickness throughout the basin relate to changes in the depositional environment. Drill hole data that indicate either the complete absence or extreme attenuation of a thick coal bed probably relate to location of the drill holes within the ancient stream channel system draining this lowland area in Early Cenozoic time. Where thick coal beds thin rapidly from the depocenter of a favorable depositional environment, it is not unusual to encounter a synclinal structure over the maximum coal thickness due to the differential compaction between organic debris in the coal depocenter and fine-grained clastics in the adjacent areas.

The Wasatch Formation of Eocene age crops out over most of the central part of the Powder River Basin and exhibits a disconformable contact with the underlying Fort Union Formation. The contact has been placed at various horizons by different workers; however, for the purpose of this report, the contact is positioned near the top of the Roland coal bed as mapped by Olive (1957) in northwestern Campbell

County, Wyoming, and it is considered to descend disconformably in the stratigraphic column to the top of the Wyodak-Anderson coal bed (Roland coal bed of Taff, 1909) along the eastern boundary of the coal measures. No attempt was made to differentiate the Wasatch and Fort Union Formations on geophysical logs or in the subsurface mapping program for this project.

Although Wasatch and Fort Union lithologies are too similar to allow differentiation in some areas, most of the thicker coal beds occur in the Fort Union section on the east flank of the Powder River Basin. Furthermore, orogenic movements peripheral to the basin apparently increased in magnitude during Wasatch time causing the deposition of friable, coarse-grained to gritty, arkosic sandstones, fine- to very fine-grained sandstones, siltstones, mudstones, claystones, brown-to-black carbonaceous shales, and coal beds. These sediments are noticeably to imperceptibly coarser than the underlying Fort Union clastics.

The Northeast Quarter of Savageton 15' Quadrangle is located in an area where surface rocks are classified within the Wasatch Formation. Olive (1957) correlated coal beds in the Spotted Horse coal field with coal beds in the Sheridan coal field (Baker, 1929) and Gillette coal field (Dobbin and Barnett, 1927), Wyoming, and with coal beds in the Ashland coal field (Bass, 1932) in southeastern Montana. This report utilizes, where possible, the coal bed nomenclature used in previous reports. The Felix coal bed was named by Stone and Lupton (1910). The Smith coal bed was named by Taff (1909). Baker (1929) assigned names to the Anderson, Canyon, and Wall coal beds. The Cook coal bed was named by Bass (1932), and the Pawnee coal bed was named by Warren (1959).

IntraSearch's correlation of thick coal beds from the Spotted Horse coal field to Gillette points out that the Wyodak coal bed, named the "D" coal bed by Dobbin and Barnett (1927), is equivalent to the Anderson, Canyon and all, or part, of the Cook coal beds to the north and west

of Gillette, Wyoming. Correlation of this suite of coal beds with the Wyodak coal bed, south and southwest of Gillette, suggest that the Anderson and Canyon coal beds equate with the upper 10 to 25 percent of the thick Wyodak coal bed, and the Cook and Wall, or Upper Wall, coal beds are equivalent to the major part of the Wyodak coal bed. Due to problematic correlations outside of the Gillette area, the name Wyodak has been informally used by many previous authors to represent the coal beds in the area surrounding the Wyodak coal mine. The name Wyodak is used in the Northeast Quarter of Savageton 15' Quadrangle, to the west in the adjacent Fats Draw Quadrangle, to the south in the Savageton Quadrangle, and in the Northeast Quarter of North Star School Quadrangle to the east. the Anderson-Canyon-Cook nomenclature is used in the Double Tanks Quadrangle, which borders the Northeast Quarter of Savageton 15' Quadrangle to the north. The Wildcat, Moyer, and Oedekoven coal beds were informally named by IntraSearch (1978b, 1979, and 1978a).

Local. The Northeast Quarter of Savageton 15' Quadrangle lies on the eastern flank of the Powder River Basin where the strata dip gently westward. The Wasatch Formation crops out over the entire quadrangle, and is comprised of friable, coarse-grained to gritty, arkosic sandstones, fine- to very fine-grained sandstones, siltstones, mudstones, claystones, brown-to-black carbonaceous shales, and coal beds.

The Fort Union Formation unconformably underlies the Wasatch Formation and is composed of very fine-grained sandstones, ciltstones, claystones, shales, carbonaceous shales, and numerous coal beds.

No significant coal outcrops or associated clinker is mentioned regarding the Northeast Quarter of Savageton 15' Quadrangle in any known publication at the time of this report. It is speculated, and highly possible, that no significant coal outcrops exist within the quadrangle.

III. Data Sources

Geophysical logs from oil and gas test bores and producing wells comprise the source of subsurface control. Some geophysical logs are not applicable to this study, for the logs relate only to the deep, potentially productive oil and gas zones. More than 80 percent of the logs include resistivity, conductivity, and self-potential curves. Occasionally the suite of geophysical logs includes gamma, density, and sonic curves. These logs are available from several commercial sources.

