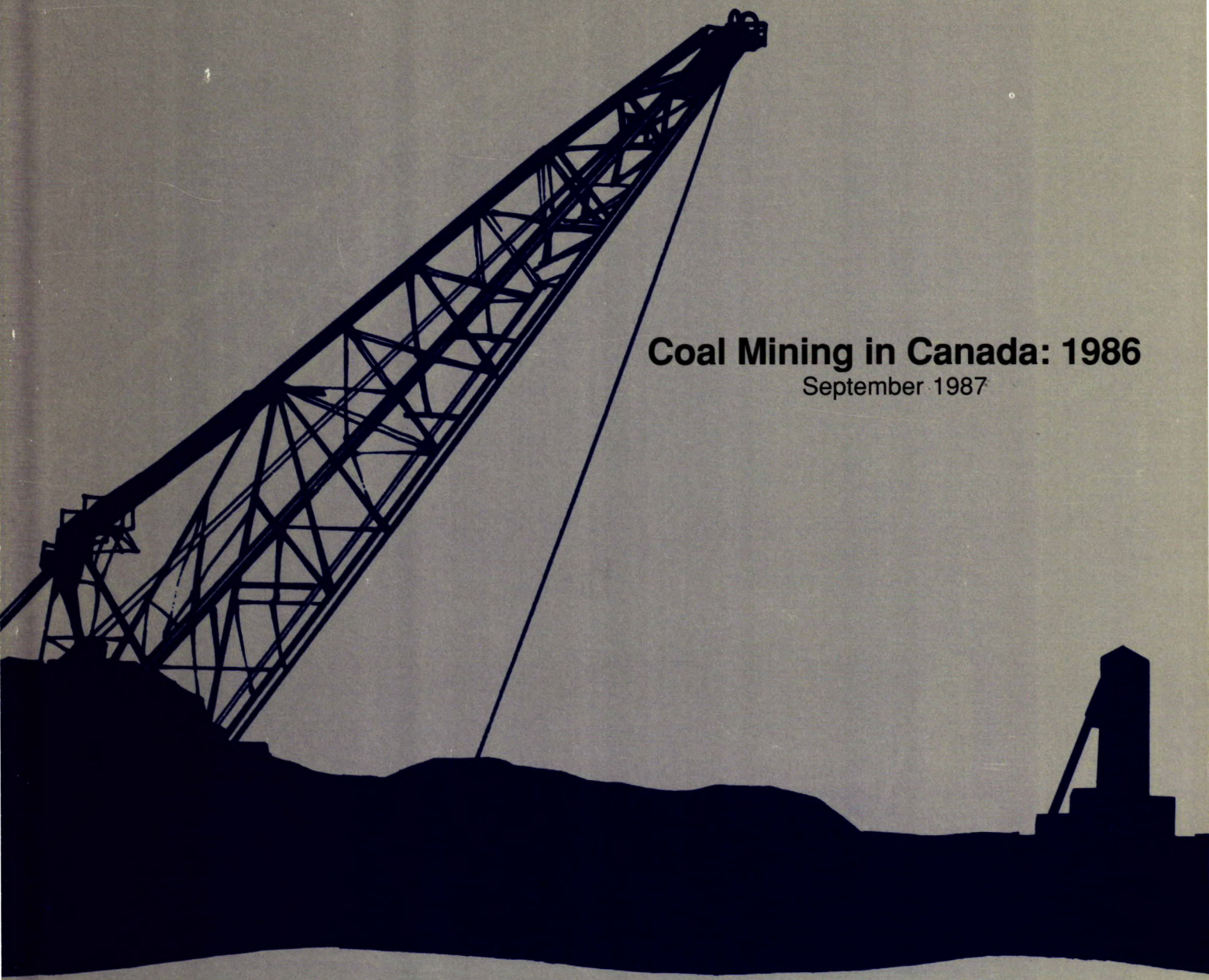
CANMET

REPORT 87-3E

Canada Centre for Mineral and Energy Technology

Centre canadien de la technologie des minéraux et de l'énergie



Coal Mining in Canada: 1986

September 1987

Energy, Mines and Resources Canada

Énergie, Mines et Ressources Canada

Canada

UNITS OF MEASUREMENT

Units of measurement in this report are in the International System of Units (SI) as approved for official use by the Canadian Standards Association and Metric Commission Canada. These units have been adopted by the Mining Association of Canada and the Coal Association of Canada. To assist with the use of metric units these two associations have published "Metric Practice Guide for the Canadian Mining and Metallurgical Industries", 1978.

Following are some useful conversion factors along with SI prefixes.

Multiply this		by this	to obtain	
British thermal unit (Btu)		1055.06	joule	J
Btu per pound		2.326	kilojoule per kilogram	kJ/kg
cubic yard		0.764 555	cubic metre	m^3
cubic yards per ton		0.842 78	cubic metres per tonne	m^3/t
foot		0.304 8	metre	m
joule	J	0.000 947 8	Btu	
kilojoule per kilogram	kJ/kg	0.429 923	Btu per pound	
kilometre	km	0.621 371	mile	
litre per second	L/s	13.1982	gallon per minute	
megajoule per kilogram	MJ/kg	429.923	Btu per pound	
metre	m	3.280 84	foot	
mile		1.609 344	kilometre	km
short tonne per acre foot		7.354 67	tonne per hectare metre	t/ham
ton (long)		1.016 046 9	tonne	t
ton (short)		0.907 184 7	tonne	t
tonne		0.984 206 5	long ton	
tonne		1.102 311	short ton	

SI PREFIXES

Multiplying Factor	Prefix	Symbol
1 000 000 000 000 000 = 10^{15}	peta	P
1 000 000 000 000 = 10^{12}	tera	T
1 000 000 000 = 10^9	giga	G
1 000 000 = 10^6	mega	M
1 000 = 10^3	kilo	k
100 = 10^2	hecto	h
10 = 10^1	deca	da

COAL MINING IN CANADA: 1986

BY

A.S. Romaniuk and H.G. Naidu

COAL RESEARCH LABORATORIES

CANMET REPORT 87-3E

September, 1987

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FOREWORD

This report updates CANMET Report 83-20E "Coal Mining in Canada: 1983" and the French version CANMET Rapport 83-20F "L'exploitation du charbon au Canada: 1983". It updates Canada's official coal reserves to December, 1985 and lists significant operational and technical information about the Canadian coal mining industry up to 1986. The staff of the Coal Research Laboratories have assembled a substantial base of information on these and related subjects during the course of their work on CANMET's Coal Reserve Assessment Project. The presentation of the data in this report will enhance the national and international dissemination of this information in a format which facilitates periodic updating and current technology review.

These reports are linked to the former EMR publication series "Operators List 4: Coal Mines in Canada", last published in January 1979. Coal production and other data covering the period 1983 to 1986 are included for statistical continuity. Also provided is a brief sketch of the geological setting for mining operations and data representative of coal qualities mined in Canada's major coalfields.

T.D. Brown
Director

ABSTRACT

COAL MINING IN CANADA: 1985

by

A.S. Romaniuk* and H.G. Naidu**

This report has two purposes: to present significant information on coal mining operations in Canada up to December 1986 and to update the assessment of Canada's coal reserves as of December, 1985.

Regarding coal mining operations the report includes names of operators, location and size of operations, a brief description of mining and coal preparation methods and major equipment used. Because the geological setting of coal operations in Canada varies in the extreme and because this setting is critical to the technology used in excavating and processing coal, a section briefly depicting the geology of major coalfields has been included.

Canada's coal reserve quantities have been updated from those presented in CANMET Report 83-20E(1). Recoverable coal reserve tonnages for Alberta have increased because of additions for the McLeod River Project in the McLeod River Coalfield(2) and the Mercoal Project in the Coalspur Coalfield (3), both in Alberta's Foothills Region. Reserves in other coalfields are, with some exceptions, those presented in the earlier report, less production for 1983, 1984 and 1985. EMR's reserve term definitions are unchanged from the earlier report.

The approval of coal projects in Alberta and British Columbia follows well-defined procedures. This has resulted in some public disclosure of data on coal reserve quantities, limiting criteria, coal quality, mining plans, environmental impact assessments, etc. Technological information used in this report was also acquired during regular visits by Coal Research Laboratories staff to operating mine sites across Canada.

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INTRODUCTION

This CANMET Report series was initiated for several reasons: to officially update Canada's coal reserves; to maintain the continuity of the former annual EMR publication series "Operators List 4: Coal Mines in Canada", (last published in January, 1979); to provide representative data on commercial coal quality; and to present information on productivity and technology which reflects the changing coal mining and coal preparation scene in Canada.

This publication includes information on mine locations, operating officials, number of employees, mining and coal preparation methodology, major equipment and production statistics. As such, it should be a useful public reference work for research planners, industrial engineers, suppliers of equipment and services and perhaps potential buyers and sellers of Canadian coal. More details on individual mine operations should, of course, be obtained directly from mine operators.

Canada's coal reserves are presented by province, by coalfield, by rank, by likely mining method and by heating value. Increases in Alberta's Foothills Region are the result of approvals for development given by Alberta's Energy Resources Conservation Board for the McLeod River Project (2) and the Mercoal Project (3). Although approved, both projects are dormant because of the currently oversupplied coal market. For most other coalfields reserves are those presented in CANMET Report 83-20E(1) less raw coal production for the years 1983, 1984 and 1985.

Most of the information and data presented has been gathered as a result of staff working on CANMET's Coal Reserve Assessment Project. This includes regular visits to coal mining operations across Canada and liaison with provincial officials concerned with regulating coal operations.

Information on the geological setting of Canada's major coalfields, as presented in CANMET Report 83-20E(1), has been largely repeated in this report because of the dominating influence geological history has on the technology used to excavate and process coal from individual deposits. Information on the ASTM classification of coal and on EMR's coal resource/reserve category definitions has likewise been largely reproduced from the earlier report, for easy reference.

GEOLOGICAL SETTING: MAJOR COALFIELDS IN CANADA

(Figures 3 to 6 show locations)

Nova Scotia

SYDNEY COALFIELD: This is by far the most important in the province and contains eleven major seams, ranging in thickness from 1.0 to 4.5 m. Six seams are considered economically important but only two are currently being mined, namely the Harbour Seam (also referred to as Sydney Main) and the Hub Seam (also called Stubbert Seam). As well, the Phalen Seam is under development by Cape Breton Development Corporation in its Phalen Colliery Development Project. Coal is Pennsylvanian in age, classed as high volatile "A" bituminous, is generally low in ash when mined underground, and high in sulphur. Almost all Sydney Coalfield reserves are submarine.

The seams are separated by consistent intervals of rock strata composed of sandstone, siltstone, mudstone, shale and limestone, suggesting deposition in a fluvial

environment within a subsiding coastal plain. The coal has not been significantly disturbed on a regional structural scale. Strata are enclosed in a series of open folds which give rise to open synclinal and anticlinal structures whose effect is to vary the dip of beds from 3° to 15°, all in a seaward direction. Seams are often split by shale and sandstone partings. The coal is considered gassy, especially the Harbour Seam. Roof conditions are variable for the same seam in different areas of the coalfield.

For more details on the Sydney coalfield readers are referred to the publications "Coal in Nova Scotia" (4) and "The effects of geological features on coal mining, Sydney Coalfield, Nova Scotia" (5).

New Brunswick

MINTO COALFIELD: This coalfield, located in central New Brunswick, covers an area of approximately 32 km by 13 km along the northern end of Grand Lake. Production comes from a single seam, classed as high volatile "A" bituminous coal, Pennsylvanian in age, varying in thickness from 0.3 to 0.7 m but for the most part ranging from 0.4 to 0.6 m. The seam is essentially flat-lying with minor undulations. Large sections of it follow surface contours, making it amenable to surface mining. The thicker part of the coal is found in the southwest (Minto) area, rather than the northeast (Chipman) area. A shale band in certain areas splits the coal seam.

Saskatchewan

ESTEVAN COALFIELD: The coal resources of southern Saskatchewan, including those of the Estevan Coalfield, were the subject of a major study and report (6) and readers are referred to this report for details on regional and local geology. Briefly, the Estevan Coalfield is the most easterly and the most developed of four coal regions stretching across southern Saskatchewan, all of which are within the Ravenscrag Formation. The Ravenscrag in the Estevan area is a syncline plunging gently to the southeast at about 4.7 m per km. The major part of this coal-bearing formation extends into the states of North Dakota, Montana and Wyoming, where it is correlated with the Fort Union Group. Estevan coal is classified as lignite "A" and is Tertiary in age.

Because of the tendency for individual seams in the Ravenscrag to thicken, thin, split or disappear correlation has been more practical when done by coal zone rather than by individual seam. Five such zones have been identified for the Estevan Coalfield. From bottom to top these are: Boundary, Estevan, Souris, Roche Percee and Short Creek. Zones vary in their areal coverage. For example, the Short Creek Zone covers an area of about 88 km^2 whereas that of the Estevan Zone covers about 442 km^2. As well, glacial and preglacial erosion has removed extensive sections of various zones, replacing coal seams with sand and gravel. Nowhere in this coalfield is more than one coal zone being mined, either because other zones are missing or because overburden is too thick for mining by surface methods under current economic conditions.

The topography of the Estevan Coalfield is relatively flat, with the exception of the valleys of the Souris River and its tributaries, Short Creek and Long Creek, which have cut the plain to a depth of about 30 m.

