UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

TEXT TO ACCOMPANY:

COAL RESOURCE OCCURRENCE

AND

COAL DEVELOPMENT POTENTIAL

MAPS

OF THE

HOMESTEAD DRAW QUADRANGLE,

CAMPBELL COUNTY, WYOMING

REVISED TEXT, OCTOBER 1980

BY

INTRASEARCH INC.

ENGLEWOOD, COLORADO

OPEN-FILE REPORT 78-829
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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/ metric ton
acre-feet	0.12335	hectare-meters
British thermal units/pound (Btu/lb)	2.326	kilojoules/kilogram (kj/kg)
British thermal units/pound (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 Homestead Draw Quadrangle, Campbell County, Wyoming. This CRO and CDP map series includes 30 plates (U. S. Geological Survey Open-File Report 78-829). The project is compiled by IntraSearch Inc., 5351 South Roslyn Street, Englewood, Colorado, under KRCRA Eastern Powder River Basin, Wyoming, Contract Number 14-08-0001-17180. This contract is a 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 Homestead Draw Quadrangle is located on the Wyoming-Montana border in Campbell County, Wyoming. It encompasses all or parts of Townships 56, 57, and 58 North, Ranges 72 and 73 West, and covers the area: 44°52'30" to 45°00' north latitude; 105°30' to 105°37'30" west longitude.

Five maintained gravel roads provide access throughout much of the quadrangle. Minor roads and trails that branch from these gravel roads provide additional access to more remote areas. U. S. Highway 14-16 lies 14 miles (22 km) to the southwest, and may be reached by travelling over maintained roads.

The closest railroad is the Burlington Northern trackage, 25 miles (40 km) to the southwest, which connects Sheridan and Gillette, Wyoming.

Olmstead Creek flows easterly across the southern half of the quadrangle, and its valley floor ranges from 3,850 feet to 3,650 feet (1,173 m to 1,113 m) above sea level. This creek coincides with a primary fault in this quadrangle trending northwest to southeast across the area. Homestead Draw, North and South Forks of Olmstead Creek, along with the Cookstove Prong of Olmstead Creek, flow easterly, and compose the other significant drainages in the area. Topographic highs in the quadrangle range up to 4,200 feet (1,280 m) above sea level. The somber grays, yellows, and browns of outcropping shales and siltstones contrast strikingly with the brilliant reds, oranges, and purples of "clinker", and deep greens of the juniper and pine tree growth.

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 Arvada, Wyoming, average wintertime minimums and summertime maximums approach +5° to +15°F (-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 (resources), as well as recoverable tons (reserves). These coal tonnages are then categorized in measured, indicated, and inferred identified 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 3,000 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 2.2 billion tons (1.9 billion metric tons) of total, unleased federal coal-in-place in the Homestead Draw Quadrangle.

The suite of maps that accompanies 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 3,000 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 the major coal resource occurrence in the Powder River Basin. The Lebo Member of the Fort Union Formation is mapped at the surface northeast of Recluse, Wyoming. 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 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 member subdivisions 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 2 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 and in-filling of these areas by tremendous 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 of 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 servicing 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. It is considered to disconformably descend 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 is 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 Homestead Draw Quadrangle is located in an area where surface rocks are classified into the Tongue River Member of the Fort Union Formation. Although the Tongue River Member is reportedly 1,200 to 1,300 feet (366 to 396 m) thick (Olive, 1957), only 500 to 600 feet (152 to 183 m) are exposed in this area. Olive (1957) correlated coal beds in the Spotted Horse coal field with coal beds in the northward extension of the Sheridan coal field, Montana (Baker, 1929), and Gillette coal field, Wyoming (Dobbin and Barnett, 1927), 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 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 and Cache coal beds were named by Warren (1959). The Wildcat and Oedekoven coal beds were informally named by IntraSearch (1978a, 1978b).

Local. The Homestead Draw Quadrangle lies on the eastern flank of the Powder River Basin, where the strata dip gently westward. The Tongue River Member of the Fort Union Formation crops out over the entire quadrangle. The Fort Union Formation is composed of very fine-grained sandstone, siltstone, claystone, shale, carbonaceous shale, and numerous coal beds.

