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NOTES ON
THE ELK RIVER COALFIELD

by

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DEPARTMENT OF MINES AND PETROLEUM RESOURCES

**GEOLOGICAL BRANCH
ASSESSMENT REPORT**

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INTRODUCTION

The following notes have been compiled with the intention of providing a general account of the Elk River coalfield. In view of the present intense activity in this coalfield it is felt that these notes may be a useful source of reference to officers of the Department, since published information on the field as a whole (considered apart from the Crowsnest Basin) is fairly scanty.

The writer has made full use of the material contained in the private geological and engineering reports filed under the Coal Act and listed in Appendix 2. The information in this report in regard to coal reserves and similar matters should therefore be regarded as restricted to officers of the Department of Mines and Petroleum Resources.

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Victoria, B. C.
October 21, 1970.

TOPOGRAPHY

The coal-bearing rocks of the Elk River coalfield extend from a southernmost limit approximately 8 miles east of Sparwood. Here they are associated with the upper section of Alexander Creek. They trend slightly west of north across Line and Ewing Creeks, occurring on both sides of the Fording River valley, beyond which they follow the east side of the Elk River valley towards the Alberta border. The total extent from north to south is 56 miles, and the greatest width 6 miles, and the average width $2\frac{1}{2}$ miles.

The Elk River coalfield occurs within the Rocky Mountains, and the area is dominated by north-south-trending mountain ranges with summits ranging typically from 7,500 to 8,500 feet with occasional peaks as high as 9,500 feet. Ranges composed mainly of Palaeozoic limestones, such as the Wisukitsak Range, tend to be rugged and precipitous, while those consisting partly or wholly of Kootenay (coal-bearing) rocks are somewhat gentler, although even these ridges reach elevations of between 7,000 and 8,000 feet.

A major feature of the area is the wide, flat-bottomed valley of the Elk River, and the smaller though similar valley of its tributary, the Fording River. The Elk rises at Elk Pass on the Alberta border and flows southerly for about 100 miles to its confluence with the Kootenay River south of Elko. Its principal tributary, the Fording, also rises near the Alberta border and flows southerly for approximately 40 miles to join the Elk 10 miles north of Sparwood. Both these river valleys are wide valleys (the Elk valley is from $\frac{3}{4}$ to a mile wide, and the Fording rather less) and contain deep alluvial gravels. The elevation of the Elk valley at Sparwood is 3,400 feet, and at Aldridge Creek, 48 miles further up, is 5,200 feet. The mountain ranges are cut by a number of creeks which flow into the two main rivers. The principal tributaries of the Fording flow from the east and include Henretta, Clode, Kilmarnock, Chauncey, Ewin, and Line Creeks. Apart from Aldridge Creek and Fording River, the principal tributaries of the Elk flow from the west and include Cadorna, Bleasdel, Quarrie, Bingay, Weigere, and Cummings Creeks.

The area is largely tree-covered, though the trees are generally small except in the main valley bottoms. A characteristic of the region is that tree growth extends considerably higher on the north slopes than on the south slopes of the mountains. A few areas have been cleared in the Elk valley and small cattle ranches established. Much of the Elk valley region is considered to be an important habitat for wildlife.

The climate is probably characteristic of the East Kootenay country, with rather long cold winters and short cool summers. The nearest weather station is at Fernie, where the average annual precipitation is about 42 inches with 145 inches of snowfall. The record winter low temperature is minus 40° F.

Access to the Elk Valley coal areas is generally good. The southern Trans Provincial Highway and the Crows Nest line of the C. P. R. traverse the Elk valley as far as Sparwood, where they continue up the valley of Michel Creek to the Crows Nest Pass. A railway branch now runs as far as the Elkview Coal Preparation Plant of Kaiser Resources Ltd., and this branch will shortly be extended up the Elk and Fording valleys to the Fording Coal plant. The Elk valley generally is well suited to railway extension.

Road access is now much improved, especially since substantial sections of a new Forest Service access road have been completed. It was possible (September 1970) to drive 49 miles from Sparwood to the Emkay-Scurry camp on Aldridge Creek in 1½ hours. A good road is now completed from the Elk River at Boivin Creek to the Fording Coal Ltd. plant site. Access to the C.N.I. Licenses in the Line Creek - Horseshoe Ridge area is via a narrow limestone canyon alongside Line Creek where the creek cuts through the Wisukitsak Range. This may present some difficulties for the bulk transportation of coal.