WILLOW BUNCH COALFIELD: Willow Bunch coals are separated from those of the Estevan Coalfield to the east by an

area of thick glacial overburden and barren beds of the Ravenscrag Formation. To the west there appears to be a belt where no coal was deposited and which separates Willow Bunch from the Wood Mountain Coalfield. The Willow Bunch Coalfield is subdivided into Willow Bunch East and Willow Bunch West by the barren Roncott Platform (6).

Six coal zones have been identified in the Willow Bunch Coalfield. Because of the dissected topography and regional geological structure all zones are present at shallow depth in limited areas within the coalfield. Modern mining in this coalfield commenced in 1978, with production from the Poplar River Mine in the southwest part of the coalfield, near Coronach. Lignite "A" is being mined from the Hart Zone.

Alberta's Plains Region

This region extends north from the international border with Montana to Lesser Slave Lake, and is bounded on the west by the Foothills Region which parallels the Rocky Mountains. Within this extensive region are four principal coal-bearing units which occur at relatively shallow depth, namely:

- in southern Alberta: Oldman and Foremost Formations (making up the Belly River Group); Upper Cretaceous in age.
- in southern and central Alberta: Horseshoe Canyon Formation; Upper Cretaceous
- in north central Alberta: Wapiti Formation; Upper Cretaceous/Tertiary
- in western Alberta, parallel to the Foothills: Paskapoo Formation; Upper Cretaceous/Tertiary.

Northwest of Edmonton the Horseshoe Canyon Formation merges into the Wapiti Formation. Coal in the formations is almost entirely subbituminous in rank. As in southern Saskatchewan, lateral continuity of individual seams is variable, but coal zones are generally persistent over large areas. Individual zones often contain several seams.

BATTLE RIVER COALFIELD: This coalfield, part of the Horseshoe Canyon Formation, has a coal zone made up of up to 3 seams aggregating 3.6 m in thickness with partings also aggregating 3.6 m. Regional dip is about 3 m per km in a west and southwest direction.

WABAMUN COALFIELD: The most economically significant coal zone in this coalfield is the extensive Lower Ardley unit which is part of the Scollard Member of the Paskapoo Formation. The Lower Ardley, from subcrop to a depth of 300 m covers an area of roughly 1 600 000 hec and stretches from Three Hills to Whitecourt, a distance of 300 km. Wabamun coal is Upper Cretaceous in age and is classed as subbituminous B. The coal zone is nearly horizontal, dipping to the southwest about 4.2 m per km with local variations as high as 12.3 m per km and as low as 1.9 m per km.

In a coal zone of thickness ranging between 9 and 13 m there are up to six seams with average cumulative coal thickness from 7 to 8.5 m. Most coal comes from two seams each 3.0 m thick with a parting of 0.5 to 1.0 m. Overlying the coal is a burden currently averaging about 20 m thick, which is expected to reach up to 60 m as mining proceeds. Overburden consists of soft glacial till underlain by weakly consolidated shales, siltstones and sandstones. The surface-mined coal seams in the Alberta plains are almost always the hardest units in the stratigraphic succession and at some mines the coal is drilled and blasted before being excavated.

Alberta's Foothills Region

COALSPUR COALFIELD: Coal measures in this coalfield are underlain by a

succession of non-marine sediments of Upper Cretaceous and Paleocene ages ranging in thickness from 1 500 to 2 100 m. Six seams of commercial interest are contained in a stratigraphic section some 250 m thick referred to as the Coalspur Beds. Two of these are currently being mined, namely Mynheer and Val D'Or. Coal rank is high volatile bituminous. A recent report by R.F. Engler (7) details the structural geology, stratigraphy and areal extent of coal measures in the Coalspur Coalfield.

In the vicinity of the Coal Valley Mine the Mynheer Seam, which is located at the base of the Coalspur Beds, ranges from 5 m to 10 m in thickness. Typically the Mynheer consists of two units: a lower Mynheer zone composed of interbedded coal, carbonaceous shale and bentonite from 2 m to 3 m in thickness, separated from the upper Mynheer, which is of variable thickness, by mudstone and sandstone. The Val D'Or Seam occurs at the top of the Coalspur Beds and ranges in thickness from 6 m to 8 m. Near the mine it consists of six to eight coal bands separated by bentonitic clay partings and a consistent sandstone parting about 1 m thick.

The Coal Valley area is in the structurally deformed Foothills Region of Western Alberta. The Laramide Orogeny, the early phase of which began in the Upper Cretaceous and the late phase ended probably in the Oligocene, initiated compression and tension stresses from the southwest. Thrust faults have caused the repetition of measures and hence the areal concentration of coal. Severe secondary faulting in coal seams has created complex structures.

Alberta's Mountain Region

CADOMIN-LUSCAR COALFIELD: Coal measures occur within the Luscar Formation which is Lower Cretaceous in age. This formation, some 435 m thick, has one major seam of commercial importance, the Jewel Seam, which occurs roughly in the middle of the formation.

The Jewel Seam has a true thickness of 8 to 10 m but, because of structural thickening, can be up to 30 m. Coal is generally clean and free of partings. Coal rank is low to medium volatile bituminous.

Being part of the Rocky Mountains, coal measures have been deformed by the Laramide Orogeny. This geological deformation typically produces coals which are friable and further degrade in size when both mined and beneficiated.

SMOKY RIVER COALFIELD: Coal seams in this coalfield are within the lower part of the Luscar Formation and are of Lower Cretaceous age. Eleven coal seams ranging in thickness from 0.6 to 7.9 m have been identified. Three of these (numbered from the bottom up) are currently being mined by surface and underground methods, namely No. 4 Seam which averages 6.1 m, No. 10 Seam which is 2.7 m and No. 11 Seam which is 3.0 m thick. The others are generally too thin and discontinuous to be economically recovered. Rock units are made up of interbedded, discontinuous sandstones, siltstones and shales which are difficult to correlate because of the absence of marker horizons other than the coal seams.

The regional geology is similar to that described for Alberta's Foothills Region. Strata are in a northwesterly trending sequence of assymetrical folds cut by thrust faults which dip to the southwest. Mining areas are limited to a flat-bottomed syncline and to the limbs of shallow dipping folds. Locally low-angle thrust faults, joint sets and the coal cleat can create difficult roof conditions underground or planes of weakness in pit walls.

Coal mined in the Smoky River Coalfield is high quality metallurgical coal, classified as low volatile bituminous.

British Columbia

CROWSNEST COALFIELD: Located in the southeast corner of the province this coalfield historically and currently is one of Canada's most important. Coal occurs in multiple seams within the Kootenay Formation which is of Lower Cretaceous (Upper Jurassic?) age. The Kootenay is some 730 m thick and contains fourteen seams of economic significance in the vicinity of the Westar Mining Ltd. operations. One seam referred to as 10 Seam is about 11 m thick and provides the bulk of coal production, all of which is now derived from surface mines.

Thrust faulting and tight folding - part of the uplifting and tectonic action which created the Rocky Mountains - have produced seam repetitions and local structural thickening. In certain parts of the coalfield these same conditions have caused seams to be eroded or rendered unmineable.

Coal rank ranges from low to medium volatile bituminous.

ELK VALLEY COALFIELD: Located north of the Crowsnest Coalfield the Elk Valley Coalfield is of major economic significance as a source of high grade metallurgical and thermal coals for the export market.

Coal seams fall within the Kootenay Formation which is of Lower Cretaceous age and generally range upward in the sequence from low volatile to high volatile, although most of the coal is on the low to medium bituminous boundary. In the vicinity of the Fording River Mine up to eleven seams are mined each with thickness between 1.5 m and some 20 m for an aggregate thickness of 65 m. The formation thickness is about 450 m. At the Greenhills Mine, located 10 km south, thirty-six seams have been identified with the bulk of production coming from five of these which range in thickness from 5 to 16 m. At the Line Creek Mine, near the south end of the coalfield, seven seams are mineable, ranging in thickness from 3 to 13 m, with the bulk of low and medium volatile coal being produced from four of these.

Structural conditions vary considerably within the coalfield, but mining generally takes place within synclines or on limbs of synclines.

PEACE RIVER COALFIELD: This coalfield is located in the Rocky Mountain foothills of north-eastern British Columbia. It is within the northwest trending fold belt which is characterized by southwest dipping thrust faults whose effect is to repeat coal measures, thereby adding to the quantity of coal in a given area. Two mines operate in this coalfield: the Quintette Mine of Denison Mines Ltd. and the Bullmoose Mine of Teck Corporation. The description which follows refers to the Quintette Mine.

Within the Quintette lease area the more economically significant coal measures occur within the Gates Member of the Commotion Formation which is part of the Fort St. John Group of Lower Cretaceous strata. Of less economic significance are the coal measures of the Gething Formation whose base is some 200 to 400 m below the Commotion.

Three areas have been identified for mine development. In the Babcock area, there are six persistent coal zones located within a shallow syncline whose limits dip up to 10%, and which plunges from 6° and 8° to the southwest (although the regional folds are northwest). To the northeast the pit is bounded by a south-westerly dipping zone of thrust

faulting. Coal seams in this area, which contain about 45% of the recoverable coal reserves for the Quintette Mine, have an aggregate thickness in excess of 18 m within a 90 m section of predominantly shale and siltstone. In the McConkey-Frame area, four or five seams with an aggregate thickness of 16.5 m to 18 m have been identified. This structure consists of two contiguous synclines with limbs dipping from 15° to 30°. A south-westerly dipping thrust fault forms a mining limit on all but the south-eastern corner of the deposit. In the Shikano area, five seams aggregating 19 m occur in a syncline and associated anticline, in a general north-west/south-east alignment.

Coal rank is medium volatile bituminous.

The correlation of coal measures from the Crowsnest Pass area to the Peace River area has been a continuing problem for regional geologists. A paper by McLean (8) is the first to present an integrated system and proposes several changes to formational nomenclature.

CLASSIFICATION OF COAL BY RANK

Canada uses the systems and procedures of the American Society for Testing and Materials (ASTM) for sampling, analysing and classifying coals by rank, as detailed in the Annual Book of ASTM Standards (9). Basically coals are ranked according to their degree of metamorphism, or progressive alteration, in the natural series from lignite to anthracite.

Classification in the ASTM system is a function of fixed carbon content and calorific value calculated on the mineral-matter-free basis. The higher rank coals are classified according to fixed carbon on the dry basis whereas the lower-rank coals are classed according to calorific value on the moist basis. The agglomerating characteristics of coals (i.e. their binding and/or swelling qualities when heated in the absence of oxygen) are used to differentiate between certain adjacent groups in the ranking. Figure 1 summarizes the ASTM classification of coal by rank.

The approved abbreviations (9) of the ranks of coal by group are:

ma = meta-anthracite
an = anthracite
sa = semianthracite
lvb = low volatile bituminous
mvb = medium volatile bituminous
hvAb = high volatile A bituminous
hvBb = high volatile B bituminous
hvCb = high volatile C bituminous
subA = subbituminous A
subB = subbituminous B
subC = subbituminous C
ligA = lignite A
ligB = lignite B

The proximate analysis of coal (and coke) by definition (9) is the assay of the moisture, ash and volatile matter and the calculation of fixed carbon by difference. In other words % fixed carbon = 100 - (% moisture + % ash + % volatile matter), with all percentages on the same moisture reference base. Other constituents such as sulphur and phosphorus are not included with proximate analysis.

The term ultimate analysis as applied to coal (and coke) is by definition (9) the determination of carbon and hydrogen in the material, as found in the gaseous products of its complete combustion, the determination of sulphur, nitrogen, and ash in the material as a whole, and the calculation of oxygen by difference. The determination of phosphorus or chlorine is not a part of the ultimate analysis of coal. Moisture is not a part of the ultimate analysis of coal but must be

VM%*	FC%*	CLASS	GROUP	CALORIFIC VALUE **	
				Btu per lb	Mj/kg
2	98	ANTHRACITIC(1)	META - ANTHRACITE		
8	92		ANTHRACITE		
14	86		SEMIANTHRACITE		
22	78	BITUMINOUS(2)	LOW VOLATILE BITUMINOUS		
31	69		MEDIUM VOLATILE BITUMINOUS		
			HIGH VOLATILE A BITUMINOUS	14 000	32.6
			HIGH VOLATILE B BITUMINOUS	13 000	30.2
			HIGH VOLATILE C BITUMINOUS	11 500	26.7
		SUBBITUMINOUS(4)	SUBBITUMINOUS A(3)	10 500	24.4
			SUBBITUMINOUS B	9 500	22.1
			SUBBITUMINOUS C	8 300	19.3
		LIGNITIC(4)	LIGNITE A	6 300	14.7
			LIGNITE B		

* Dry, mineral-matter-free basis
** Moist, mineral-matter-free basis
(1) Non-agglomerating; if agglomerating classified as low volatile bituminous
(2) Commonly agglomerating
(3) If agglomerating classified as high volatile C bituminous
(4) Non-agglomerating
VM: Volatile matter
FC: Fixed carbon

Figure 1 – Summarized classification of coal by rank (after Report ER 79-9; Energy, Mines and Resources, Ottawa; December 1979)

determined in order that analytical data may be connected to bases other than that of the analysis sample. As some coals contain mineral carbonates, and practically all coals contain clay or shale which in turn contains combined water -- a part of the carbon, hydrogen, and oxygen found in the products of combustion may arise from these mineral components.

The Free-Swelling Index (FSI) of coal is a number ranging from 1 to 9 based on a small-scale test of the free-swelling properties of coal. The results may be used as an indication of the caking characteristic of the coal when burned as a fuel, and hence is an indicator of the coals suitability for coke-making purposes. Basically, the test involves a one-gram sample being heated in a covered crucible and the resulting coke button's profile being compared with a series of standard profiles.