Four main faults occur within the area, and the largest trends northwest to southeast across the entire southern half of the quadrangle, where it displays a displacement of 10-30 feet (3-9 m). A less prominent fault extends north from the aforementioned fault and exhibits up to 10 feet (3 m) of displacement. Because of ambiguities between U. S. Geological Survey Open-Filed surface geological data (McKay, 1973), and subsurface coal occurrences defined in the quadrangle by IntraSearch, IntraSearch requested and was granted permission to augment the areal geology and structural mapping in the southern part of the Homestead Draw Quadrangle. Based upon the photogeologic interpretation of 1:24,000 scale, color aerial photography, two faults are added to the surface mapping in the southwest part of the area. These north-trending faults display approximately 10 feet (3 m) of vertical offset. As a result of the photogeologic study, certain adjustments and additions are affixed to the areal geology mapping. Details of these augmentations are discussed later in the report under the heading Coal Bed Occurrence.

III. Data Sources

Areal geology of the coal outcrops and associated clinker is derived from the preliminary geologic map of the Croton 1 NE (Homestead Draw) Quadrangle (McKay, 1973). Coal bed correlations between McKay's Homestead Draw Quadrangle and the Moorhead coal field publication (Bryson and Bass, 1973) are difficult due to the paucity of subsurface control and the difference in coal bed nomenclature between the two publications. The following table sets forth the coal bed nomenclature relationship between the Homestead Draw Quadrangle of McKay, and the Bay Horse Quadrangle, Montana, just to the north of Homestead Draw Quadrangle, that utilizes Bryson and Bass' publication.

Homestead Draw Quadrangle	Bay Horse Quadrangle
Dietz	Dietz
Upper Canyon	Canyon
Lower Canyon	Upper Cook
Cook	# 5
Wall	No equivalent
Pawnee	Cache
Cache	No equivalent

Modification of coal bed nomenclature used by McKay (1973) is necessary to retain consistency in regional correlations by IntraSearch in this project. Specifically, in this report, the Dietz coal bed (McKay, 1973) is changed to the Anderson coal bed, and the Anderson coal bed (McKay, 1973) is changed to the Smith coal bed.

Geophysical logs from oil and gas test bores and producing wells compose 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 and its 3-mile perimeter area were scanned to select those with data applicable to Coal Resource Occurrence mapping. Paper copies of the logs were obtained and interpreted, and coal intervals annotated. Maximum accuracy of coal bed identification was accomplished where gamma, density and resistivity curves were available. Coal bed tops and bottoms were identified on the logs at the midpoint between the minimum and maximum curve deflections. The correlation of coal beds within and between quadrangles was 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 details, 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 Homestead Draw 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

Fort Union Formation coal beds that are present in all or part of the Homestead Draw Quadrangle include, in descending stratigraphic order: the Smith, Anderson, Canyon, Cook, Wall, Pawnee, Cache, Wildcat, and Oedekoven coal beds. A suite of maps composed of: coal isopach and mining ratio, where appropriate; structure; overburden isopach; areal distribution of identified resources; identified resources and hypothetical resources, where applicable, is prepared for each of these coal beds, except for the Smith and Anderson coal beds where insufficient data precludes detailed mapping. Interburden contours are presented on the overburden isopachs maps of the Pawnee coal bed.

Physical and chemical analyses for the Cache coal bed are set forth below as per data obtained from the Montana Bureau of Mines and Geology drill hole number 741, located in sec 4, T. 57 N., R. 72 W. For other coal beds occurring within the Homestead draw quadrangle, the "as received" proximate analysis; the Btu value computed on a moist, mineral-matter-free basis;* and the coal ranks are as follows:

COAL BED NAME		DATA SOURCE IDENTIFICATION	AS RECEIVED BASIS						MOIST, M-M-F BTU/LB	COAL RANK
			ASH %	FIXED CARBON %	MOISTURE %	VOLATILES %	SULFUR %	BTU/LB		
Smith	(U)	Hole 7340	3.5	38.0	30.0	28.5	0.31	8371	8700	Subbtm. C
Anderson	(U)	Hole 746	6.3	31.1	32.6	30.0	0.33	7498	8045	Lignite A
Canyon	(U)	Hole 744	4.3	32.9	35.1	27.8	0.31	7298	7650	Lignite A
Cook	(**)	Hole SH-64	3.1	36.2	30.8	29.9	0.15	7948	8225	Lignite A
Wall	(U)	Hole 7426	9.5	29.3	32.2	29.0	0.50	7279	8112	Lignite A
Pawnee	(U)	Hole 7424	7.9	41.0	31.9	29.2	0.39	7344	8025	Lignite A
Cache	(U)	Hole 741	9.5	30.5		28.6	0.49	7271	7650	Lignite A

* The moist, mineral-matter-free Btu values are calculated in the manner stipulated in the publications by American Soceity for Testing and Materials (1971).