All geophysical logs available in the quadrangle are scanned to select those with data applicable to Coal Resource Occurrence mapping. Paper copies of the logs are obtained and interpreted, and coal intervals are annotated. Maximum accuracy of coal bed indentification is accomplished where gamma, density, and resistivity curves are available. Coal bed tops and bottoms are picked on the logs at the midpoint between the minimum and maximum curve deflections. The correlation of coal beds within and between quadrangles is achieved utilizing a fence diagram to associate local correlations with regional coal occurrences.

The reliability of correlations, set forth by IntraSearch in this report, varies depending on: the density and quality of lithologic and geophysical logs; the detail, thoroughness, and accuracy of published and unpublished surface geological maps; and interpretative proficiency. There is no intent on the part of IntraSearch to refute nomenclature established in the literature or used locally by workers in the area. IntraSearch's nomenclature focuses upon the suggestion of regional coal bed names applicable throughout the eastern Powder River Basin. It is expected, and entirely reasonable, that some differences of opinion regarding correlations, as suggested by IntraSearch, exist. Additional drilling for coal, oil, gas, water, and uranium, coupled with

expanded mapping of coal bed outcrops and associated clinkers will broaden the data base for coal bed correlations and allow continued improvement in the understanding of coal bed occurrences in the eastern Powder River Basin.

The topographic map of the Savageton 15' Quadrangle is published by the U. S. Geological Survey, compilation date 1971. Land network and mineral ownership data are compiled from land plats available from the U. S. Bureau of Land Management in Cheyenne, Wyoming. This information is current to October 13, 1977.

IV. Coal Bed Occurrence

Wasatch and Fort Union coal beds that are present in all or part of the Northeast Quarter of Savageton 15' Quadrangle include in descending stratigraphic order, the Felix, Smith, Upper Wyodak, Middle Wyodak, Lower Wyodak, Pawnee, upper Wildcat, Lower Wildcat, Moyer and Oedekoven. A complete suite of maps (structure, coal isopach, mining ratio where needed, overburden/interburden isopach, identified resources, and areal distribution of identified resources) is prepared for the Upper Wyodak and Middle Wyodak coal beds, and for the Felix, Smith, Lower Wyodak and the Pawnee-Wildcat-Moyer-Oedekoven coal zones.

No physical and chemical analyses are known to have been published regarding the coal beds in the Savageton 15' Quadrangle, However, the proximate analysis performed on a general "as received" basis for Campbell County coal beds are as follows:

COAL BED NAME		ASH %	FIXED CARBON %	MOISTURE %	VOLATILES %	SULFUR %	BTU/LB
Felix (U)	Hole 7324	6.993	35.200	25.010	32.798	0.629	8544
Smith (U)	Hole 7312C	6.167	33.340	29.610	30.883	1.068	8215
Wyodak (U)	Hole 755	4.438	35.522	27.405	32.719	0.207	8568
Pawnee (U)	Hole 7424	7.880	31.029	31.910	29.183	0.386	7344

(U) - U. S. Geological Survey & Montana Bureau of Mines & Geology-1974, 1976a, 1976b

The Coal Data Sheet, Plate 3, shows the downhole identification of coal beds within the quadrangle as interpreted from geophysical logs, from oil and gas test bores, and producing sites. A datum coal bed is utilized to position columnar sections on Plate 3. This portrayal is schematic by design; hence, no structural or coal thickness implications are suggested by the dashed correlation lines projected through no record (NR) intervals. Inasmuch as the Upper Wyodak coal bed underlies the entire quadrangle, it is designated as datum for the correlation diagram. The Upper Wyodak coal bed and the Lower Wyodak coal zone show the thickest coal bed occurrences throughout the quadrangle. The Felix, Smith, Pawnee, Wildcat, Moyer and Oedekoven coal beds are relatively thin throughout most of the area.

The Felix coal zone lies approximately 90 to 550 feet (27 to 168 m) beneath the surface throughout the quadrangle and is composed of several thin coal beds. The composite thickness for the coal zone ranges from 4 to 33 feet (1.2 to 10 m) with maximum thicknesses occurring in the northeast quarter, thinning to the south and west. Individually the coal beds comprising the Felix coal zone seldom exceed 10 feet (3 m) in thickness. The total clastic interval separating the various coal beds comprising the coal zone varies from 41 to 176 feet (13 to 54 m). Structure contours drawn on top of the Felix coal zone depict a broad northward-plunging anticline extending across the eastern half of the quadrangle. A smaller northward-plunging syncline extends through the western half of the study area. The overburden above the Felix coal bed varies in thickness from less than 100 feet (30 m) to more than 500 feet (152 m). The Felix coal zone lies less than 500 feet (152 m) in depth beneath the surface throughout 98 percent of the quadrangle.