QUALITY CHARACTERISTICS OF COAL IN CANADA

All ranks of coal occur in Canada, although little anthracitic coal has been produced since the closure in 1979 of the Canmore Mines, located at the eastern entrance to Banff National Park. Besides this wide range in rank, it is worth noting that coals of the same rank, but from different regions, can vary significantly when quality characteristics are compared. For example, much of the high volatile bituminous coal from the Sydney Coalfield in Nova Scotia is an agglomerating coal, relatively high in sulphur and low in ash. The same rank of coal from the Coalspur Coalfield in Alberta's Foothills is non-agglomerating, low in sulphur and high in ash. Table 1 summarizes the salient quality characteristics of coal in the major coalfields or coal regions of Canada.

Since 1918 CANMET (formerly the Mines Branch) has been publishing data on the quality of Canada's commercial coals, including sulphur content. The modern version of these reports is in the form of supplements to the CANMET Report series "Analysis Directory of Canadian Commercial Coals." Sulphur content in its three forms (pyrite, sulphate and organic) was first presented in Supplement No. 4 (1982), along with trace mercury contents. Data on these elements were again presented in Supplement No. 5(1983). Supplement No. 6 (10) presents, for the first time, chlorine and fluorine contents.

Table 1 presents representative data on the quality of commercial coal in coalfields across Canada. The specifics of available commercial coals should, of course, be addressed to individual operators (see Table 7).

CANADA'S COAL RESERVES: AN UPDATE

Resource and Reserve Terminology:

This report like its predecessors (1,11) attempts to provide some answers to the question of national coal supply. Readers are referred to these earlier reports for a discussion of the concepts incorporated into EMR's definitions for various coal resource and reserve categories.

The reserve definitions used in this report are unchanged from those used in CANMET Report 83-20E(1). Although unchanged there is some concern about how realistic current reserve quantities are. This applies not only to Canada, but to all coal producing nations competing in the export marketplace during times when coal (and other fossil fuels) are decreasing in value. It is always easier to add reserve quantities to a national reserve base during times of economic growth because the criteria of overall economic feasibility are easier to understand and accept. The issue needs consensus at an international level.

Coal Reserves by Province/Coal Region/Coalfield

Coal reserve quantities listed in Table 2 fit the definition of coal reserves stated in Appendix "B". The resource base from which coal reserves are derived is that part of resources classified as RESOURCES OF IMMEDIATE INTEREST, in the categories MEASURED and INDICATED, as defined in Appendix "A". Data on the resource base have been included in Table 2 to indicate potential for further development in particular regions or coalfields.

Alberta's coal resources and reserves are assessed by its Energy Resources Conservation Board (ERCB) and are reported annually (12). However, ERCB's criteria and procedures for defining resources differ from those used by Energy, Mines and Resources and a direct correlation between the two systems is not possible. However, there appears to be a reasonable correlation between EMR's definition of reserves and ERCB's "mine permit reserves" for reasons which follow.

Developers wishing to mine coal in Alberta must first obtain a permit to develop and a license to operate from ERCB. An application for a permit must contain extensive site-specific information on in-situ coal quantities, coal quality, proposed mining methods, marketing of coal, etc. This may be considered the equivalent of an engineering feasibility study. Accordingly, that part of ERCB's mine permit reserves referred to (12) as coal "remaining in place" has been considered equivalent to EMR's COAL-IN-MINEABLE SEAMS and ERCB's "reserves of raw coal" has been considered equivalent to EMR's "RECOVERABLE COAL". These equivalents have been used in Table 2 for reserves in coalfields in the Province of Alberta.

Coal Reserves by Rank

Tonnage figures for British Columbia and for Canada as a whole have purposely not been totalled, because such summations would include coal of various ranks which, when lumped together, give a number with little meaning for supply purposes. Totals can more usefully be expressed in terms of coal rank and heating value, as shown in Table 3. Coal deposits with less than 2 megatonnes recoverable coal have been excluded from this table.

Coal Reserves by Likely Mining Method

The mining methods currently used or identified for individual coal deposits in engineering feasibility studies are presented in Table 4. The two surface mining methods refer to the basic way overburden is stripped from the coal, and not to how coal is excavated.

Changes in Recoverable Coal Reserves

Table 5 lists the changes between recoverable coal reserves as presented in CANMET Report 83-20E(1) and this report. A discussion of the changes follows.

Almost all of Nova Scotia's coal reserves are located in the the Sydney Coalfield. The Donkin-Morien Project of the Cape Breton Development Corporation has the largest block of recoverable reserves. Although New Brunswick's Minto Coalfield reserves are low there are prospects of developing additional reserves from the existing resource base in the Minto Coalfield and from the Beersville Coalfield to the northeast.

New data on the extensive lignite deposits in southern Saskatchewan are

not available, so the recoverable coal reserves for Saskatchewan are those presented in CANMET Report 83-20E, less production from 1983 to 1985, inclusive.

Recoverable coal reserves in the Foothills Region increased significantly with approvals for the McLeod River Project (2) and the Mercoal Project (3).

For British Columbia the decrease in reserves is mainly due to production. The potential for new developments in British Columbia and virtually all other regions in canada depends primarily on more favourable market conditions.

Table 6 presents the ratio of recoverable coal reserves to raw coal production for 1985, for those coalfields with operating mines. At best it is a rough indication of coal supply, as it is based on the naive assumption that coal demand, coal price, the cost of production, the cost of transportation, etc. are all constants.

LIST OF COAL MINE OPERATORS, 1986

Table 7 lists coal mine operators, by province and by coalfield as of 1986 in a format similar to that used in CANMET Report 83-20E (1). Figures 3 to 6 show locations of mine operations. Mine output refers to raw coal production.

Since the publication of CANMET Report 83-20E (1) there have been some mine closures, and some new developments in eastern Canada.

In the Sydney Coalfield, a major fire on 5 April, 1984 forced the permanent closure of No. 26 Colliery of Cape Breton Development Corporation - CBDC's major source of metallurgical coal. Work began almost immediately afterwards on the Phalen Colliery Development Project, to replace the lost production capacity and to utilize the displaced work force. This new mechanized mine is expected to begin production in the summer, 1987. The Donkin-Morien Development Project, having reached the Harbour Seam with two 7.5 m diameter tunnels bored mostly by a full-faced tunnel boring machine, has been placed on hold, until such time as coal markets warrant further development. Two smaller operations in the Sydney Coalfield were ended: NOVACO's Point Aconi Pit ceased coal production in May, 1985 having reached the economic stripping ratio and Selminco's Princess Coal Reclamation Project ceased operations in February, 1986 having completed the processing of 2.3 Mt of dump refuse to produce about 290,000t of saleable coal. Pioneer Coal Ltd. began the Airport Swamp Project under contract to CBDC in September, 1986 with the bulldozer stripping of the Gardner Seam for a planned annual production of 100,000t.

The closure of the last of British Columbia's underground coal mines was announced in 1984 by Westar Mining Ltd. The Michel Underground Mine had two components: the hydraulic mine component was scheduled to end production in mid-1985, but was forced to shut down in January, 1985 by a fire in an adjacent sealed-off area; the room-and-pillar component was ended in February, 1986. Both underground operations were being phased out in favour of more economical surface mineable coal from the main Harmer Surface Mine.

OPERATING STATISTICS

Operating data presented in Tables 7 to 11 are in a format comparable to that used in former issues of "Operators List 4: Coal Mines in Canada" so that comparable statistics are maintained. For statistics on producer's disposition of saleable coal, and other tabulations, readers are referred to the EMR annual report series "Statistical Review of Coal in Canada" (13).

There are various measures of productivity in mining, with output per person employed as perhaps the most common. Table 11 presents such data by basic mining method. It must be pointed out that surface mining involves two different technologies for removal of overburden. Dragline stripping is decidedly more productive but requires a favourable topographic setting where coal seams are nearly flat and reasonably regular. Stripping with shovel-truck units is the common method of overburden removal in mountainous regions.

Table 12 gives another measure of productivity in terms of value of production per person. This table identifies broad economic trends which are a composite of many factors. Besides persons employed, productivity changes can reflect changes in capital employed, changes in coal prices, technology and operating methodology.

SOURCES OF INFORMATION AND ACKNOWLEDGEMENTS

The approval of coal projects in Alberta and British Columbia follows well-defined procedures (14,15) which have resulted in some public disclosure of data on coal reserve quantities, limiting criteria, coal quality, mining plans, environmental impact assessments etc. In this regard the writers wish to acknowledge assistance in accessing public documents held in the Coal Department of Alberta's Energy Resources Conservation Board and the Mineral Resources Branch of B.C.'s Ministry of Energy, Mines and Petroleum Resources. Along with these two provincial agencies, the authors also acknowledge the assistance of the Nova Scotia Department of Mines and Energy, the New Brunswick Department of Natural Resources and the Saskatchewan Department of Energy and Mines. The cooperation of the Energy Statistics Section of Statistics Canada is acknowledged. Finally, the authors wish to thank the managers of various coal mining operations and developments across Canada who, without exception, have permitted field trips to their mine properties.

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APPENDIX A

EMR'S COAL RESOURCE CLASSIFICATION
(essentially from Report ER 79-9)

A meaningful reporting of Canada's coal resources must be made in the context of a classification scheme that takes into account the great diversity of the nation's coal deposits. The coal resource classification scheme classifies the resources according to two basic considerations: (a) the assurance of their existence and (b) the feasibility of exploitation. Each of these considerations is subdivided into categories having defined parameters. The definitions of terms and parameters used in this scheme are given below. They are somewhat similar to those used in the United States (Averitt, 1969) but are modified to suit local conditions that are present in Canadian coal deposits.

Definition of Resource Terms

COAL RESOURCES

The term "coal resources" is defined as the coal that is contained in seams occurring within specified limits of thickness and depth from surface.

ASSURANCE OF EXISTENCE

The terms "measured", "indicated", "inferred" and "speculative" denote the level of confidence with which given quantities of resources have been determined or estimated; they are defined as follows:

Measured Resources are resources for which tonnages are computed from information revealed in outcrops, trenches, mine workings and boreholes. The spacing of points of observation necessary to justify confidence in the character and continuity of coal seams differs from region to region according to the character of the deposits and the geological conditions. In general the points of observation should be separated by less than the following distances:

Coal regions in Canada	Maximum distance between points of observation (in metres)
Cordillera*	300
(150 m in severely contorted areas)	
Plains	
Alberta	800
Saskatchewan	800
New Brunswick	400
Nova Scotia	
Sydney Coalfield, offshore	
Harbour and Phalen seams	1 600
Other seams	800
Sydney Coalfield, onshore	800
Other coalfields	300

*Cordillera region includes all British Columbia and the Foothills and Mountain regions of Alberta.

Indicated Resources are resources for which tonnages are computed partly from specific measurements and partly from reasonable geological projections. For the general coal regions in Canada, the points of observation should be separated by less than the following distances:

Coal regions in Canada	Maximum distance between points of observation (in metres)
Cordillera	600
(300 m in severely contorted areas)	
Plains	
Alberta	1 600
Saskatchewan	1 600
New Brunswick	800
Nova Scotia	
Sydney Coalfield, offshore	
Harbour and Phalen seams	4 800
Other seams	1 600
Sydney Coalfield, onshore	1 600
Other coalfields	600

Inferred Resources are resources for which quantity estimates are based largely on a broad knowledge of the geologic character of the bed or region and for which few measurements of seam thickness are available. The estimates are based primarily on an assumed continuity of coal seams in areas remote from the points of observation used to calculate measured or indicated resources.

Speculative Resources are resources for which quantity estimates are based on information from a few scattered occurrences. Resources of this description are mainly in frontier areas where coal mining or exploration have not taken place.

FUTURE CONSIDERATION

It is realized that it would be more meaningful to express the assurance of existence (level of confidence) by a range of possible error rather than by an arbitrary spacing of the points of observation. As an example, a measured resource estimate might be stated to have a level of confidence to within plus or minus 10 percent. To achieve this requires complex analysis.

FEASIBILITY OF EXPLOITATION

Resources of Immediate Interest consist of coal seams that, because of favourable combinations of thickness, quality, depth and location, are considered to be of immediate interest for exploration or exploitation activities. The conditions set out below do not apply rigorously in each case, but they give a general indication of thickness and depth of coal seams included in this category. In all cases, coal beds are included that are thinner or deeper than listed below but are nonetheless being mined at this time.

Cordillera:	Coal of all ranks in beds at least 1.5 m thick that can be surface-mined.
	Anthracitic and bituminous coal seams at least 1.5 m thick to a depth of 300 m, that are too deep for surface mining but might be mined underground.
Plains: (Alberta and Saskatchewan)	Bituminous and subbituminous coal beds at least 1.5 m thick to a depth of 230 m. Lignite seams at least 1.5 m thick that can be surface-mined (generally to depths less than 45 m).
New Brunswick:	Seams at least 0.4 m to a depth of 24 m.
Nova Scotia:	
Offshore:	Seams at least one metre thick to a depth of 1 200 m.

Nova Scotia:

Onshore:	Seams at least 0.5 m thick to depths of 45 m and all seams at least one metre thick to depth of 1 200 m.

Resources of Future Interest consist of coal seams that, because of less favourable combinations of thickness, quality, depth and location, are not of immediate interest but may become of interest in the foreseeable future. The following limits are applied (excluding the resources of immediate interest described above):

Cordillera:	Seams at least 1.5 m thick to depths of 750 m.
Plains: (Alberta and Saskatchewan)	Seams at least one metre thick to depths of 450 m.