** Matson, R. E., and Blumer, J. W. (1973).

(U) U. S. Geological Survey and Montana Bureau of Mines and Geology (1976).

The Coal Data sheets, plates 3A and 3B, show the down-hole identification of coal beds within the quadrangle as interpreted from U. S. Geological Survey and Montana Bureau of Mines and Geology drill holes and geophysical logs from oil and gas test bores and from producing sites. 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.

Comparison of in-progress correlation and nomenclature data with Bion H. Kent and Robert G. Hobbs (U. S. Geological Survey - Coal Branch personnel) indicates preliminary interpretative agreement of downhole data at the Davis Oil Co. - Exeter Drilling & Exploration Co., 15-27 Amoco et al. Federal SW SW Sec. 27, T. 57 N., R. 73 W.

In the subsurface, coal beds in the Homestead Draw Quadrangle area generally are uniform in occurrence throughout the entire area; however, due to the outcrop configurations and geographic distribution of subsurface data, several coal datums are used for correlation purposes (plates 3A and B). Much of the Tongue River Member of the Fort Union Formation crops out on this quadrangle. Most of the Smith and Anderson coal beds have been eroded or burned in this area. The Canyon, Cook, and Wall coal beds are eroded from the eastern part of the quadrangle. The Pawnee coal bed crops out in the northeastern portion of the quadrangle, and the thin Cache, Wildcat, and Oedekoven coal beds underlie portions of the quadrangle. Neither the Wildcat nor the Oedekoven coal beds require CRO-CDP mapping, due to insufficient areal extent and thickness.

The Canyon coal bed is eroded from approximately 60 percent of the quadrangle. Considerable burning along the outcrop is apparent throughout much of the area, especially in the southern section. The coal bed thickness ranges from 20 to 30 feet (6 to 9 m) with increasing thickness to the west (plate 4). A north-south trending synclinal feature is located along the western boundary. Much of the Canyon coal bed structural configurations appear fault related. The overburden above the Canyon coal bed attains a maximum of approximately 240 feet (73 m).

The Cook coal bed occurs 115 to 130 feet (35 to 40 m) below the Canyon coal bed and ranges in thickness from less than 5 to 21 feet (1.5 to 6 m). It is eroded from approximately 30 percent of the area and small areas of burning are evident along the outcrop. Generally, the coal thickness increases toward the west. The Cook coal bed divides into two units that are separated by interburden ranging from 0 to 30 feet (0 to 9 m) (plate 9). A south-plunging syncline occurs along the western half of the quadrangle. The Cook coal bed lies a maximum of approximately 420 feet (128 m) beneath the surface.

The Wall coal bed occurs 50 to 135 feet (15 to 41 m) below the Cook coal bed. It ranges from 0 to 16 feet (0 to 5 m) in thickness with increasing thickness toward the west. It is eroded from approximately 10 percent of the quadrangle along the eastern half and pinches out toward the north (plate 14). The coal bed dips gently westward with a significant structural low area located in the southwest portion of the quadrangle. The overburden above the Wall coal bed ranges from 0 feet (0 m) to greater than 500 feet (152 m).

The Pawnee coal bed occurs 45 to 150 feet (14 to 46 m) below the Wall coal bed. It ranges in thickness from 7 to 19 feet (2.1 to 6 m) and occurs as a doublet with interburden ranging from 0 to 60 feet (0 to 18 m). The thickest part of the coal bed occurs along the southern quarter of the quadrangle (plate 19). Two south-plunging synclines are located in the northwest and southeast parts of the quadrangle. The Pawnee coal bed crops out in the drainages along the eastern boundary and attains a maximum depth of 680 feet (207 m).