Electric power is available from the Calgary Power Company's 136 K.V. powerline which traverses the Elk valley. A branch to Fording Coal Ltd. has been constructed across the Greenhill Range.

HISTORY

The presence of coal in the Elk River coalfield was probably first recognized during the latter half of the 19th century. It was alluded to in the Progress Reports of the Geological Survey of Canada for 1880-82 and 1882-84. In the 1885 Annual Report of the Geological Survey, Dr. G. M. Dawson describes in some detail a visit he had made to the Elk and Fording valleys. The presence of extensive coal float was observed and the outcrops of seams in creek beds traced.

Considerable prospecting activity took place in the period from 1900 to 1910. Several companies acquired substantial holdings; the section of the coalfield from the Alberta boundary to Aldridge Creek was held by Northern Coal and Coke Company, from Aldridge Creek to Henretta Creek (including Greenhills Range) by the C. P. R., and from Henretta Creek to Grave Creek by Imperial Coal and Coke Company. The work done during this period included the driving of short tunnels and crosscuts at Aldridge Creek and the stripping and examining of surface outcrops of seams in other parts of the coalfield. By 1909 a surprisingly complete picture had been obtained of the general configuration and economic possibilities of the Elk River coalfield. This was described in some detail by W. F. Robertson in the Minister of Mines Annual Report, 1909. Considerable information is also contained in Geological Survey Memoir 69 "Coal Fields of British Columbia" by D. B. Dowling (1915).

During the years from 1910 to 1920 various examinations and reports were made for clients on various parts of the coalfield by independent mining engineers, but little work was done. After about 1920 interest faded and there was little further activity for nearly 50 years. Most licenses were allowed to lapse, and only the Canadian Pacific Railway retained some licenses in good standing. These form the nucleus of what is now the Fording Coal Limited property.

In 1952 some prospecting and sampling was carried out by West Canadian Collieries Ltd.

In 1956 and 1957 some stripping and exploration was done by Utah

Construction and Mining Ltd. on the east side of the Fording valley on Smith Creek, Todhunter Ridge, and Bear Mountain. As was usual in this period, declining markets and transportation costs rendered the project unattractive and the option was dropped.

The present surge of activity began in the summer of 1967 when Canadian Pacific Oil and Gas began exploration on the present Fording Coal property under the direction of H. G. Rushton, P. Geol. In the same year Scurry Rainbow Oil Limited acquired a large number of Coal Licences in the northern part of the coalfield extending north from Aldridge Creek, and a start was made on exploration work in this area. Also in 1967 McIntyre Porcupine Mines Ltd. carried out exploration work in the Alexander Creek and Line Creek areas in the south part of the coalfield.

In 1968 exploration work on the Fording Coal property was increased in tempo; over 30,000 feet of diamond drilling was completed, and 1,871 feet of adits were driven in the various coal seams. On the Scurry Rainbow ground an extensive programme was carried out by the North American Coal Corporation (for Scurry Rainbow) under the direction of Mr. Virgil Carmichael, P. Eng.

In 1969 work on the Fording property was continued by a new company, Fording Coal Limited, a wholly-owned subsidiary of Cominco Ltd. (40%) and Canadian Pacific Investments Ltd. (60%). The decision was reached this year that the property would be put into production early in 1972, the company having negotiated a 15-year contract with the Japanese.

On the Scurry Rainbow property work was continued in 1969 by the company's own staff under the direction of D. M. Lane, P. Eng. On October 15th the company entered into an agreement with Morrison-Knudsen Company whereby the latter would have an option to acquire an undivided half interest in Scurry Rainbow's Elk River holdings. This option was exercised on December 15, 1969, and assigned to a subsidiary, Enkay Canada Natural Resources Ltd. An operating company has been formed, known as Enkay Scurry Limited.

At the southern end of the coalfield Crows Nest Industries had acquired the Coal Licences covering the Ewin Pass, Line Creek, and Horseshoe Ridge areas and, commencing in 1968 and continuing in 1969, carried out a vigorous exploration programme, especially on Line Creek and Horseshoe Ridges, and on Crown Mountain.