Nova Scotia:

Offshore:	Seams at least one metre thick with depths in excess of 1 200 m.
Onshore:	Seams at least one metre thick with depths in excess of 1 200 m.

FUTURE CONSIDERATIONS

When new mining technologies and/or changing economic conditions have indicated the possibility of mining thinner or deeper seams, or seams that are otherwise currently excluded from the estimates, it may become necessary to change the parameters for determining the feasibility of exploitation so as to include these coals in the estimates.

APPENDIX B

EMR'S COAL RESERVE CLASSIFICATION
(essentially from Report ER 79-9)

The terminology used in this report is similar to that given in CANMET Report 83-20E.

COAL IN MINEABLE SEAMS is that part of measured and indicated resources of immediate interest that can be considered for mining using current technology and economics, before there is any allowance for mining losses. To qualify as COAL IN MINEABLE SEAMS the following conditions must apply:

- that feasibility studies have been done, specific plans for mining method and processing (if needed) have been adopted and the overall economic feasibility for developing the coal deposit appears favourable.
- that the necessary infrastructure (townsite, power and transportation facilities) is either in place or can be amortized through coal sales.
- that the coal is legally accessible for excavation i.e. the development considered is beyond the prospectus or initial disclosure stage in the regulatory process and has received approval-in-principle from the provincial government concerned with controlling development.
- that all coal being considered for development is likely to be marketable at minimum acceptable profit levels.

RECOVERABLE COAL is that part of COAL IN MINEABLE SEAMS that would be recoverable as run-of-mine or raw coal, making allowances for mining losses. For example, in surface mining, a portion of the top of a seam will likely be lost with overburden in the stripping operation, or a part of the seam next to the spoil pile will not likely be excavated. In underground operations the most common mining loss is associated with pillars left as supports or barriers.

CLEAN COAL is that part of RECOVERABLE COAL that remains as the prime saleable product after upgrading in a preparation plant.

SALEABLE COAL is coal that meets saleable specifications; it may be clean coal with acceptable moisture content or raw coal that is ready to be used without further upgrading. Saleable coal differs from CLEAN COAL in that its quantity includes losses in shipment and, in most instances, moisture added in processing.

TABLE 1 — QUALITY CHARACTERISTICS OF COAL IN CANADA, BY REGION AND COALFIELD

Region Coalfield	Rank	Current Use (potential use)	Proximate Analysis% 1 run-of-mine coal 2 clean metallurgical coal 3 clean thermal coal	M	A	VM	FC
NOVA SCOTIA							
Sydney	hvb	80% thermal	1	5-7	12-24	26-31	38-46
			1	7-10	10-21	28-33	44-47
		20% metallurgical	2	3	3	33-35	59-61
			3	5	7-8	33-35	52-55
NEW BRUNSWICK							
Minto	hvb	thermal	1	1-4	15-26	29-34	42-51
SASKATCHEWAN							
Estevan	lig	thermal	1	32-34	8-12	26-31	27-31
Willow Bunch	lig	thermal	1	36-40	10-13	23-26	26-28
ALBERTA PLAINS							
Battle River	sub	thermal	1	25-26	8-13	28-30	33-37
Sheerness	sub	thermal	1	24-27	8-15	25-30	34-37
Wabamun	sub	thermal	1	19-22	11-17	27-29	36-39
Wetaskiwin	sub	(thermal)	1	18-20	13-16	27-28	36-38
ALBERTA FOOTHILLS							
Coalspur	hvb	thermal	1	10-14	25-35	24-28	31-35
			3	8-9	10	33-35	46-48
Obed Mountain	hvb	thermal	1	13-17	25-35	20-30	28-32
			3	8	13	36	43
ALBERTA MOUNTAINS							
Cadomin Luscar	mvb	metallurgical	1	4-6	15-25	18-22	56-61
		(thermal)	2	7-8	9-10	21-25	57-63
Smoky River	lvb	metallurgical	1	3-8	12-18	15-17	60-63
		and some thermal	2	6	7-8	17-22	66-69
BRITISH COLUMBIA							
Comox	hvb	(thermal)	1	7-8	10-12	35-36	47
Crowsnest	lvb-mvb	metallurgical	1	3-9	12-35	18-24	53-66
		and thermal	2	8	9-10	19-22	61-64
			3	7	15-17	20-23	54-57
Elk Valley	lvb-mvb	metallurgical	1	4-14	12-30	19-29	50-59
	-hvb	and some thermal	2	7-8	6-10	20-33	52-64
			3	7	15-17	20-23	55-58
Flathead	mvb	(thermal)	1	3-6	25-35	22	40-50
Hat Creek	lig-sub	(thermal, chemical feedstock)	1	23	32	24	21
Peace River	mvb	metallurgical	1	3-6	20-35	19-25	53-60
		and thermal	2	8	9-10	22-23	59-62
			3	8	10-11	22-23	58-61

Abbreviations used for rank: lig=lignitic; sub=subbituminous; hvb=high volatile bituminous; mvb=medium volatile bituminous; lvb=low volatile bituminous
Abbreviations used for proximate analysis: M=moisture; A=ash; VM=volatile matter; FC=fixed carbon

Sulphur %	Heating Value (moist basis MJ/kg)	Remarks
1.2-2.0	23-28	Harbour Seam, Glace Bay and New Waterford areas
3.3-4.9	23-27	Hub Seam, Point Aconi area; coals highly reactive;
1.2	30-33	supply of met. coal interrupted by fire and
2.5-3.0	30	closure of No. 26 Colliery 5 April, 1984.
5-12	25-30	high sulphur, high ash
0.3-0.6	15-17	
0.3-0.8	12-14	high moisture
0.4-0.5	17-19	variable ash
0.4-0.5	16-19	variable ash
0.2-0.3	17-19	variable ash
0.2-0.4	19-20	
02.-0.4	19-20	variable quality; clay bands in
0.3	25	coal demand selective mining
0.3-1.2	16-19	same remarks as for Coalspur Coalfield
0.5	25	
0.2-0.4	27-30	
0.2-0.4	30-32	
0.3-0.5	28-31	
0.4-0.5	33-34	
0.5-0.6	27	Quinsam Project samples
0.2-0.6	22-29	clean thermal coal has higher ash
0.4	30-32	
0.3-0.5	26-27	
0.4-0.6	24-29	several blends of clean coal are
0.4-0.6	27-32	produced to customers' specs.
0.5	20-25	
0.5	20-25	% VM is an average value
0.4	11.6	values shown are averages for a
0.3-0.6	22-28	highly variable coal
0.3	29-31	
0.5	28-30	

Table 2 — Estimates of coal reserves in Canada (December, 1985) (1)

PROVINCE Region Coalfield	RESOURCES of immediate interest (2) (x 10^6 tonnes) Measured	Indicated	RESERVES (x 10^6 tonnes) Coal-in-mineable seams	Recoverable coal	Clean (3) coal	Coal (4) rank
NOVA SCOTIA						
Sydney (5)	156	1,428	567	413	384	hvb
Inverness	-	-	2.6	1.3	N/A	hvb
Cumberland-Springhill	-	-	0.1	0.1	N/A	hvb
Pictou	24	6	0.2	0.1	N/A	hvb
Sub-Total	204	1,469	570	415	384	
NEW BRUNSWICK						
Minto	6	13	9.6	8.6	N/A	hvb
Beersville	14	14	13.6	12.2	N/A	hvb
Sub-Total	20	27	23.2	20.8		
SASKATCHEWAN						
Estevan	283	497	-	-	N/A	lig
Willow Bunch	747	1,044	-	-	N/A	lig
Wood Mountain	278	733	-	-	N/A	lig
Cypress	162	407	-	-	N/A	lig
Sub-Total	1,470	2,681	2,088	1,670		
ALBERTA PLAINS (6)						
Alix	-		4.1	2.8	N/A	sub
Ardley	-		2.0	1.4	N/A	sub
Battle River	-		136	76	N/A	sub
Drumheller	-		41.9	10.6	N/A	sub
Mayerthorpe	-		3.1	2.0	N/A	sub
Morinville	-		13.1	8.3	N/A	sub
Sheerness	-		192	134	N/A	sub
Thorhild-Abee	-		1.6	1.2	N/A	lig
Tofield-Dodds	-		0.9	0.6	N/A	sub
Wabamun	-		642	480	N/A	sub
Wetaskiwin	-		249.9	155	N/A	sub
Sub-Total	41,860	-	1,287	872		
ALBERTA FOOTHILLS (6)						
Coalspur	-		449	316	196	hvb
Obed Mountain	-		197	154	95	hvb
McLeod River	-		387	330	208	hvb
Sub-Total	2,490	-	1033	800	499	
ALBERTA MOUNTAINS (6)						
Cadomin-Luscar	-		161	77	59	mvb
Smoky River	-		420	163	117	lvb
Sub-Total	7,760	-	581	240	176	

Table 2 — Estimates of coal reserves in Canada (December, 1985) (1) (continued)

PROVINCE Region Coalfield	RESOURCES of immediate interest (2) (x 10^6 tonnes) Measured	Indicated	RESERVES (x 10^6 tonnes) Coal-in-mineable seams	Recoverable coal	Clean (3) coal	Coal (4) rank
BRITISH COLUMBIA						
Crowsnest	6,286	9,436	540	436	333	lvb-mvb
Elk Valley			1,133	1,069	713	lvb-mvb-hvb
Nanaimo	-	-	3.2	1.6	N/A	hvb
Peace River	996	462	710	476	353	mvb
Comox	-	-	16	15	10	hvb
Hat Creek	-	-	739	566	N/A	lig-sub

Notes

(1) for EMR definition of resource/reserve terminology see Appendices "A" and "B"

(2) source: J.D. Hughes, Geological Survey of Canada, as published for 1984 by the Coal Association of Canada in "1986 Review and Directory"

(3) for coalfields with operating mines, clean coal reserves were calculated using plant recoveries published in CANMET Report No. 86-5 (15)

(4) lig = lignitic; sub = subbituminous; hvb = high volatile bituminous; mvb = medium volatile bituminous; lvb = low volatile bituminous

(5) source: S. Forgeron, Cape Breton Development Corporation; personal communication; reserves data valid as of December, 1986

(6) reserves for Alberta are those published for permitted mine sites in ERCB Report ST-31 (12)

(-) not determined or not published in source document

N/A not applicable

Table 3 — Coal reserves in Canada, by rank (December, 1985)

Rank Region Coalfield	Recoverable coal (megatonnes)	Assumed heating value MJ/kg	Recoverable coal heating value (petajoules)
LIGNITIC			
Saskatchewan			
All coalfields	1,670	13.8	23,000
British Columbia			
Hat Creek	566	13.5	7,600
Sub-Total, Lignitic	2,236		30,600
SUBBITUMINOUS			
Alberta			
Alix	3	16	50
Battle River	76	18	1,350
Drumheller	11	19	200
Morinville	8	16	150
Sheerness	134	17.5	2,350
Wabamun	480	18.0	8,650
Wetaskiwin	155	19.5	3,000
Others	4	16	50
Sub-Total, Subbituminous	871		15,800
BITUMINOUS			
Nova Scotia			
Sydney	413	25.5	10,550
Others	2	25	50
New Brunswick			
Minto	8	27	200
Beersville	12	27	300
Alberta			
Coalspur	316	19.5	6,150
McLeod River	330	19	6,250
Obed Mountain	154	19	2,950
Cadomin Luscar	77	28	2,150
Smoky River	163	29	4,750
British Columbia			
Comox	15	27	400
Crowsnest	436	25	10,900
Elk Valley	1,069	25	26,750
Peace River	476	25	11,900
Sub-Total, Bituminous	3,471		83,300
TOTAL, ALL Ranks	-	-	129,700
BITUMINOUS METALLURGICAL, included in BITUMINOUS above			
Nova Scotia	115		
Alberta	240		
British Columbia	1,563		
TOTAL, Metallurgical	1,918		

Table 4 — Coal reserves in Canada, by likely mining method
(December 1985)
(in megatonnes)

Rank Province Coalfield	Recoverable coal	Surface methods		Underground methods		
		shovel/ truck	dragline	longwall	room & pillar	hydraulic
LIGNITIC						
Saskatchewan						
All coalfields	1,670		1,670			
British Columbia						
Hat Creek	566	566				
Sub-Total, Lignitic	2,236	566	1,670			
SUBBITUMINOUS						
Alberta						
Alix	3	3				
Battle River	76		76			
Drumheller	11			11		
Morinville	8	8				
Sheerness	134		134			
Wabamun	480		480			
Wetaskiwin	155		155			
Others	4	4				
Sub-Total, Subbituminous	871	15	845	11		
BITUMINOUS						
Nova Scotia						
Cumberland-Springhill	0.1	0.1				
Inverness	1.4				1.4	
Pictou	0.1	0.1				
Sydney	413			413		
New Brunswick						
Minto	9		9			
Beersville	12		12			
Alberta						
Coalspur	316	294	22			
McLeod River	330	330				
Obed Mountain	154	47	107			
Cadomin-Luscar	77	77				
Smoky River	163	68			95	
British Columbia						
Comox	15	6	9			
Crowsnest	436	378				58
Elk Valley	1,069	1,059	10			
Peace River	476	390			86	
Sub-Total, Bituminous	3,472	2,649	169	413	182	58
TOTAL, by Basic Method		Surface: 5,914		Underground: 664		
TOTAL, by Mining Method		3,230	2,684	424	182	58

