UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

TEXT TO ACCOMPANY:

COAL RESOURCE OCCURRENCE

AND

COAL DEVELOPMENT POTENTIAL

MAPS

OF THE

TECKLA SOUTHWEST QUADRANGLE,

CAMPBELL COUNTY, WYOMING

BY

INTRASEARCH INC.

DENVER, COLORADO

OPEN FILE REPORT 79-311
1979

This report is preliminary, and has not been edited or reviewed for conformity with United States Geological Survey standards or stratigraphic nomenclature.

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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 Teckla Southwest Quadrangle, Campbell County, Wyoming. This CRO and CDP map series includes 19 plates (U. S. Geological Survey Open-File Report 79-311). The project is compiled by IntraSearch Inc., 1600 Ogden Street, Denver, Colorado, under KRCRA Northeastern 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 (KRCRA) in the western United States.

The Teckla Southwest Quadrangle is located in Campbell County, in northeastern Wyoming. It encompasses parts of Townships 41 and 42 North, Ranges 71 and 72 West, and covers the area: 43° 30' to 43° 37' 30" north latitude; 105° 22' 30" to 105° 30' west longitude.

Main access to the Teckla Southwest Quadrangle is provided by State Highway 59 which angles north-south across the western half of the study area. Several unimproved gravel roads that branch from State Highway 59 constitute an avenue of access to much of the quadrangle. The closest railroad is the Burlington Northern trackage approximately 8 miles (13 km) to the northeast at the Jacobs Ranch and Black Thunder coal mines. This trackage is under construction southward to Douglas, Wyoming.

Elevations attain heights of 5127 feet (1563 m) above sea level in the central portion of the Teckla Southwest Quadrangle; 400 to 500 feet (122 to 137 m) above the valley floors. Drainage is provided by Spring Creek in the southwest quadrant, Horse Creek in the southeast area, and Porcupine Creek in the northwest portion of the quadrangle. These three intermittent streams drain southeastward into the Cheyenne River. 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 ten to twelve inches (25 to 30 cm) of annual precipitation that falls in this semi-arid region accrues principally in the springtime. Summer and fall precipitation usually originates from thunderstorms, and infrequent snowfalls of six 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 approach +5° to +15°F (-15° and -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: 1) the delineation of lignite, subbituminous coal, bituminous coal and anthracite at the surface and in the subsurface on federal land; 2) the identification of total tons in place as well as recoverable tons; 3) categorization of these tonnages into measured, indicated, and inferred reserves and resources, and hypothetical resources; and 4) recommendations 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 6.5 billion tons (5.9 billion metric tons) of total unleased federal coal resource in the Teckla Southwest Quadrangle.

The suite of maps that accompany this report set forth and portray 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, that includes 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 Lebo Member of the Fort Union Formation is mapped at the surface northeast of Recluse, Wyoming, east of the principal coal outcrops and associated clinkers (McKay, 1974), and 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 working with subsurface data, principally geophysical logs, in the basin are trying to develop criteria for subsurface recognition of the Lebo-Tullock and Tongue River-Lebo contacts, 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 tropic to subtropic depositional environment included broad, inland flood basins with extensive swamps, marshes, freshwater lakes, and a sluggish but active northeastward discharging drainage system, superimposed on a near base level, emerging sea floor. Much of the vast areas 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 areas surrounding the Powder River Basin created a structural basin of asymmetric characteristic, 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 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 discrete balance between subsidence of the earth's crust and in-filling 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 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 attentuation of a thick coal bed probably relate to location of the drill hole within the ancient stream channel system draining this low land 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 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 that is a part of this CRO-CDP 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 Teckla Southwest Quadrangle is located in an area where surface rocks are classified into the Wasatch Formation. Although the Wasatch Formation is reportedly 700 to 800 feet (213 to 244 m) thick (Olive, 1957), only 400 to 450 feet (122 to 137 m) are exposed in this area. 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 Smith coal bed was named by Taff (1909), and 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 ten to twenty-five 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 Wildcat and Moyer coal beds were informally named by IntraSearch (1978, 1979).

Local. The Teckla Southwest Quadrangle lies on the eastern flank of the Powder River Basin, where the strata dip gently westward to northwestward. 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.

A bifurcating west to northwest trending syncline in the northern portion of the quadrangle is portrayed by the structural contours on top of the Smith and Wyodak coal beds.

III. Data Sources

Areal geology of the coal outcrops and associated clinker is derived from the Preliminary Coal Resource Occurrence Map of the C Bed in the Teckla SW Quadrangle by Goolsby (1976). IntraSearch refers to the C coal bed of Goolsby (1976) as the Smith coal bed in this report.