The Cache coal bed lies 35 to 145 feet (11 to 44 m) below the Pawnee coal bed and ranges in thickness from 0 to 18 feet (0 to 5 m). A non-coal interval in the coal bed ranges from 0 to 50 feet (0 to 25 m) in thickness throughout much of the quadrangle. A zero coal isopach line is present in the southeast sector and in a small localized area in the northwest portion of the quadrangle (plate 24). A small structural low is present across the northern half of the area trending northeast to southwest. The Cache coal bed lies from 75 to 750 feet (23 to 229 m) beneath the surface.

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 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 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 Homestead Draw 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 measured sections where there is sparse subsurface control. Where coal 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 above 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 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), and 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, and inferred parts of identified 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 1,750, or 1,770--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 tonnages (reserves) are 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 complex 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 feet 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.

In the western part of Homestead Draw Quadrangle, the Anderson, Canyon, and Cook coal beds lie at shallow depths, and have a high development potential for surface mining. Although the Wall, Pawnee, and Cache coal beds are present at moderate depths throughout much of the area, the coal beds are thin. Hence, cubic yards to recoverable ton ratios for the aforementioned coal beds are high, which defines areas of moderate and low development potential. The Coal Development Potential for Surface Mining Methods map indicates that a major percentage of the quadrangle is of high development potential. This classification results from the interrelation between multiple coal bed occurrence, exhibiting gentle west dip, and moderate topographic relief that increases in elevation to the west. Table 1 sets forth the estimated strippable reserve base tonnages per coal bed for this quadrangle.

Underground Mining Coal Development Potential. Subsurface coal mining development potential throughout the Homestead Draw 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 development potential relates to the occurrence of coal beds more than 5 feet (1.5 m) thick buried from 500 to 3,000 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 1,000 feet (305 m) to 3,000 feet (914 m) beneath the surface, or 2) a coal bed or coal zone 5 feet (1.5 m) or more in thickness that lies 500 feet (152 m) to 1,000 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 1,000 to 3,000 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 1,000 to 3,000 feet (305 to 914 m).

The coal development potential for in-situ gasification on the Homestead Draw Quadrangle is low, hence no CDP map is generated for this map series. The resource tonnage for "in-situ" gasification with low development potential totals approximately 221 million tons (200 million metric tons) (Table 3). None of the coal beds in the Homestead Draw Quadrangle qualify for a moderate or high development potential rating for in-situ gasification.

Table 1.--Strippable Coal Reserve Base and Hypothetical Resource Data (in short tons) for Federal Coal Lands in the Homestead Draw 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				
Canyon	300,810,000	260,000	-	301,070,000
Cook	142,450,000	136,020,000	84,610,000	363,080,000
Wall	49,500,000	15,200,000	197,730,000	262,430,000
Pawnee	55,770,000	132,360,000	404,640,000	592,770,000
Cache	6,810,000	19,050,000	270,810,000	296,670,000
Total	555,340,000	302,890,000	957,790,000	1,816,020,000
Hypothetical Resources				
Canyon	-	-	37,740,000	37,740,000
GRAND TOTAL	555,340,000	302,890,000	995,530,000	1,853,760,000

Table 2.--Coal Reserve Base Data (in short tons) for Underground Mining Methods for Federal Coal Lands in the Homestead Draw Quadrangle, Campbell County, Wyoming.

Coal Bed Name	High Development Potential	Moderate Development Potential	Low Development Potential	Total
Canyon	-	-	-	-
Cook	-	-	-	-
Wall	-	-	-	-
Pawnee	-	-	35,500,000	35,500,000
Cache	-	-	174,630,000	174,630,000
TOTAL	-	-	210,130,000	210,130,000

Table 3.--Coal Reserve Base Data (in short tons) for In-Situ Gasification for Federal Coal Lands in the Homestead Draw Quadrangle, Campbell County, Wyoming.

Coal Bed Name	High Development Potential	Moderate Development Potential	Low Development Potential	Total
Canyon	-	-	-	-
Cook	-	-	-	-
Wall	-	-	-	-
Pawnee	-	-	35,500,000	35,500,000
Cache	-	-	174,630,000	174,630,000
TOTAL	-	-	210,130,000	210,130,000

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