Table 5 — Changes in recoverable coal reserves, Dec. 1982 to Dec. 1985

Province/ Region	Recoverable coal reserves ($x10^6$t)			Remarks
	Report 83-20E	This report	Difference	
Nova Scotia	445	415	-30	decrease represents raw coal production 1983-1985, some reserves lost with closure of No. 26 Colliery and some recalculations.
New Brunswick	18	21	+3	
Saskatchewan	1,697	1,670	-27	decrease represents raw coal production 1983-1985.
Alberta Plains	918	872	-46	decrease due to production 1983-1985.
Alberta Foothills	272	800	+528	increase the result of approvals for Mercoal and McLeod River Projects.
Alberta Mountains	254	240	-14	decrease due mostly to production.
British Columbia				
bituminous	2,098	1,996	-102	decrease due to production and closure of Michel Underground Mine.
lignitic	566	566		
Canada Total: lig	2,263	2,236	-27	
sub	918	871	-47	
bit	3,087	3,471	+384	
BITUMINOUS METALLURGICAL, included in BITUMINOUS above				
Nova Scotia	133	115	-18	
Alberta	254	240	-14	
British Columbia	1,643	1,563	-80	
Total, Metallurgical	2,030	1,918	-112	

Table 6 — Ratio of Recoverable Reserves to 1985 Production by Coalfield

Major Coalfield	(a) Recoverable Reserves as of Dec. 1985 (x 10^6 tonnes)	(b) Raw Coal Production 1985 (x 10^6 tonnes)	Ratio $\frac{(a)}{(b)}$
Sydney	413	2.584	160
Minto	8.6	0.564	15
S. Saskatchewan	1,670	9.967	168
Battle River	76	2.744	28
(2) Sheerness	134	.296	450
Wabamun	480	13.792	35
(3) Coalspur	316	3.330	95
(2) Obed Mountain	154	1.356	114
Cadomin-Luscar	77	5.227	15
Smoky River	163	1.688	97
Crowsnest	436	10.383	42
(4) Elk Valley	1,069	12.349	87
Peace River	476	13.012	37

Notes:

(1) Recoverable coal reserves refer to coal that would be recoverable as run-of-mine or raw coal.

(2) Mines in these coalfields were not operating at representative capacities in 1985.

(3) The Coalspur Coalfield includes the undeveloped Mercoal Project of Manalta Coal Ltd.

(4) The Elk Valley Coalfield includes the undeveloped Elk River Project of Elco Mining Ltd.

TABLE 7 — COAL MINE OPERATORS, 1986

Mine Operator & Head Office	Mine Name, Location & Representative	Basic Mine Type	1986 Mine Output 10^3T (Preliminary)	No. of Employees	Major Markets
NOVA SCOTIA					
SYDNEY COALFIELD					
Cape Breton Development Corp. P.O. Box 2500 Sydney, N.S. B1P 6K9	Lingan Colliery New Waterford, N.S. P. Jones-Colliery General Manager	underground (submarine)	1,617	staff: 37 others: 1,116	thermal coal for electric power generation and export; metallurgical coal for export and local markets.
	Prince Colliery Point Aconi, NS G. White - Colliery General Manager	underground (submarine)	1,120	staff: 26 others: 647	thermal coal for electric power generation locally and in other parts of N.S.
	Phalen Colliery Development Project New Waterford, N.S. D. Merner - Project Manager	underground (submarine)	322	staff: 29 others: 578	metallurgical coal for export and local markets; thermal coal for local power generation and export.
Selminco Joint Venture P.O. Box 289 New Waterford N.S. B1M 4K4	Summit Coal Reclamation Project New Waterford, N.S. G. Potter - Project Manager	reclamation of old mine waste dumps	131	staff: 6 others: 34	local thermal coal market
Thomas Brogan & Sons Construction Ltd. 126 Main St. Sydney Mines, N.S. B1V 2L7	Point Aconi Pit Sydney Mines, N.S. Thomas Brogan Manager	surface	34	staff: 2 others: 16	local electric power generation
MABOU-INVERNESS COALFIELD					
Evans Coal Mines Ltd. R.R. 1 Inverness County, N.S. B0E 1N0	St. Rose Mine Margaree Harbour Gary Evans - Manager	underground	35	staff: 3 others: 42	local domestic and electric power generation
PICTOU COALFIELD					
Pioneer Coal Ltd. Nova Construction Ltd. Antigonish, N.S.	Drummond Pit Westville, N.S. D. Clifton - Mine Manager	surface	108	staff: 2 others: 12	local electric power generation and industrial use
NEW BRUNSWICK					
MINTO COALFIELD					
N.B. Coal Ltd. P.O. Box 520 Minto, N.B. E0E 1J0	Minto/Chipman Area Pits A. Cormier - President	surface	490	staff: 14 others: 236	electric power generation in N.B.

Coal Rank and Seam (s)	Mining Method & Major Equipment	Coal Preparation Facilities	Remarks
high volatile A bituminous Harbour Seam; 2.1 m thick; dips 9° but varies from 5° to 10° seaward	advancing longwalls; 3 shearer faces with powered roof supports; 8 roadway cutter loaders; 3 ranging arm double drum shearers	run-of-mine coal to rotary breaker at pithead prior to movement by rail to Victoria Junction Preparation Plant (1976) which has two separate circuits of 430 and 260 tonnes/hr. feed capacity; larger washes higher sulphur coal (2.0-4.0%S) and smaller the lower sulphur coal (1.2-2.0%S); plant uses conventional heavy-medium cyclones for +0.6 mm raw feed and froth flotation for 0.6 mm x 0 fines	3 advancing longwalls operating Coal Division of CBDC employs a total of approx. 3,580, including 170 in prep. plant and others in general mine services, rail transport, shops and ship loading
high volatile A bituminous Hub Seam; 2.3 m thick; dip about 3°	retreating longwalls; 2 shearer faces with powered roof supports; 14 roadway cutter loaders; 2 ranging arm double drum shearers	run-of-mine coal moved by truck directly to power generating plants	1 retreating longwall operating
high volatile A bituminous to medium volatile bituminous; Phalen Seam, 1.7 to 3.0 m thick with thick section including a stone split; dips 16° near shore and flattens seaward	panel-and-pillar extraction at shallow depths, then retreating longwalls; equipping one shearer face with powered roof supports; 10 roadway cutter loaders 1 ranging arm double drum shearer	run-of-mine coal to rotary breaker at pithead prior to movement by rail to Victoria Junction Preparation Plant	coal produced in 1986 was from development headings; mine start-up expected in summer 1987; projected output is 1.5 Mt saleable coal per annum
high volatile A bituminous; discard mostly from former Harbour and Phalen Seam underground operations	plant feed excavated by frontend loader or backhoe and trucked to prep. plant	Summit Recovery Plant (1982) includes conditioner/breaker, water cyclones and dewatering screens; capacity 91 tonnes /hr.	from start-up in May, 1982 to end of December, 1986 approx. 2.5 Mt of dump material was processed to produce 325,000 tonnes coal
high volatile A bituminous; two seams each 0.9 m thick; near level	tractor and dragline stripping; 1 dragline 5.3 m^3 6 bulldozers 3 frontend loaders, 6.9 m^3, 6.1 m^3 and 3.8 m^3	run-of-mine coal delivered directly to power plant	
high volatile B bituminous; No. 5 Seam 2.4 m thick; variable dip, near 16°	room-and-pillar; mechanical miner roof bolter	mechanical dry cleaning; capacity 72 tonnes/hr.	
high volatile bituminous; Acadia Seam approx. 2 m thick; variable dip approx. 12° - 15°	tractor and backhoe stripping; 3 bulldozers 2 frontend loaders 3 backhoes	run-of-mine coal trucked directly to users	started producing late in 1984
high volatile A bituminous; single seam; 0.3 to 0.5 m thick; flat	dragline stripping; five draglines with bucket capacities of 49.7 m^3, 9.2 m^3, 12.2 m^3, 9.9 m^3 and 4.6 m^3 6 bulldozers 7 loaders 5 rotary drills 31 haulage trucks of 13.6 tonnes 2 haulage trucks of 27.2 tonnes	run-of-mine coal is crushed, but not screened	N.B. Coal operates 4 pits and 3 pits are operated under contract

Mine Operator & Head Office	Mine Name, Location & Representative	Basic Mine Type	1986 Mine Output 10^3T (Preliminary)	No. of Employees	Major Markets
SASKATCHEWAN					
ESTEVAN COALFIELD					
Bienfait Coal Co. c/o Luscar Ltd. 800 Royal Trust Tower Edmonton, Alberta T5J 2Z2	Bienfait Mine P.O. Box 399 Bienfait, Sask. S0C 0M0 Mr. S. Kingdon Mine Manager	Surface	1,260	staff: 17 others: 49	electric power generation both locally and for Manitoba and Ontario; lignitic char produced for barbeque briquettes
Manitoba and Saskatchewan Coal Co. Ltd. c/o Luscar Ltd. 800 Royal Trust Tower T5J 2Z2	Boundary Dam Mine P.O. Box 908 Estevan, Sask. S4A 2A7 Mr. W. Hume Mine Manager	Surface	1,279	staff: 14 others: 54	local electric power generating plant
Manalta Coal Ltd. P.O. Box 2880 Calgary, Alberta T2P 2M7	Costello Mine Estevan, Sask. P. Christian Mine Manager	Surface	187	staff: 9 others: 24	local electric power generation and domestic heating; industrial use in Saskatchewan and Manitoba
	Utility Mine P.O. Box 760 Estevan, Sask. S4A 2A6 W. Weymark Mine Manager	Surface	2,196	staff: 18 others: 59	local electric power generation
WILLOW BUNCH Manalta Coal Ltd. P.O. Box 2880 Calgary, Alberta T2P 2M7	Poplar River Mine P.O. Box 599 Coronach, Sask. S0H 0Z0 Wayne Kelly Mine Manager	Surface	3,360	staff: 20 others: 138	local electric power generation
ALBERTA'S PLAINS REGION					
BATTLE RIVER COALFIELD					
Forestburg Collieries Ltd. c/o Luscar Ltd. 800 Royal Trust Tower Edmonton, Alberta T5J 2Z2	Diplomat Mine Forestburg, Alberta O. Saboe - Mine Manager	Surface	25	staff: 4 others: 10	local electric power generation: industrial and domestic markets in western Canada
	Paintearth Mine Forestburg, Alberta R. Evans - Mine Manager	Surface	1,323	staff: 22 others: 52	local electric power generation
Manalta Coal Ltd. P.O. Box 2880 Calgary, Alberta T2P 2M7	Vesta Mine Halkirk, Alberta T0L 1M0 T.J. Jenish Mine Manager	Surface	1,055	staff: 18 others: 42	local electric power generation
SHEERNESS COALFIELD					
Manalta Coal Ltd. P.O. Box 2880 Calgary, Alberta T2P 2M7	Montgomery Mine Hanna, Alberta T0J 1P0 D.L. Meads - Mine Manager	Surface	1,021	staff: 15 others: 37	electric power generation and local domestic uses: some industrial markets
WABAMUN COALFIELD					
Manalta Coal Ltd. P.O. Box 2880 Calgary, Alberta T2P 2M7	Highvale Mine P.O. Box 30 Seba Beach, Alberta T0E 2B0 I.J. Wiens - Mine Manager	Surface	11,803	staff: 65 others: 320	local electric power generation