The major source of subsurface control, particularly on deep coal beds, is the geophysical logs from oil and gas test bores and producing wells. 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 eighty percent of the logs include resistivity, conductivity, and self-potential curves. Occasionally the logs include 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, interpreted, and coal intervals annotated. Maximum accuracy of coal bed identification 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.

In some parts of the Powder River Basin, additional subsurface control is available from U. S. Geological Survey open-file reports that include geophysical and lithologic logs of shallow holes drilled specfically for coal exploration. A sparse scattering of subsurface data points are shown on unpublished CRO-CDP maps compiled by the U. S. Geological Survey, and where these data are utilized, the rock-coal intervals are shown on the Coal Data Map (Plate 1). Inasmuch as these drill holes have no identifier headings, they are not set forth on the Coal Data Sheet (Plate 3). The geophysical logs of these drill holes were not available to IntraSearch to ascertain the accuracy of horizontal location, topographic elevation, and downhole data interpretaion.

The reliability of correlations, set forth by IntraSearch in this report, vary 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 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 Teckla Southwest Quadrangle is published by the U. S. Geological Survey, compilation date, 1971. Land network and mineral ownership data are compiled from land plats obtained 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 Formation coal beds that are present in all or part of the Teckla Southwest Quadrangle include, in descending stratigrphic order, the Smith, Upper Wyodak (Anderson), Wyodak, Pawnee, Wildcat, and Moyer coal beds. A complete suite of maps (structure, isopach, mining ratio, overburden/interburden, identified resources and areal distribution of identified resources) is prepared for each of these coal beds, except for the Upper Wyodak (Anderson) and Pawnee coal beds, where insufficient data and lack of areal extent preclude detailed mapping.

No physical and chemical analyses are known to have been published regarding the coal beds in the Teckla Southwest Quadrangle. However, "as received" basis proximate analyses are published for the Upper Wyodak (Anderson) coal bed in the adjacent Teckla Quadrangle to the east and the Wyodak coal bed at the Black Thunder coal mine approximately 6 miles (10 km) to the northeast. These analyses are as follows:

COAL BED NAME		ASH	FIXED CARBON	MOISTURE	VOLATILES	SULFUR	BTU/LB
Upper Wyodak (Anderson) (U)	Hole 7544	4.501	32.688	24.332	38.450	0.201	8953
Wyodak (1)		4.760	35.000	28.360	31.880	0.330	8605

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

(1) - U. S. Department of the Interior, Draft Environmental Statement for the Development of Coal Resources in the Eastern Powder River Coal Basin of Wyoming.

All analyses except for BTU/LB are expressed as a percentage.

The Coal Data Sheet, Plate 3, shows the downhole identification of coal beds within the quadrangle as interpreted from U. S. Geological Survey and Montana Bureau of Mines and Geology drill holes, and 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) areas. Inasmuch as the Wyodak coal bed underlies the entire quadrangle, it is designated as datum for the correlation diagram. The Wyodak coal bed shows the thickest coal bed occurrence throughout the quadrangle. The Smith, Upper Wyodak (Anderson), Pawnee, Wildcat, and Moyer coal beds are relatively thin throughout the study area.

The Smith coal bed crops out in the northern two-thirds of the study area and averages approximately 9 feet (2.7 m) thick. Absent from the eastern and southern portions of the quadrangle, the Smith coal bed varies from 0 to 10 feet (0 to 3 m) in thickness. Structural contours on top of the Smith coal bed define a northwest dip of less than two degrees and two, broad, east-west trending synclines (Plate 5). The Smith coal bed lies less than 350 feet (107 m) beneath the surface throughout the Teckla Southwest Quadrangle.

The Wyodak coal bed lies 400 to 537 feet (122 to 164 m) beneath the Smith coal bed, and averages 79 feet (24 m) thick. Thicknesses for the Wyodak coal bed range from 65 feet (20 m) in the southwest portion to 91 feet (28 m) in the northeast quadrant of the study area. Non-coal intervals within the Wyodak coal bed are present in the southern and western portions of the study area and vary up to 148 feet (45 m) in thickness. The Wyodak coal bed isopach map indicates the total coal bed thickness irrespective of the occurrence of up to 148 feet (45 m) of clastic rock within or between the Wyodak coal bed members. This interburden is located west and south of the Wyodak split line shown on the Isopach Map of Overburden and Interburden of Wyodak Coal Bed, Plate 11.

Structural contours on top of the Wyodak coal bed portray a broad bifurcating northwest trending syncline in the northwest portion of the quadrangle. The Wyodak coal bed dips gently northwestward and lies less than 500 feet (152 m) beneath the surface throughout approximately fifty percent of the study area.