The Smith coal zone occurs approximately 270 to 416 feet (82 to 127 m) beneath the overlying Felix coal zone and is composed primarily of three thin coal beds. The total coal zone thickness ranges from 3 to 18 feet (0.9 to 5 m) with maximum thicknesses occurring in the northern half of the quadrangle, significantly thinning to the south. The clastic interval separating the coal beds comprising the coal zone varies from 0 to 94 feet (0 to 29 m). Structure contours drawn on top of the Smith coal zone indicate two small, northwest-plunging anticlines extending across the northern half of the quadrangle from the east. The southern half of the quadrangle dips gently to the north. Less than 750 feet (229 m) to more than 1000 feet (305 m) of overburden overlies the Smith coal bed.

The Upper Wyodak coal bed lies approximately 152 to 398 feet (46 to 121 m) below the Smith coal zone, and ranges in thickness from 55 to 90 feet (17 to 27 m). Maximum thicknesses occur in the west-central area of the quadrangle and generally thin to the east. Structure contours drawn on top of the Upper Wyodak coal bed indicate an anticlinal high in the northeast quarter of the quadrangle and a synclinal low in the northwest quarter. The Upper Wyodak coal bed in the southern half of the quadrangle dips gently to the northwest. The Upper Wyodak coal bed lies less than 1000 feet (305 m) to more than 1250 feet (381 m) beneath the surface.

The Middle Wyodak coal bed has an extremely localized occurrence within the quadrangle, and is mapped on three 8 1/2 x 11 inch sheets (Figures 1, 2 and 3). The Middle Wyodak coal bed occurs approximately 70 to 91 feet (21 to 28 m) below the Upper Wyodak coal bed along the east-central boundary of the quadrangle. The coal bed thickness ranges from 0 to 31 feet (0 to 9 m). Structure contours drawn on top of the Middle Wyodak depict a southwest-plunging anticline throughout the area of coal occurrence. The overburden above the Middle Wyodak coal bed is approxi-

mately 1275 to 1400 feet (389 to 427 m) thick.

The Lower Wyodak coal zone occurs approximately 65 to 272 feet (20 to 83 m) beneath the Upper Wyodak coal bed and approximately 100 to 121 feet (31 to 37 m) beneath the localized Middle Wyodak coal bed. It is composed of a thick coal bed overlying several thin coal beds. The total coal zone thickness ranges from 0 to 60 feet (0 to 18 m) with maximum thicknesses located in the northwest quarter of the quadrangle, generally thinning to the southwest. A localized absence of both the thick upper and thin lower coal beds in the northeast quarter accounts for the significant thinning of the coal zone thickness in that area. Structure contours drawn on top of the Lower Wyodak coal zone indicate a northwestward-plunging anticline extending across the southern half of the study area and a synclinal low extending from the north into the northwest quarter. The thickness of overburden above the Lower Wyodak coal zone varies from less than 1250 feet (381 m) to more than 1500 feet (457 m).

The Pawnee-Wildcat-Moyer-Oedekoven coal zone is separated from the Lower Wyodak coal zone by 120 to 634 feet (37 to 193 m) of clastic sediments, and is composed of five thin, lenticular coal beds. The total coal zone thickness ranges from 5 to 40 feet (1.5 to 12 m) with maximum thicknesses occurring in the southeast quarter and along the eastern boundary of the quadrangle, thinning to the west. The Pawnee coal bed shows the thickest single coal bed occurrence for the coal zone, often exceeding 15 feet (5 m). The Wildcat coal beds show a thin, somewhat lenticular coal bed occurrence throughout the quadrangle. The Moyer and Oedekoven coal beds are thin and very lenticular showing a very localized occurrence throughout portions of the study area. The total clastic interval separating the various coal beds comprising the coal zone varies from 0 to 760 feet (0 to 232 m) in thickness. Structure contours drawn on top of the