Coal Rank and Seam (s)	Mining Method & Major Equipment	Coal Preparation Facilities	Remarks
lignilic A; single seam in Estevan Zone is 6.4 m thick includes two partings lolalling 1.2 m; near horizontal	dragline stripping; 1 dragline 53.6 m^3 1 dragline 8.4 m^3 2 frontend loaders 9.8 m^3 8 haulage trucks 55 tonnes 1 rotary drill 5 bulldozers	screening plant only	employees working in calciner not included
lignitic A: single seam in Estevan Zone is 3.5 m thick with parting of variable thickness up to 1.8 m; near horizontal	dragline stripping; 1 dragline 30.6 m^3 1 dragline 8.4 m^3 1 dragline 5.4 m^3 1 coal power shovel 7.7 m^3 6 haulage trucks 64 tonnes 1 rotary drill 3 bulldozers 2 frontend loaders 9.8 m^3	crushing and screening done at local power generating plant	
lignitic A; two seams totalling 2.5 m in Estevan Zone separated by parting up to 1.5 m, near horizontal	dragline stripping; 1 dragline 48 m^3 1 coal power shovel 12 m^3 1 frontend loader 5.3 m^3 6 haulage trucks 64 tonnes 2 bulldozers	mine tipple has capacity of 600 tonnes/hr.	
lignitic A; one seam in Estevan Zone 3.8 m with parting up to 0.3 m; near horizontal	dragline stripping; 1 dragline 69 m^3 1 dragline 26 m^3 1 coal power shovel 12 m^3 1 coal hydraulic shovel 12 m^3 6 haulage trucks 91 tonnes 2 bulldozers	crushing and screening at power plant; capacity 1,000 tonnes/hr.	Sask. Power Corp. is mine owner
lignitic A; Hart Seam is 3.0-4.3 m thick with a parting up to 1.4 m thick; near horizontal	dragline stripping; 2 draglines 69 m^3 1 coal power shovel 12 m^3 1 coal loading backhoe 12 m^3 4 haulage trucks 136 tonnes 4 bulldozers 1 frontend loader 12.2 m^3	crushing and screening at mine tipple; capacity 1,200 tonnes/hr.	dewatering required prior to mining
subbituminous C; Horseshoe Canyon Formation; one seam 1.2 m thick; near horizontal	dragline stripping; 1 dragline 8.4 m^3 4 haulage trucks 54 tonnes 2 bulldozers 1 frontend loader 7.6 m^3	some crushing and screening at mine tipple; capacity 225 tonnes/hr.	
subbituminous C; Horseshoe Canyon Formation; two seams of aggregate thickness to 4.5 m with parting up to 1.5 m; near horizontal	dragline stripping; 1 dragline 52 m^3 4 haulage trucks 120 tonnes 2 frontend loaders 9.9 m^3 3 bulldozers 3 scrapers	crushing and screening at local power plant	
subbituminous C; No. 1, 2 and 3 of thickness up to 3.0 m and 2 partings up to 2.0 m; near horizontal	dragline stripping; 1 dragline 44.4 m^3 1 coal power shovel 8 m^3 1 coal power shovel 4 m^3 6 haulage trucks 64 tonnes 3 bulldozers	crushing and screening at mine tipple capacity 2,000 tonnes/hr.	Alberta Power Ltd. is mine owner
subbituminous C; two seams: Main Seam 2.4 m thick and Top Seam 0.3 m to 0.6 m thick occurs 1.2 m above main; near horizontal	1 dragline 24 m^3 2 bulldozers 1 coal power shovel 5.7 m^3 2 frontend loaders 5.0 m^3 3 haulage trucks 100 tonnes 3 scrapers	crushing and screening at tipple, capacity 230 tonnes/hr.	prior to Dec./82 was named Roselyn Mine
up to five seams being mined in coal zone (Lower Ardley Unit) varying in thickness from 9.3-11.3 m of which 8.5 m is coal near horizontal	1 dragline 44 m^3 1 dragline 38 m^3 1 dragline 23 m^3 1 dragline 67 m^3 5 coal power shovels 12 m^3 4 haulage trucks 145 tonnes 4 haulage trucks 136 tonnes 5 haulage trucks 91 tonnes 12 bulldozers 1 tractor-mounted drill 1 frontend loader 5.7 m^3	tipple; capacity 2, 700 tonnes/hr.	TransAlta Utilities Corp. is mine owner

Mine Operator & Head Office	Mine Name, Location & Representative	Basic Mine Type	1986 Mine Output 10^3T (Preliminary)	No. of Employees	Major Markets
WABAMUN COALFIELD continued					
Fording Coal Ltd. 200, 205 - 9th Ave S.E. Calgary, Alberta T2G 0R4	Whitewood Mine P.O. Box 88 Wabamun, Alberta T0E 2K0 J. Popowich - Mine Manager	Surface	2,257	staff: 18 others: 75	local electric power generation:
ALBERTA'S FOOTHILLS REGION COALSPUR COALFIELD					
Luscar Ltd. 800 Royal Trust Tower Edmonton, Alberta T5J 2Z2	Coal Valley Mine Edson, Alberta Ed Komperdo - General Manager	Surface	2,968	staff: 80 others: 235	electric power generation in Ontario and thermal coal export markets
OBED MOUNTAIN COALFIELD					
Obed Mountain Coal Co. P.O. Box 999 Calgary, Alberta T2P 2K6	Obed Marsh Mine Bag Service 7600 Hinton, Alberta T0E 1B0 J.W. Basse - General Manager	Surface	1,531	staff: 40 others: 65	thermal coal for export
ALBERTA'S MOUNTAIN REGION CADOMIN-LUSCAR COALFIELD					
Cardinal River Coal Ltd. c/o Luscar Ltd. 800 Royal Trust Tower Edmonton, Alberta T5J 2Z2	Luscar Mine Hinton, Alberta R. Morin-Mine Manager	Surface	1,900	staff: 74 others: 238	metallurgical coal primarily for export market
Gregg River Resources Ltd. c/o Manalta Coal Ltd. P.O. Box 2880 Calgary, Alberta T2P 2M7	Gregg River Mine Hinton, Alberta B. Payne - Mine Manager	Surface	2,533	staff: 103 others: 286	metallurgical coal for export market
SMOKY RIVER COALFIELD					
Smoky River Coals Ltd. c/o McIntyre Mines Ltd. 355-4th Avenue, S.W. Calgary, Alberta T2P 0J5	Mine 1774 Grande Cache, Alberta M.L. Henson Vice President	Surface	734	(both mines) staff: 98 others: 210	metallurgical coal for export market and some thermal coal for local power generation
	Mines 1765/09/A,B,C (as above)	Underground	470		(as above)
BRITISH COLUMBIA CROWSNEST COALFIELD					
Byron Creek Collieries Ltd. c/o Esso Minerals Canada Ltd. 237-4th Avenue, S.W. Calgary, Alberta T2P 0H6	Coal Mountain Mine (formerly Corbin Mine) Sparwood, B.C. J. Aiello - General Manager	Surface	1,052	staff: 63 others: 131	thermal coal for domestic (Ontario) and export markets

Coal Rank and Seam (s)	Mining Method & Major Equipment	Coal Preparation Facilities	Remarks
subbituminous B; up to 6 seams being mined in a coal zone (Lower Ardley Unit) of average cumulative thickness 7.3 m; near horizontal	dragline stripping; 1 dragline 46 m^3 1 coal power shovel 6 m^3 1 coal power shovel 4 m^3 6 haulage trucks 64 tonnes 1 frontend loader 5.7 m^3 4 bulldozers	crushing and screening at mine tipple; capacity 1,100 tonnes/hr.	TransAlta Utilities Corp. is mine owner
high volatile C/B bituminous, three of five seams are mineable; Val D'or Seam (up to 10.7 m, including partings) Upper Silkstone Seam (up to 3.7 m) and Mynheer Seam (up to 9.1 m, including partings): variable dips due to folding/faulting	basic stripping with shovel-truck units and draglines; selective stripping with hydraulic excavators and scrapers; 1 dragline 32.0 m^3 1 dragline 10.9 m^3 1 power shovel 11.5 m^3 1 power shovel 6.9 m^3 2 backhoes 5.4 m^3 1 rotary drill 6 haulage trucks 154 tonnes 14 haulage trucks 91 tonnes 5 bulldozers	prep. plant (1978) has coarse fraction cleaned in heavy medium drum separator, medium-sized fraction in heavy medium cyclones and fine fraction in classifying and compound water-only cyclones; clean coal dried by belt press filters and fluid bed dryer fired by both coal and gas; feed capacity; 720 tonnes/hr.	
high volatile bituminous-C; No. 1 & 2 Seams with thickness 3.5 m & 2.9 m respectively, near horizontal	dragline and shovel-truck stripping; 1 dragline 57 m^3 1 power shovel 13 m^3 1 easy miner 1 drill 5 dozers 2 frontend loaders 9 trucks 109 tonnes 5 trucks 32 tonnes	gravity separation in coarse and fine BATAC jigs; thermal drying in rotating kilns with a three stage electrostatic precipitator	
medium volatile bituminous; Jewel Seam approx. 10 m thick but varies with folding; minor rider seams present; dip variable because of folding	shovel-truck stripping; 1 power shovel 23.0 m^3 1 power shovel 11.5 m^3 1 dragline (for coal) 3.8 m^3 13 haulage trucks 154 tonnes 1 frontend loader 2 rotary drills 4 bulldozers	prep. plant (1970, major expansion 1980) has coarse fraction washed in heavy medium cyclones, screens and froth flotation cells; coal dried in coal-fired fluid bed dryers; feed capacity 600 tonnes/hr.	Consolidation Coal Co. of Canada is 50% owner
medium volatile bituminous; Jewel Seam 10 m thick with thickening in synical troughs; dip variable	shovel-truck stripping; 2 hydraulic excavators 14 m^3 1 power shovel 23 m^3 3 frontend loaders 11 m^3 6 haulage trucks 109 tonnes 6 haulage trucks 154 tonnes 7 bulldozers	in prep. plant (1983) coarse fraction washed in heavy medium bath; medium fraction cleaned in heavy medium cyclones and fine fraction in compound water cyclones; capacity 600 tonnes/hr.	
low volatile bituminous; Seam #4 (6.1 m thick but ranges from 4.3-7.9 m), Seam #10 (2.7m thick but ranges from 1.9-6.0 m); Seam #11 (3.0 m thick but ranges from 1.2-4.0 m); dip variable	shovel-truck stripping; 5 power shovels 11.5 m^3 24 haulage trucks 134 tonnes 9 haulage trucks 76 tonnes 5 coal trucks 45 tonnes 3 frontend loaders 10 m^3 3 rotary drills 7 bulldozers	prep. plant (1969) has coarse fraction cleaned in heavy medium cyclones, fine fraction cleaned in froth flotation cells; coal product dried in natural gas-fired fluid bed dryer; feed capacity 590 tonnes/hr.	
Seam #4 as above: dip varies from near level up to 14°	room-and-pillar; 8 continuous miners 12 shuttle cars 12 roof bolters	(as above)	
medium volatile bituminous; #1 Seam has highly variable thickness from a few meters up to some 60 m and higher in certain faulted and folded areas	shovel-truck stripping; 1 hydraulic shovel 14.5 m^3 4 frontend loaders 9 m^3 2 frontend loaders 6 m^3 13 haulage trucks 77 tonnes 5 haulage trucks 109 tonnes 2 rotary drills 6 bulldozers	in prep. plant (1978) coarse and fine coal fractions are separated, coarse coal cleaned in a five-cell jig and dewatered, then recombined with fine coal; dried mechanically; feed capacity 330 tonnes/hr.	

Mine Operator & Head Office	Mine Name, Location & Representative	Basic Mine Type	1986 Mine Output 10^3T (Preliminary)	No. of Employees	Major Markets
CROWSNEST COALFIELD					
Westar Mining Ltd. 1176 W. Georgia St. Vancouver, B.C. V6E 4B8	Harmer Surface Mine Sparwood, B.C. L.W. Riffel- General Manager	Surface	5,449	(both mines) staff: 210 others: 855	metallurgical coal for export market
	Michel Underground Mine Sparwood, B.C. B. Hart- General Superintendent of Underground Mines	Underground	25		(as above)
ELK VALLEY COALFIELD					
Fording Coal Ltd. 200, 205 - 9th Ave. S.E. Calgary, Alberta T2G 0R4	Fording River Mines Elkford, B.C. J.G. Gardiner - Vice President and General Manager	Surface	7,524	staff: 380 others: 800	metallurgical coal for export market
Westar Mining Ltd. 1176 W. Georgia St. Vancouver, B.C. V6E 4B8	Greenhills Mine Elkford, B.C. L.J. Lindsay - General Manager	Surface	2,839	staff: 75 others: 440	primarily met. coal for export market as well as thermal coal for export
Crowsnest Resources Ltd. P.O. Box 2699 Stn. M. Calgary, Alberta T2P 3Y9	Line Creek Mine P.O. Box 2003 Sparwood , B.C. V0B 2G0 D.A. Riva - General Manager	Surface	2,314	staff: 108 others: 361	metallurgical and thermal coal export markets
PEACE RIVER COALFIELD					
Teck Corporation 1199 W. Hastings St. Vancouver, B.C. V6E 2K5	Bullmoose Mine P.O. Box 500 Tumbler Ridge, B.C. V0C 2W0 M. Lipkewich - Mine Manager	Surface	2,514	staff: 95 others: 350	metallurgical and thermal coal export markets
Denison Mines Ltd. Coal Division 650 W. Georgia St. Vancouver, B.C. V6B 4N7	Quintette Mine P.O. Box 1500 Tumbler Ridge, B.C. V0C 2W0 John Sanders V.P./General Manager B. Morash Mine Manager	Surface	9,919	staff: 360 others: 1,090	metallurgical and thermal coal export markets