In 1970 work was continuing on all three major properties, and Fording Coal was preparing for production with a crew of 300 men employed. Some idea of the scope of the exploration will be gained from the following figures of feet drilled up to the end of 1969. Almost the whole of the total is diamond drilling (mainly HQ 2½" wireline):-

C.P.O.G. - Fording Coal	1967	2,528 ft. (percussion)
	1968	30,934 ft.
	1969	<u>27,000 ft.</u>
	Total	60,452 ft.
Scurry-Rainbow	1968	4,354 ft.
		7,610 ft. (percussion)
	1969	<u>9,646 ft.</u>
	Total	21,610 ft.
C.N.I.	1969 Crown Mt.	5,500 ft.
	Line Cr.	<u>20,000 ft.</u>
	Total	25,500 ft.
Totals to the end of 1969		
C.P.O.G. - Fording Coal		60,452 ft.
Scurry-Rainbow		21,610 ft.
C.N.I.		<u>25,500 ft.</u>
GRAND TOTAL		107,562 ft.

In addition a total of 5,520 feet of adit and crosscut development was done in the coalfield (about 1,800 feet on each of the three properties), as well as a great expanse of access roads and seam stripping.

GENERAL GEOLOGY

STRATIGRAPHY

As in the East Kootenay coalfields generally, the coal seams of the Elk River coalfield are contained within the Kootenay formation, considered to be of Juro-Cretaceous age. It consists of a succession of non-marine sandstones, siltstones, shales, and coal seams. Except for the coal seams, the lithological units tend to be variable in thickness and often lenticular in occurrence. The coal seams, on the other hand, are remarkable for their thickness and continuity. Rushton suggests that "the sediments, especially in the coal-bearing half of the succession, represent a series of littoral and deltaic deposits, where rapid changes both horizontally and vertically are the rule rather than the exception".

The total stratigraphic thickness of the Kootenay formation in the Elk River coalfield is from 3,500 to 4,000 feet. The upper portion is frequently absent as a result of erosion, and a typical thickness in the area is 1,600 to 2,500 feet. All the mineable coal seams are contained in the lower 1,600 feet, and above the basal sandstone member which is 150 to 200 feet thick.

Norris (1959) sub-classified the Kootenay formation into five members. While this was applied to a type section at Grassy Mt., Alberta, it may be applied in an approximate way to the sedimentary succession in the Elk River area. Rushton suggests the following subdivision on the Fording Coal property:-