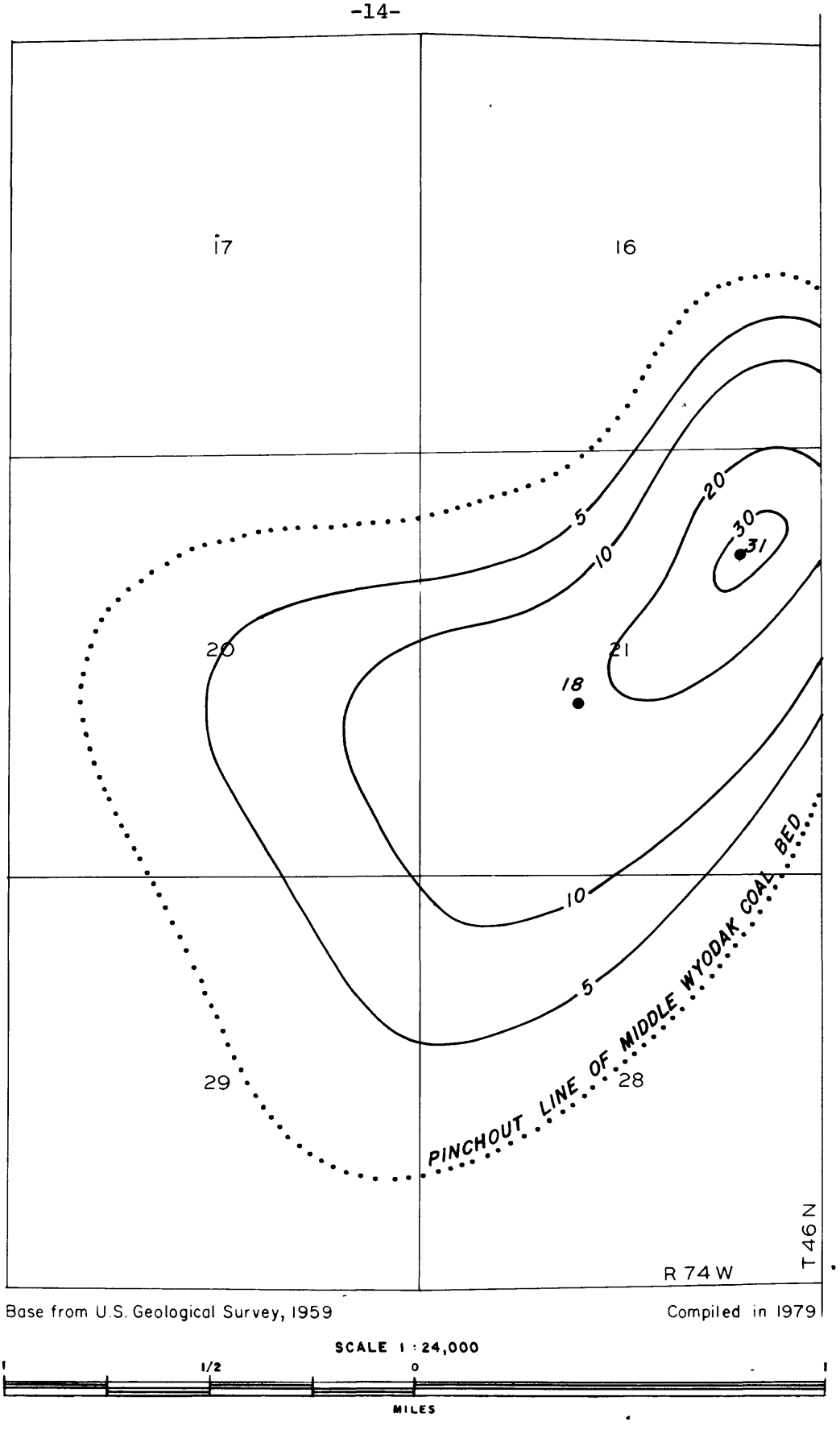
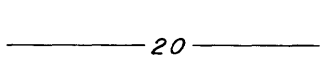


FIGURE 1
ISOPACH MAP
OF MIDDLE WYODAK COAL BED IN
THE NE 1/4 SAVAGETON 15' QUADRANGLE
CAMPBELL COUNTY, WYOMING
(See following page for Explanation)

EXPLANATION FOR FIGURE 1



ISOPACHS OF COAL BED-Showing thickness in feet, interval 10 feet, with intermediate 5 foot contour.

DRILL HOLE-Showing coal thickness in feet.

To convert feet to meters, multiply feet by 0.3048.