Coal Rank and Seam (s)	Mining Method & Major Equipment	Coal Preparation Facilities	Remarks
low to medium volatile bituminous; essentially one seam called 10 Seam thickness from 12 to 15 m; dip varies from 18° to 55° but mostly in range of 20°	shovel-truck stripping; 4 power shovels 19 m³ 4 power shovels 11 m³ 1 power shovel 23 m³ 22 haulage trucks 180 tonnes 14 haulage trucks 154 tonnes 18 haulage trucks 90 tonnes 1 haulage truck 320 tonnes 1 frontend loader 27 m³ 4 frontend loaders 17 m³ 9 rotary drills 12 bulldozers	Elkview Coal prep. Plant (1970, expanded in 1972) has two streams; coarse coal cleaned in heavy medium vessels and middle-sized fraction in heavy medium cyclones; fine coal cleaned in two water cyclones, vibrating sieve bands and froth flotation cells' fine coal dried in fluid bed dryer; feed capacity 1,600 tonnes/hr.	production in 1986 interrupted by labour dispute
as above, except dip in hydraulic mining section ranges in order of 35° whereas room-and-pillar section dip is 10° to 15°	room-and-pillar	(as above)	room-and-pillar closed in January, 1986 hydraulic operation closed in January, 1985
primarily low volatile, but also medium and high volatile bituminous; up to 11 seams mined, ranging in thickness from 1.5-11 m; dip varies with regional synclinal structure but generally in the range 20° to 25°	shovel-truck stripping on both Eagle Mountain and Greenhills sides plus dragline stripping on Greenhills side; 5 shovels 23 m³ 3 shovels 11.5 m³ 1 dragline 45.8 m³ 1 dragline 3.8 m³ 41 haulage trucks 154 tonnes 21 haulage trucks 108 tonnes 7 frontend loaders 11.5 m³ 8 rotary drills 19 bulldozers tracked 5 bulldozers rubber tyred	prep. plant (1972) has two streams; coarse coal cleaned in vertical wheel separators and middle-sized fraction in heavy medium cyclones; fine coal has water only cyclones and froth flotation cells; clean coal dryers are gas-fired; feed capacity 1,200 tonnes/hr.	
medium and high volatile bituminous; of some 14 seams in mine area Seams Nos. 1, 7, 10 & 16 provide 80% of recoverable coal and range in thickness from 3 to 15 m; dip varies in synclinal structures from 20° to 60°	shovel truck stripping; 5 hydraulic shovels 14 m³ 2 frontend loaders 21 m³ 1 frontend loader 17 m³ 9 haulage trucks 154 tonnes 1 haulage truck 105 tonnes 14 haulage trucks 90 tonnes 5 rotary drills 7 bulldozers	prep. plant (1983) has two streams; coarse coal cleaned in heavy medium cyclones; fine size cleaned in two stage water only cyclones, two-stage sieve bands and froth flotation cells; coal dryers are gas-fired; feed capacity currently approx. 500 tonnes/hr.	
low and medium volatile bituminous; 4 of 7 seams in mine area have 90% of reserves; thickness 3 m to 13 m; dips range 0° to 45°	shovel-truck stripping; 2 power shovels 11.5 m³ 1 power shovel 14 m³ 2 hydraulic excavators 3.4 m³ 2 hydraulic excavators 8 m³ 2 frontend loaders 11.5 m³ 7 haulage trucks 109 tonnes 10 haulage trucks 77 tonnes 17 haulage trucks 40 tonnes 3 rotary drills 6 bulldozers	separate met, and thermal coal prep. plants; in thermal prep. plant coarse fraction is dry screened, then cleaned in two-product heavy medium bath; fine coal is mechanically dewatered; combined coal product is mechanically dried; feed capacity 275 tonnes/hr. in met. prep, plant coarse fraction treated in heavy medium cyclones; fine coal cleaned in two-stage water cyclones and froth flotation cells; clean coal dryers are gas-fired; feed capacity 375 tonnes/hr.	
medium volatile bituminous; six seams with thickness between 1.0 m and 4.8 m;	shovel-truck stripping; 4 power shovels 12.5 m³ 2 hydraulic excavators 12 m³ 4 haulage trucks 155 tonnes 20 haulage trucks 110 tonnes 3 frontend loaders 4 m³ 1 frontend loader 9 m³ 2 frontend loaders 11.5 m³ 3 rotary drills 5 bulldozers	in prep. plant (1983) coarse coal fraction is cleaned in heavy medium cyclones; fine coal fraction has three stages of cleaning utilizing two-stage water cyclones and froth flotation cells; clean coal is dried in coal-fired fluid bed dryer; feed capacity 450 tonnes/hr.	
medium volatile bituminous; between four and six seams mined in various pits with aggregate thicknesses between 17 m & 19 m; dips within synclinal folds in range 0° to 90°	shovel truck stripping; 2 power shovels 26 m³ 2 power shovels 23 m³ 4 elect. hydraulic shovels 1 hydraulic shovel 14 m³ 1 backhoe 14 m³ 2 backhoes 14 m³ 4 frontend loaders 11 m³ 2 frontend loaders 8.4 m³ 45 haulage trucks 154 tonnes 7 drills 22 bulldozers	prep. plant (1983) has two met. coal circuits each of 600 tonnes/hr. feed capacity and one thermal coal circuit of 350 tonnes/hr. feed capacity, four cleaning processes used; heavy medium cyclones; water only washing cyclones and froth flotation cells	

Table 8 — Saleable coal production (1) and value (2), by rank and by province, 1984-1986

	1984		1985		1986	
	(x 10^3 tonnes)	(x 10^6 $)	(x 10^3 tonnes)	(x 10^6 $)	(x 10^3 tonnes)	(x 10^6 $)
BITUMINOUS						
Nova Scotia	3 093	162	2 800	158	2 695	155
New Brunswick	564	30	560	30	490	27
Alberta	7 630	337	7 841	331	6 994	262
British Columbia	20 775	1 020	22 994	1 106	20 359	881
TOTAL	32 062	1 549	34 195	1 625	30 538	1 325
SUB-BITUMINOUS						
Alberta	15 422	126	16 871	146	17 525	163
LIGNITIC						
Saskatchewan	9 918	131	9 672	135	8 281	122
ALL RANKS — CANADA TOTAL	57 402	1 806	60 738	1 906	56 344	1 610

Sources: Statistics Canada; Energy Mines and Resources Canada; Alberta Energy Resources Conservation Board

(1) Production represents clean coal output plus raw coal sales from mines with preparation plants, plus raw coal sales where there is no preparation plant in the mine area.

(2) value is F.O.B. mine.

Table 9 — Raw coal production by rank, province and type of mining 1984-1986

(x 10^3 tonnes)	1984		1985		1986	
	u/g	surface	u/g	surface	u/g	surface
BITUMINOUS						
Nova Scotia	3 196	297	3 076	260	3 094	252
New Brunswick		564		560		490
Alberta	608	10 166	494	10 299	471	9 665
British Columbia	964	30 019	282	34 828	25	31 611
TOTAL	4 768	41 046	3 852	45 947	3 590	42 018
SUB-BITUMINOUS						
Alberta		15 422		16 872		17 525
LIGNITIC						
Saskatchewan		9 918		9 672		67 825
CANADA	4 768	66 386	3 852	72 491	3 590	67 825
CANADA u/g + surface	71 154		76 343		71 415	

Sources: Statistics Canada; Energy, Mines and Resources Canada; Alberta Energy Resources Conservation Board

Table 10 — Average number of employees (1) in Canadian coal mines, by province, 1967-1986

Year	Nova Scotia	New Brunswick	Saskatchewan	Alberta	British Columbia	Canada Total
1967	6 497	731	165	1 132	453	8 978
1968	6 023	676	153	1 098	477	8 427
1969	4 983	476	134	1 210	568	7 371
1970	4 380	302	177	1 743	1 272	7 874
1971	4 066	241	189	2 031	1 542	8 069
1972	4 466	210	173	1 893	1 962	8 704
1973	3 624	201	190	1 649	2 192	7 856
1974	3 449	218	204	1 825	2 446	8 142
1975	3 011	238	252	2 121	2 794	8 416
1976	3 493	236	286	2 441	2 539	8 996
1977	3 812	247	327	2 481	2 914	9 781
1978	3 995	244	389	2 733	3 253	10 574
1979	3 623	224	425	2 502	3 495	10 269
1980	3 857	264	463	3 152	3 680	11 416
1981	3 748	285	486	2 859	3 804	11 182
1982	4 623	273	472	2 824	4 921	13 113
1983	4 082	279	408	2 825	4 052	11 646
1984	2 832	247	403	2 601	5 822	11 905
1985	2 731	262	409	2 629	5 829	11 860
1896 (P)	3 730	250	408	2 102	5 320	11 740

Sources:

(a) Statistics Canada annual on coal, catalogue series 26-206.

(b) for Saskatchewan, 1975-85 inclusive, quarterly reports, Saskatchewan Mining Industry Accident Summaries, Occupational Health & Safety Branch, Department of Human Resources and Labour.

(c) for Alberta, sources (a) and (b) above.

Notes:

(1) includes production and related workers as well as salaried employees at the mine plus employees located elsewhere than at the mine.

(P) = preliminary.

Table 11 — Productivity in coal mining, by province and by type of mining, 1986

	Raw Coal Production (1) ('000 tonnes)			Production saleable coal ('000 tonnes)	Manpower (2)			Productivity (tonnes) raw coal per person-year		Productivity (tonnes saleable coal per person year, overall)
					Mining & Related		Total			
	Surf	u/g	Total		Surf	u/g		Surf	u/g	
NOVA SCOTIA	273	3 094	3 367	2 695	72	3 625	3 697	3 790	850(3)	730 (3)
NEW BRUNSWICK	490		490	490	250		250	1 960		1 960
SASKATCHEWAN	8 281		8 281	8 281	400		400	20 700		20 700
ALBERTA	27 190	471	27 611	24 519	1 987	123	2 110	13 680	3 830	11 620
BRITISH COLUMBIA	31 611		31 611	20 359	5 320		5 320	5 940	-	3 830
CANADA	67 825	3 565	71 360	56 344	8 029	3 748	11 777	8 450	960	6 060

Surf = surface mines u/g = underground mines

Notes:

(1) producers with less than 30,000 t excluded.

(2) manpower figures, include all persons at mine sites and in offices serving local operations.

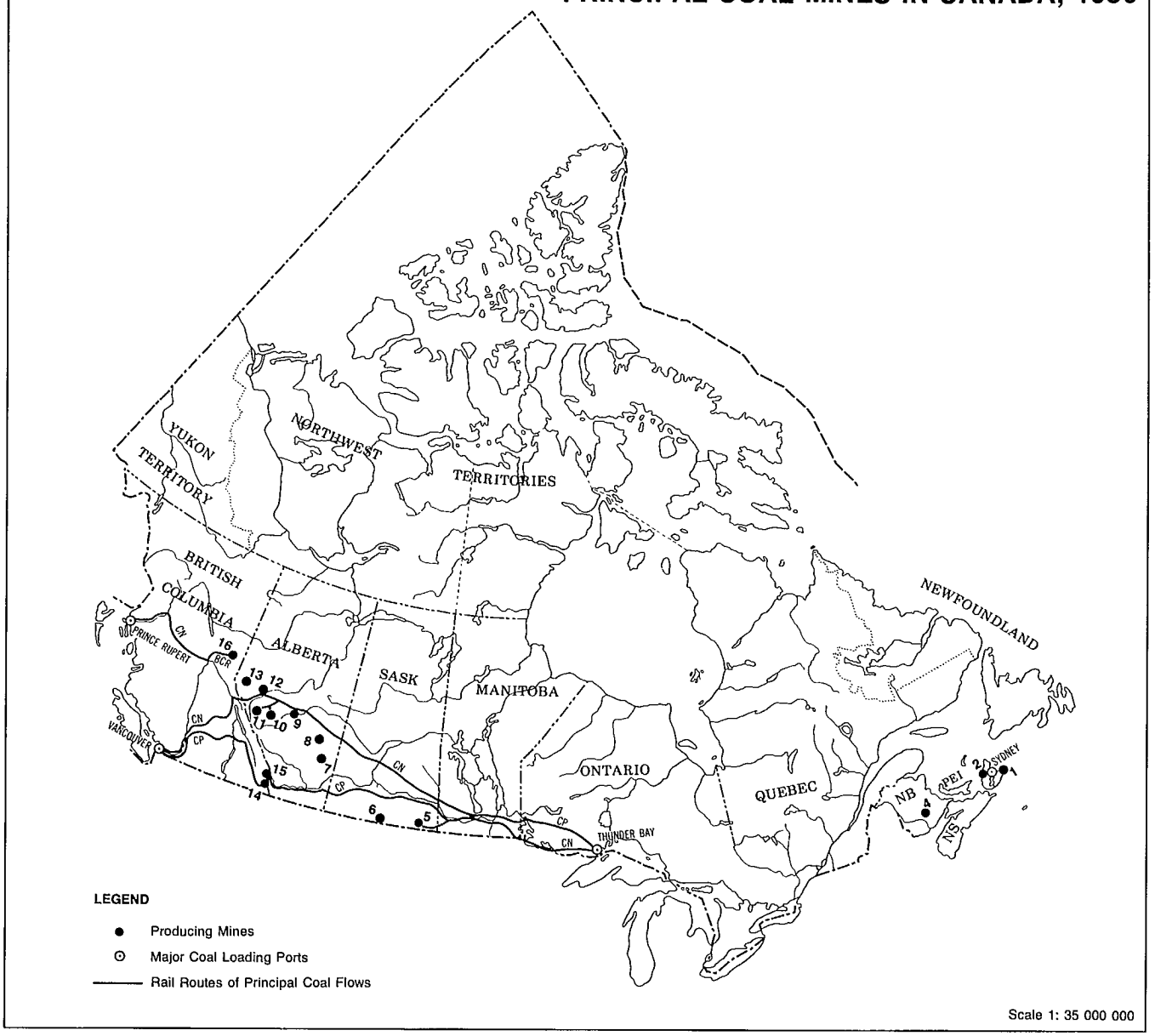
(3) productivity not representative because Phalen Colliery under development as noted in Table 7, along with Donkin-Morien Development Project.