From 440 to 675 feet (134 to 206 m) of clastic sediment separate the Wildcat-Moyer coal zone from the overlying Wyodak coal bed. Thicknesses for the Wildcat-Moyer coal zone vary from 15 to 55 feet (5 to 17 m), and average 23 feet (7 m). Non-coal intervals of 175 to 279 feet (53 to 85 m) thick separate the Wildcat and Moyer coal beds. Structural contours on top of the Wildcat-Moyer coal zone define a westward dip of one to two degrees. The Wildcat-Moyer coal zone lies 960 to 1550 feet (293 to 472 m) beneath the surface throughout the Teckla Southwest Quadrangle.

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 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 elevations correctness. 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 ratio, and Coal Development Potential maps.

Subsurface mapping is based on geologic data within and adjacent to the Teckla Southwest 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 isopach contours do not honor surface measured sections, the surface thicknesses are thought to be attenuated by oxidation and/or erosion, hence 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 is 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 ninety-five 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), 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 1770 (the number of tons of subbituminous C coal per acre-foot, 13,018 metric tons per hectare-meter), to determine total tons in place. Recoverable tonnage is calculated at ninety-five 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 two to three 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 is as follows:

$$MR = \frac{t_o\ (0.911)\ *}{t_c\ (rf)}$$

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

*Use (0.922) for lignite

A surface mining potential map is 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 5:1 ratio.

The following mining ratio criteria is 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 potential is high for approximately fifteen percent of the quadrangle. These high potential areas are located mainly in the southern and northwestern portions of the study area and relate to the occurrence of the thick Wyodak coal bed less than 500 feet (152 m) beneath the surface.

Approximately twenty-five percent of the study area is classified as moderate potential for surface mining. These moderate potential areas are due to increasing amounts of overburden on the Wyodak coal bed, resulting in mining ratios between 5:1 and 7:1. Thirty percent of the quadrangle is considered low potential for surface mining. The low potential areas in the northern half of the Teckla Southwest Quadrangle relate to the thin Smith coal bed buried 350 feet (107 m) or less beneath the surface. Low potential areas in the southern half of the quadrangle are due to the absence of the Smith coal bed and mining ratios greater than 7:1 for the Wyodak coal bed. Twenty percent of the quadrangle in the eastern and southern quadrants is unsuitable for surface mining where the Smith coal bed is less than 5 feet (1.5 m) thick and overburden thicknesses for the Wyodak coal bed exceed 500 feet (152 m). The remaining ten percent of the study area involves non-federal coal. Table 1 sets forth the estimated strippable reserve base tonnages per coal bed for the quadrangle.

Underground Mining Coal Development Potential. Subsurface coal mining potential throughout the Teckla Southwest 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 buried 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 500 feet (152 m) to 3000 feet (914 m) beneath the surface, or 2) coal beds 5 feet (1.5 m) or more in thickness that lie 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).

The coal development potential for in-situ gasification on the Teckla Southwest Quadrangle is low, hence no CDP map is generated for this map series. The coal resource tonnage for in-situ gasification with low development potential totals approximately 4.2 billion tons (3.8 billion metric tons) (Table 3). None of the coal beds in the Teckla Southwest Quadrangle qualify for a moderate or high development potential rating.

Table 1.--Strippable Coal Reserve Base Data (in short tons) for Federal Coal Lands in the Teckla Southwest 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
Smith	16,370,000	16,640,000	140,420,000	173,430,000
	(0-5:1 Mining Ratio)	(5:1-7:1 Mining Ratio)	(>7:1 Mining Ratio)	
Wyodak	532,210,000	1,214,220,000	195,410,000	1,941,840,000
TOTAL	548,580,000	1,230,860,000	335,830,000	2,115,270,000

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

Coal Bed Name	High Development Potential	Moderate Development Potential	Low Development Potential	Total
Wyodak	——	——	2,322,880,000	2,322,880,000
Wildcat-Moyer	——	——	1,917,070,000	1,917,070,000
TOTAL	——	——	4,239,950,000	4,239,950,000

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

Coal Bed Name	High Development Potential	Moderate Development Potential	Low Development Potential	Total
Wyodak	—	—	2,322,880,000	2,322,880,000
Wildcat-Moyer	—	—	1,917,070,000	1,917,070,000
TOTAL	—	—	4,239,950,000	4,239,950,000

SELECTED REFERENCES

Baker, A. A., 1929, The northward extension of the Sheridan coal field, Big Horn and Rosebud Counties, Montana: U. S. Geol. Survey Bull. 806-B, p. 15-67.

Bass, N. W., 1932, The Ashland coal field, Rosebud, Powder River, and Custer Counties, Montana: U. S. Geol. Survey Bull. 831-B, p. 19-105.

Brown, R. W., 1958, Fort Union Formation in the Powder River Basin, Wyoming: Wyo. Geol. Soc. Guidebook, Thirteenth Annual Field Conf., p. 111-113.