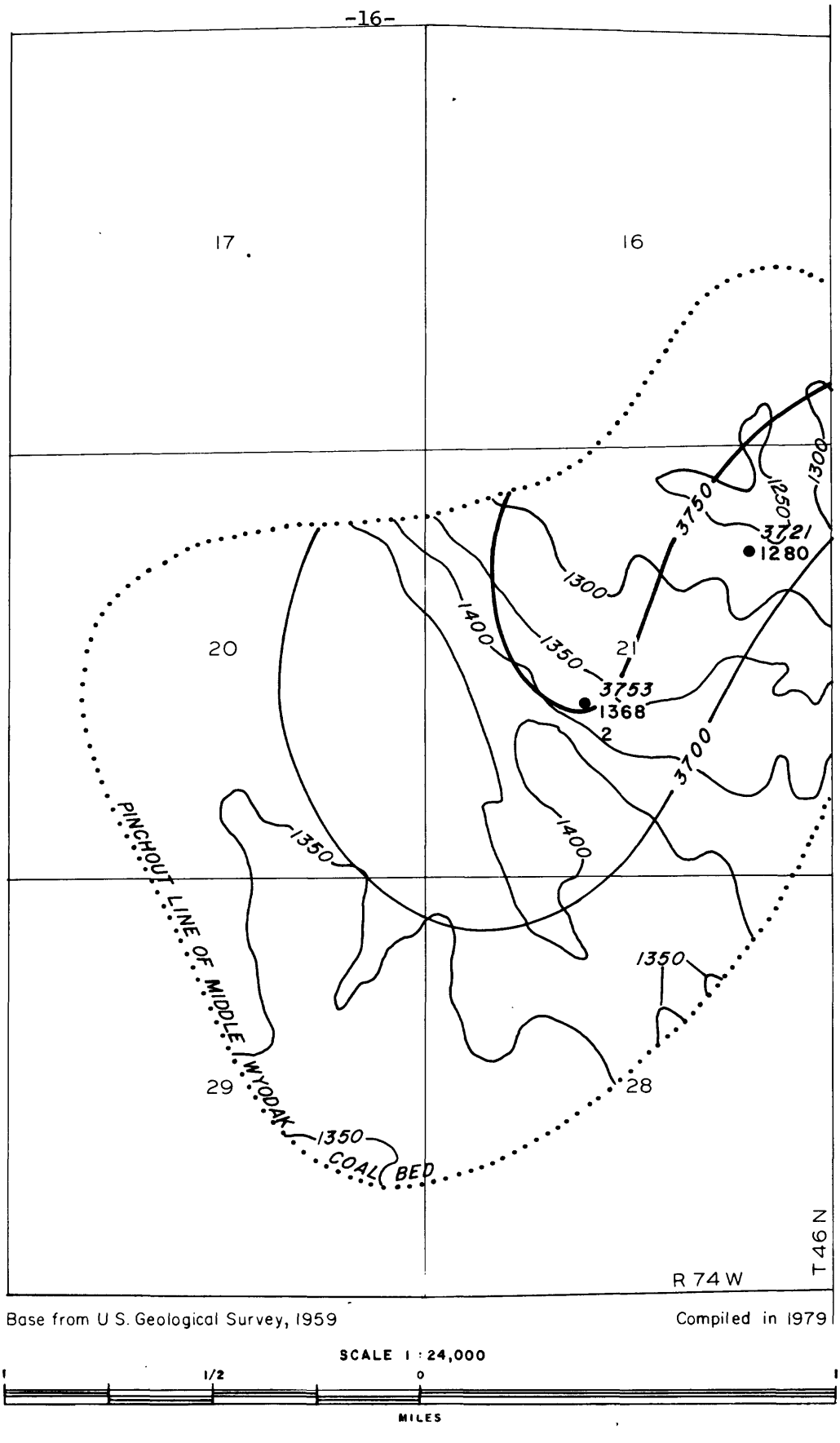


FIGURE 2
STRUCTURE CONTOUR AND ISOPACH OF OVERBURDEN MAP
OF MIDDLE WYODAK COAL BED IN
THE NE 1/4 SAVAGETON 15' QUADRANGLE
CAMPBELL COUNTY, WYOMING
(See following page for Explanation)

EXPLANATION FOR FIGURE 2

3750
3700

STRUCTURE CONTOURS-Drawn on top of coal bed. Contour interval 50 feet. Datum is mean sea level.

1400

OVERBURDEN ISOPACH-Showing thickness of overburden, in feet, from the surface to the top of the coal bed. Isopach interval 50 feet.

3753
1368
2

DRILL HOLE-Slanted number showing elevation at top of coal bed; upper vertical number showing thickness of overburden from the surface to the top of the coal bed, lower vertical number showing interburden thickness between upper and lower splits of the coal bed. Measurements in feet.

To convert feet to meters, multiply feet by 0.3048.