Table 12 — Productivity in coal mining, by province and by value of production: 1980-1986

	1980	1981	1982	1983	1984	1985	1986 (p)
Nova Scotia (bituminous)							
Value of production (1) ($ x 10^3)	133 000	133 000	175 000	144 000	162 000	158 000	155 000
Manpower (2)	3 857	3 748	4 623	4 082	2 832	2 731	3 730
Productivity ($ x 10^3 per person-year)	34	35	38	35	57	58	42
New Brunswick (bituminous)							
Value of production ($ x 10^3)	17 000	23 000	24 000	29 000	30 000	30 000	27 000
Manpower	264	285	273	279	247	262	250
Productivity ($ x 10^3 per person-year)	64	81	88	104	121	115	108
Saskatchewan (lignitic)							
Value of production ($ x 10^3)	32 000	55 000	73 000	95 000	131 000	135 000	122 000
Manpower	463	486	472	408	403	409	408
Productivity ($ x 10^3 per person-year)	69	113	155	233	325	330	299
Alberta (bituminous)							
Value of production ($ x 10^3)	247 000	272 000	338 000	371 000	337 000	331 000	262 000
Manpower	n/a	n/a	n/a	2 107	n/a	1 854	1 114
Productivity ($ x 10^3 per person-year)	n/a	n/a	n/a	176	n/a	179	235
Alberta (sub-bituminous)							
Value of production ($ x 10^3)	55 000	79 000	88 000	112 000	126 000	146 000	163 000
Manpower	n/a	n/a	n/a	718	n/a	775	988
Productivity ($ x 10^3 per person-year)	n/a	n/a	n/a	156	n/a	188	165
British Columbia (bituminous)							
Value of production ($ x 10^3)	458 000	591 000	654 000	588 000	1 020 000	1 106 000	881 000
Manpower	3 680	3 804	4 921	4 052	5 822	5 829	5 320
Productivity ($ x 10^3 per person-year)	124	155	133	145	175	190	166
Canada (all coal ranks)							
Value of production ($ x 10^3)	942 000	1 153 000	1 352 000	1 339 000	1 806 000	1 906 000	1 610 000
Manpower	11 416	11 182	13 113	11 646	11 905	11 860	11 740
Productivity ($ x 10^3 per person-year)	83	103	103	115	152	161	137

Sources:
for value of production, in unadjusted dollars: Statistical Review of Coal in Canada, 1986, Energy, Mines and Resources, Ottawa.
for manpower: same sources as for Table 10
(p) = preliminary n/a = figures not available

PRINCIPAL COAL MINES IN CANADA, 1986



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INDEX FOR MAP

Nova Scotia
(bituminous coal)

1. Lingan Mine (Cape Breton Development Corporation)
   Prince Mine (Cape Breton Development Corporation)
   Point Aconi Pit (Novaco Ltd.)
2. St. Rose Mine (Evans Coal Mines Ltd.)

New Brunswick
(bituminous coal)

4. (Minto / Chipman Area Pits (N. B. Coal Ltd.)

Saskatchewan
(lignitic coal)

5. Bienfait Mine (Bienfait Coal Co.)
   Boundary Dam Mine (M & S Coal Co.)
   Costello Mine (formerly Klimax Mine) (Manalta Coal Ltd.)
   Utility Mine (Saskatchewan Power Corporation, with Manalta as operator)
6. Poplar River Mine (Manalta Coal Ltd.)

Alberta
(subbituminous coal)

7. Montgomery Mine (formerly Roselyn Mine) (Manalta Coal Ltd.)
8. Vesta Mine (Alberta Power Limited, with Manalta as operator)
   Diplomat Mine (Forestburg Collieries Ltd.)
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9. Highvale Mine (TransAlta Utilities Corporation, with Manalta as operator
   Whitewood Mine (TransAlta Utilities Corporation, with Manalta as operator)

(bituminous coal)

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11. Luscar Mine (Cardinal River Coals Ltd.)
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British Columbia
(bituminous coal)

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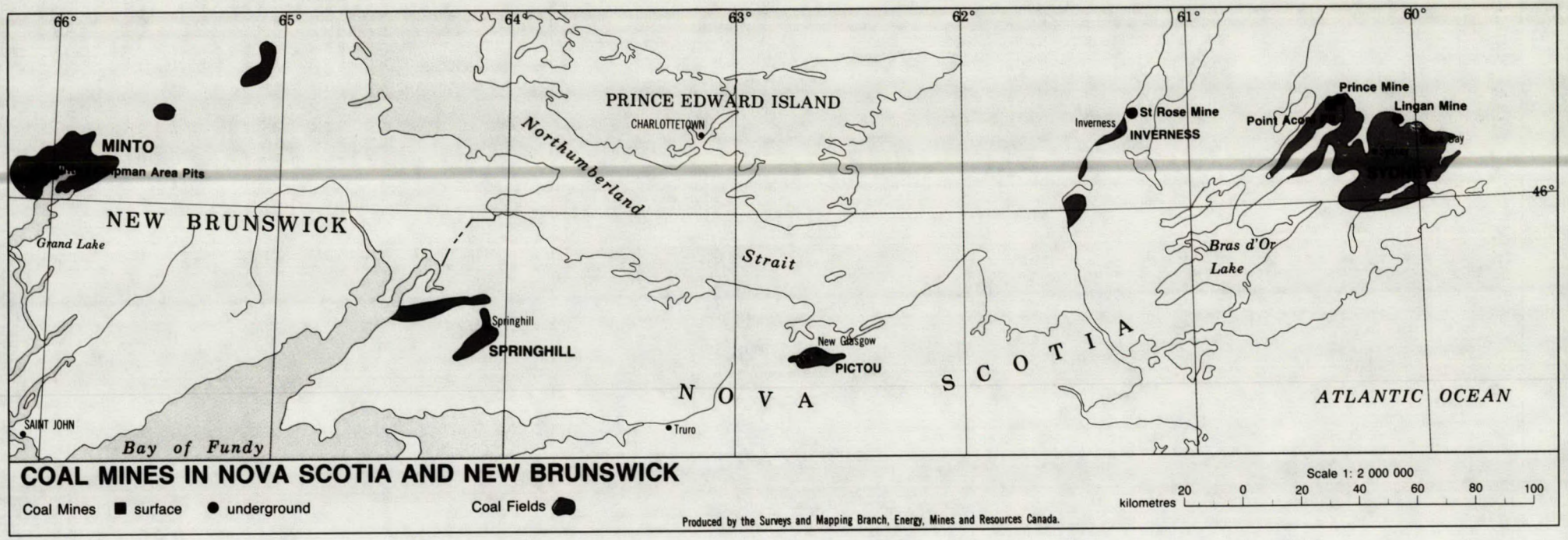
    Fording River Mine (Fording Coal Ltd.)
    Greenhills Mine (Westar Mining Ltd.)
16. Quintette Mine (Denison Mines Limited and others)
    Bullmoose Mine (Teck Corporation and others)


66°
65°
64°
63°
62°
61°
60°
46°
PRINCE EDWARD ISLAND
CHARLOTTETOWN
Northumberland
Strait
NEW BRUNSWICK
Grand Lake
MINTO
Chapman Area Pits
Springhill
SPRINGHILL
New Glasgow
PICTOU
Truro
SAINT JOHN
Bay of Fundy
N O V A S C O T I A
Inverness
St Rose Mine
INVERNESS
Point Aconi
Prince Mine
Lingan Mine
SYDNEY
Bras d'Or Lake
ATLANTIC OCEAN
COAL MINES IN NOVA SCOTIA AND NEW BRUNSWICK
Coal Mines ■ surface ● underground
Coal Fields
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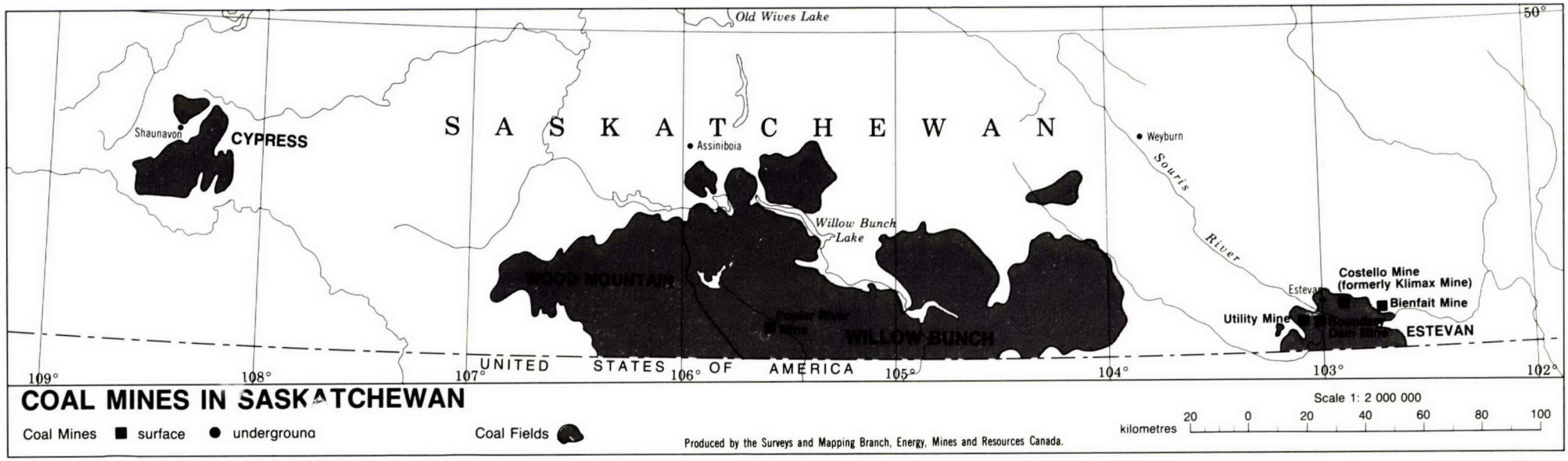
Old Wives Lake
50°
Shaunavon
CYPRESS
S A S K A T C H E W A N
Assiniboia
Weyburn
Souris River
Willow Bunch Lake
WOOD MOUNTAIN
Poplar River Mine
WILLOW BUNCH
Costello Mine (formerly Klimax Mine)
Bienfait Mine
Utility Mine
ESTEVAN
109°
108°
107°
UNITED STATES OF AMERICA
106°
105°
104°
103°
102°
COAL MINES IN SASKATCHEWAN
Coal Mines ■ surface ● underground
Coal Fields
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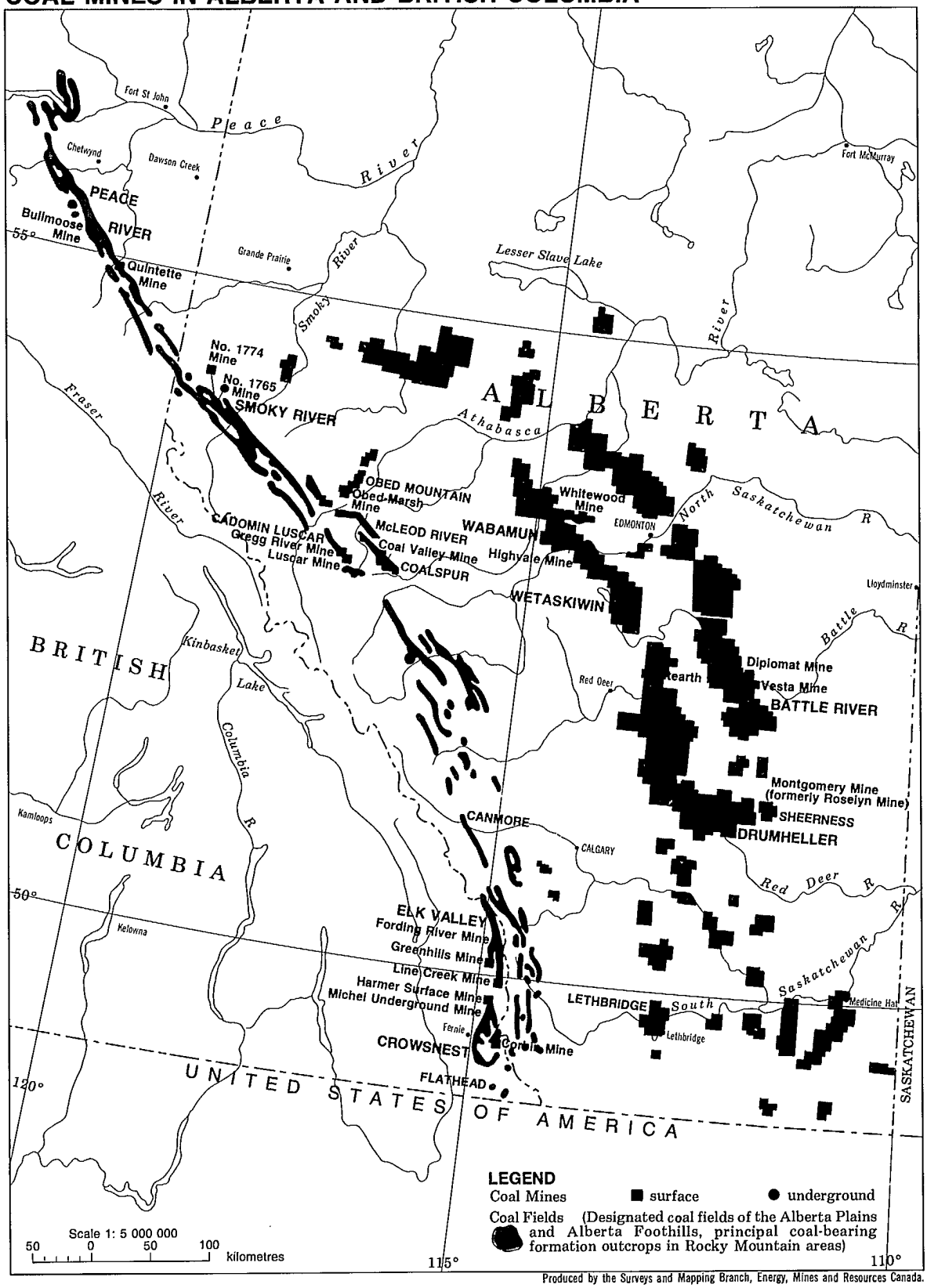
Scale 1: 2 000 000
kilometres 20 0 20 40 60 80 100

COAL MINES IN ALBERTA AND BRITISH COLUMBIA



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