Dobbin, C. E., and Barnett, V. H., 1927, The Gillette coal field northeastern Wyoming, with a chapter on the Minturn district and northwestern part of the Gillette field by W. T. Thom, Jr.: U. S. Geol. Survey Bull. 796-A, p. 1-50.

Glass, G. B., 1975, Review of Wyoming coal fields, 1975: Wyoming Geol. Survey Public Information circ. 4, p. 10.

Goolsby, J. E., 1976, Preliminary coal resource occurrence map of the C coal bed in the Teckla SW Quadrangle, Campbell County, Wyoming: U. S. Geol. Survey unpublished report, scale 1:24,000.

IntraSearch Inc., 1978, Coal resource occurrence and coal development potential of the Rocky Butte Quadrangle, Campbell County, Wyoming: U. S. Geol. Survey Open-File Report 78-830, 22 p.

________________, 1979, Coal resource occurrence and coal development potential of the Larey Draw Quadrangle, Campbell County, Wyoming: U. S. Geol. Survey Open-File Report 79-023, 29 p.

Jacob, A. F., 1973, Depositional environments of Paleocene Tongue River Formation: Am. Assoc. of Petroleum Geologists Bull., vol. 56, no. 6, p. 1038-1052.

McKay, E. J., 1974, Preliminary geologic map of the Bertha 2 NW (Rocky Butte) Quadrangle, Campbell County, Wyoming: U.S. Geol. Survey Open-File Report 74-173, scale 1:24,000.

Olive, W. W., 1957, The Spotted Horse coal field, Sheridan and Campbell Counties, Wyoming: U.S. Geol. Survey Bull. 1050, 83 p.

Schell, E. M., and Mowat, G. D., 1972, Reconnaissance map showing some coal and clinker beds in the Fort Union and Wasatch Formations in the eastern Powder River Basin, Campbell and Converse Counties, Wyoming: U.S. Geol. Survey Open-File Report, scale 1:63,360.

Taff, J. A., 1909, The Sheridan coal field, Wyoming: U.S. Geol. Survey Bull. 341-B, p. 123-150.

U.S. Bureau of Mines and U.S. Geological Survey, 1976, Coal resource classification system of the U.S. Bureau of Mines and U.S. Geological Survey: U.S. Geol. Survey Bull. 1450-B, 7 p.

U.S. Department of the Interior, May 31, 1974, Development of coal resources in the eastern Powder River Coal Basin of Wyoming, Draft Environmental Statement, Interagency Team: Bureau of Land Management, U.S. Geological Survey, Department of Agriculture, U.S. Forest Service, Interstate Commerce Commission, 6 volumes, vol. III, p. III-55, Table 6.

U.S. Geological Survey and Montana Bureau of Mines and Geology, 1973, Preliminary report of coal drill-hole data and chemical analyses of coal beds in Sheridan and Campbell counties, Wyoming, and Big Horn County, Montana: U.S. Geol. Survey Open-File Report 73-351, 51 p.

______1974, Preliminary report of coal drill-hole data and chemical analyses of coal beds in Campbell County, Wyoming: U.S. Geol. Survey Open-File Report 74-97, 241 p.

______1976a, Preliminary report of coal drill-hole data and chemical analyses of coal beds in Campbell and Sheridan Counties, Wyoming; Custer, Prairie, and Garfield Counties, Montana; and Mercer County, North Dakota: U.S. Geol. Survey Open-File Report 76-319, 377 p.

______1976b, Preliminary report of coal drill-hole data and chemical analyses of coal beds in Campbell, Converse, and Sheridan Counties of Wyoming; and Big Horn, Richland, and Dawson Counties, Montana: U.S. Geol. Survey Open-File Report 76-450, 382 p.

______1977, Preliminary report on 1976 drilling of coal in Campbell and Sheridan Counties, Wyoming; and Big Horn, Dawson, McCone, Richland, Roosevelt, Rosebud, Sheridan, and Wibaux Counties, Montana: U.S. Geol. Survey Open-File Report 77-283, 403 p.

______1978, Preliminary report of 1977 coal drilling in eastern Montana and northeastern Wyoming; Geophysical logs for Campbell and Converse Counties, Wyoming: U.S. Geol. Survey Open-File Report 77-721 E, 202 p.

Warren, W. C., 1959, Reconnaissance geology of the Birney-Broadus coal field, Rosebud and Powder River Counties, Montana: U.S. Geol. Survey Bull. 1072-J, p. 561-585.

Weimer, R. J., 1977, Stratigraphy and tectonics of western coals, <u>in</u> Geology of Rocky Mountain Coal, A Symposium, 1976: Colorado Geol. Survey Resource Series 1, p. 9-27.