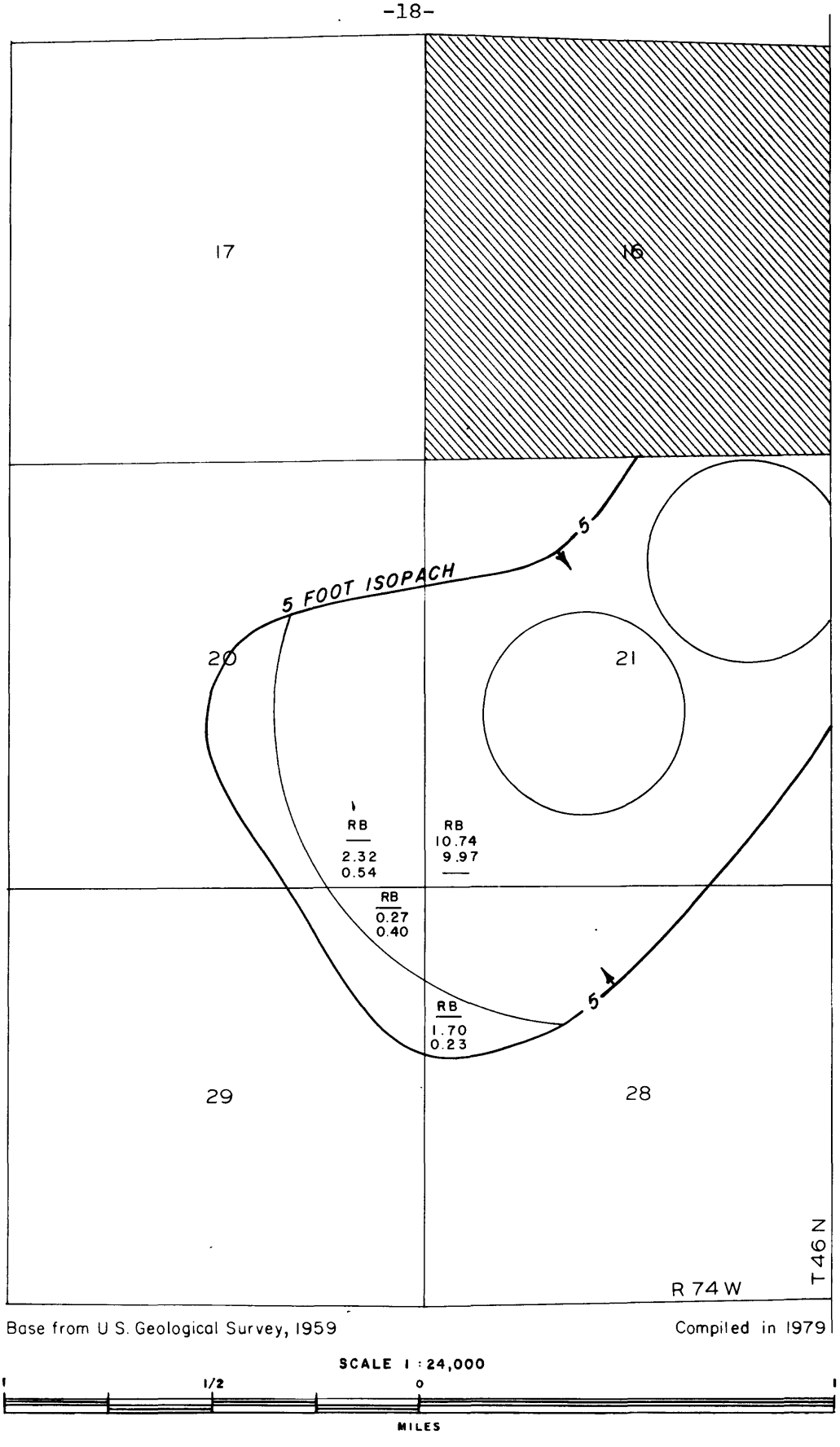
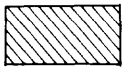
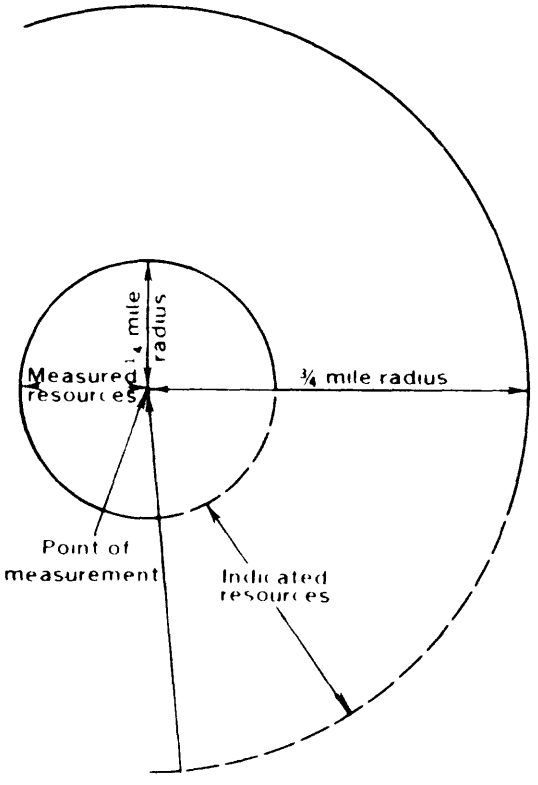


FIGURE 3
AREAL DISTRIBUTION OF IDENTIFIED RESOURCES
AND IDENTIFIED RESOURCES MAP
OF MIDDLE WYODAK COAL BED IN
THE NE 1/4 SAVAGETON 15' QUADRANGLE
CAMPBELL COUNTY, WYOMING
(See following page for Explanation)

EXPLANATION FOR FIGURE 3



NON-FEDERAL COAL LAND-Coal tonnages not evaluated.



BOUNDARY LINES-Enclosing areas of measured, indicated and inferred coal resources of the coal bed. Dashed where projected from adjacent quadrangles.

RB

—— (Measured)
2.32 (Indicated)
0 54 (Inferred)

IDENTIFIED RESOURCES OF COAL BED-In millions of short tons. Dash indicates no resources in that category.

To convert miles to kilometers, multiply miles by 1.609.

To convert short tons to metric tons, multiply short tons by 0.9072.

Pawnee coal bed indicate a gentle regional dip the west with two broad northwest-plunging anticlines occurring in the southwest and and northeast quarters of the quadrangle, respectively. The Pawnee-Wildcat-Moyer-Oedekoven coal zone occurs at depths ranging from less than 1750 feet (533 m) to more than 2000 feet (610 m).

V. Geological and Engineering Mapping Parameters

The correct horizontal location and elevation of drill holes utilized in subsurface mapping are critical to map accuracy. IntraSearch Inc., plots the horizontal location of the drill hole as described on the geophysical log heading. Occasionally this location is superimposed on or near to a drillsite shown on the topographic map, and the topographic map, horizontal location is utilized. If the ground elevation on the geophysical log does not agree with the topographic elevation of the drillsite, the geophysical log ground elevation is adjusted to conformance. If there is no indication of a drillsite on the topographic map, the "quarter, quarter, quarter" heading location is shifted within a small area until the ground elevation on the heading agrees with the topographic map elevation. If no elevation agreement can be reached, the well heading or data sheet is rechecked for footage measurements and ground elevation accuracy. Inquiries to the companies who provided the oil and gas geophysical logs frequently reveal that corrections have been made in the original survey. If all horizontal location data sources have been checked and the information accepted as the best available data, the drillsite elevation on the geophysical log is modified to agree with the topographic map elevation. IntraSearch Inc., considers this agreement mandatory for the proper construction of most subsurface maps, but in particular, the overburden isopach, the mining ratio, and Coal Development Potential maps.

Subsurface mapping is based on geologic data within, and adjacent, to the Northeast Quarter of Savageton 15' Quadrangle area. Data from geophysical logs are used to correlate coal beds and control contour lines for the coal thickness, structure, and overburden maps. Isopach lines are also drawn to honor selected surface measured sections where there is sparse subsurface control. Where isopach contours do not honor surface measured sections, the surface thicknesses are thought to be attenuated by oxidation and/or erosion; hence they are not reflective of total coal thickness. Isopach lines extend to the coal bed outcrops, the projections of coal bed outcrops, and the contact between porcellanite (clinker) and unoxidized coal in place. Attenuation of total coal bed thickness is known to take place near these lines of definition; however, the overestimation of coal bed tonnages that results from this projection of total coal thickness is insignificant to the Coal Development Potential maps. Structure contour maps are constructed on the tops of the main coal beds. Where subsurface data are scarce, supplemental structural control points are selected from the topographic map along coal outcrops.

In preparing overburden isopach maps, no attempt is made to identify coal beds that occur in the overburden to a particular coal bed under study. Mining ratio maps for this quadrangle are constructed utilizing a 95 percent recovery factor. Contours of these maps identify the ratio of cubic yards of overburden to tons of recoverable coal. Where ratio control points are sparse, interpolated points are computed at the intersections of coal bed and overburden isopach contours using coal structure, coal isopach, and topographic control. On the Areal Distribution of Identified Resources Map (ADIR), coal bed reserves are not calculated where the coal is less than 5 feet (1.5 m) thick, where the coal occurs at a depth greater than 500 feet (152 m), where non-

federal coal exists, or where federal coal leases, preference-right lease applications, and coal prospecting permits exist.

Coal tonnage calculations involve the planimetering of areas of measured, indicated, inferred reserves and resources, and hypothetical resources to determine their areal extent in acres. An Insufficient Data Line is drawn to delineate areas where surface and subsurface data are too sparse for CRO map construction. Various categories of resources are calculated in the unmapped areas by utilizing coal bed thicknesses mapped in the geologically controlled area adjacent to the insufficient data line. Acres are multiplied by the average coal bed thickness and 1750, or 1770--the number of tons of lignite A or subbituminous C coal per acre-foot, respectively (12,874 or 13,018 metric tons per hectare-meter, respectively), to determine total tons in place. Recoverable tonnage is calculated at 95 percent of the total tons in place. Where tonnages are computed for the CRO-CDP map series, resources and reserves are expressed in millions of tons. Frequently the planimetering of coal resources on a sectionized basis involves complexly curvilinear lines (coal bed outcrop and 500-foot stripping limit designations) in relationship with linear section boundaries and circular resource category boundaries. Where these relationships occur, generalizations of complexly curvilinear lines are discretely utilized, and resources and/or reserves are calculated within an estimated 2 to 3 percent, plus or minus, accuracy.

VI. Coal Development Potential

Strippable Coal Development Potential. Areas where coal beds are 5 feet (1.5 m) or more in thickness and are overlain by 500 feet (152 m) or less of overburden are considered to have potential for surface mining and are assigned a high, moderate, or low development

potential based on the mining ratio (cubic yards of overburden per ton of recoverable coal). The formula used to calculate mining ratios for subbituminous coal is as follows:

$$MR = \frac{to\ (0.911)^*}{tc\ (rf)}$$

where MR = mining ratio
to = thickness of overburden
tc = thickness of coal
rf = recovery factor
0.911*= conversion factor (cu. yds./ton)

*A conversion factor of 0.922 is used for lignite.

A surface mining development potential map (Plate 29) was prepared utilizing the following mining ratio criteria for coal beds 5 to 40 feet (1.5 to 12 m) thick:

1. Low development potential = 15:1 and greater ratio.
2. Moderate development potential = 10:1 to 15:1 ratio.
3. High development potential = 0 to 10:1 ratio.

The following mining ratio criteria are utilized for coal beds greater than 40 feet (12 m) thick:

1. Low development potential = 7:1 and greater ratio.
2. Moderate development potential = 5:1 to 7:1 ratio.
3. High development potential = 0 to 5:1 ratio.

The surface mining development potential is low for approximately 70 percent of the Northeast Quarter of Savageton 15' Quadrangle. The low surface mining development potential areas are located in the central and northern portions of the quadrangle. A moderate development potential rating covers approximately 10 percent of the study area, primarily throughout the northeast quarter. These low and moderate development potential ratings are attributed to low-to-moderate overburden-to-coal ratios for the Felix coal zone, respectively. None of the coal beds in this quadrangle qualifies for a high potential rating. The remaining 20 percent is classified as non-federal coal land or as no potential for surface mining. Table 1 sets forth the estimated strippable reserve and hypothetical resources

base tonnages per coal bed for the quadrangle.

Underground Mining Coal Development Potential. Subsurface coal mining potential throughout the Northeast Quarter of Savageton 15' Quadrangle is considered low. Inasmuch as recovery factors have not been established for the underground development of coal beds in this quadrangle, reserves are not calculated for coal beds that occur more than 500 feet (152 m) beneath the surface. Table 2 sets forth the estimated coal resources in tons per coal bed.

In-Situ Gasification Coal Development Potential. The evaluation of subsurface coal deposits for in-situ gasification potential relates to the occurrence of coal beds more than 5 feet (1.5 m) thick buried from 500 to 3000 feet (152 to 914 m) beneath the surface. This categorization is as follows:

1. Low development potential relates to: 1) a total coal section less than 100 feet (30 m) thick that lies 1000 feet (305 m) to 3000 feet (914 m) beneath the surface, or 2) a coal bed or coal zone 5 feet (1.5 m) or more in thickness which lies 500 feet (152 m) to 1000 feet (305 m) beneath the surface.

2. Moderate development potential is assigned to a total coal section from 100 to 200 feet (30 to 61 m) thick, and buried from 1000 to 3000 feet (305 to 914 m) beneath the surface.

3. High development potential involves 200 feet (61 m) or more of total coal thickness buried from 1000 to 3000 feet (305 to 914 m).

A coal development potential map (Plate 30) is prepared using the above criteria. The coal development potential for in-situ gasification within the Northeast Quarter of Savageton 15' Quadrangle is moderate for the majority of the study area. A low development potential

rating covers approximately two percent of the quadrangle in the northeast quarter. None of the quadrangle qualifies for a high coal development potential for in-situ gasification. The remaining area is classified as non-federal coal land and not evaluated for in-situ gasification development. The coal resource tonnage totals for in-situ gasification with moderate and low development potential is given on Table 3.

Table 1.--Strippable Coal Reserve Base Data (in short tons) for Federal Coal Lands in the Northeast Quarter of Savageton 15' Quadrangle, Campbell County, Wyoming.

Development potentials are based on mining ratios (cubic yards of overburden/ton of recoverable coal).

Coal Bed	High Development Potential (0-10:1 Mining Ratio)	Moderate Development Potential (10:1-15:1 Mining Ratio)	Low Development Potential (>15:1 Mining Ratio)	Total
RESERVE BASE TONNAGE				
Felix	-----	148,340,000	549,380,000	697,720,000
TOTAL	-----	148,340,000	549,380,000	697,720,000

Table 2.--Coal Resource Base and Data (in short tons) for Underground Mining Methods for Federal Coal Lands in the Northeast Quarter of Savageton 15' Quadrangle, Campbell County, Wyoming.

Coal Bed Name	High Development Potential	Moderate Development Potential	Low Development Potential	Total
Felix	-----	-----	13,750,000	13,750,000
Smith	-----	-----	584,870,000	584,870,000
Upper Wyodak	-----	-----	4,171,520,000	4,171,520,000
Middle Wyodak	-----	-----	26,170,000	26,170,000
Lower Wyodak	-----	-----	1,798,600,000	1,798,600,000
Pawnee-Wildcat Moyer-Oedekoven	----	-----	1,247,130,000	1,247,130,000
TOTAL	-----	-----	7,842,040,000	7,842,040,000

Table 3.--Coal Resource Base Data (in short tons) for In-Situ Gasification for Federal Coal Lands in the Northeast Quarter of Savageton 15' Quadrangle, Campbell County, Wyoming.

Coal Bed Name	High Development Potential	Moderate Development Potential	Low Development Potential	Total
	-----	6,997,930,000	844,110,000	7,842,040,000
TOTAL	-----	6,997,930,000	844,110,000	7,842,040,000

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