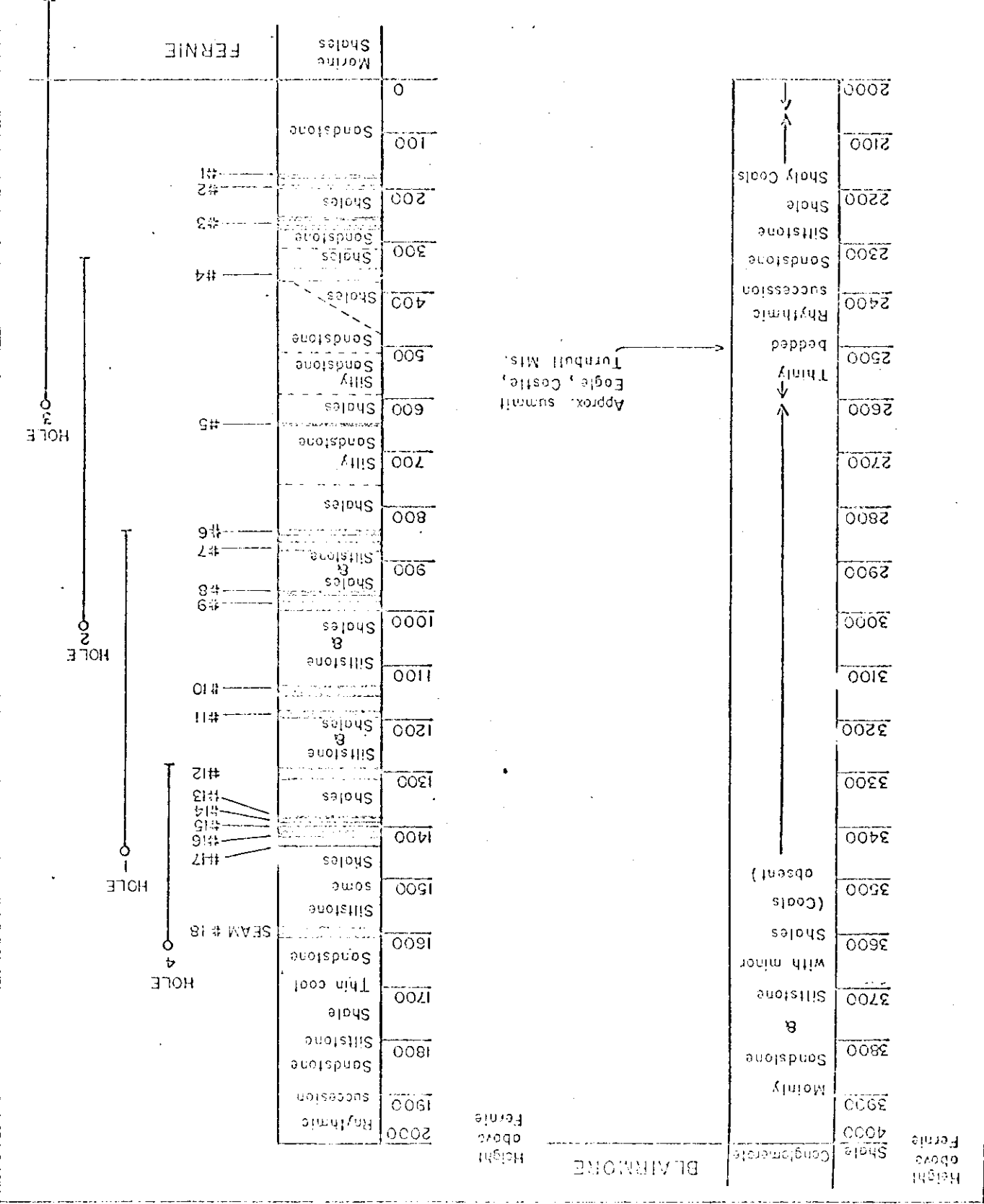
FORMATION	MEMBER	APPROX. THICKNESS	REMARKS
KOOTENAY	Elk	800 ft. in Fording R.	Sandstones & siltstones, no coal seams.
	Mutz	2,000 ft.	Rhythmic sedimentation. Contains Nos. 5-18 seams at Fording Coal. Deposit on erosion surface of Hillcrest member.
	Hillcrest	70 ft.	Sandstone. Deposited on eroded surface of Adanac member.
	Adanac	200 ft.	Contains Nos. 1, 2, & 4 seams at Fording Coal. Deposited on slightly erosional surface of Moose Mt. member.
	Moose Mountain	150 - 200 ft.	Basal sandstone (medium to coarse grained, current bedded).

GENERALIZED STRATIGRAPHIC SECTION

ELK RIVER COAL PROJECT

OIL AND GAS LIMITED
Geological Dept.
MINING DIVISION

DATE: 10/67
CONT. INT. H.G.R.
APPROVAL BY:
SCALE: 1"=200'
FILE NO.:



The basal sandstone member of the Kootenay formation forms a prominent cliff-marker in many localities. It is underlain conformably by the Fernie marine shales of Jurassic age. These are dark shales and thin sandstones, and tend to outcrop at the base of the mountains and along the sides of valleys.

Overlying the Kootenay, also apparently conformably, is the lower Cretaceous Blairmore formation, the basal member of which is a quartz pebble conglomerate. The Blairmore comprises non-marine sandstones, shales, and conglomerates.

STRUCTURE

As a result of the tectonic history of the eastern Cordillera, the Kootenay formation occurs as a series of disconnected segments. In British Columbia there are three broad but separated structural basins in which the Kootenay formation occurs: the Flathead area, the Fernie basin, and the Elk River area. The Elk River field is separated from the Fernie basin by the Erickson and other thrust faults which have elevated a great ridge of palaeozoic limestones forming the Wisukitsak Range and the Erickson Ridge.

The extent of the outcrop of the Kootenay formation has already been described under 'topography'. It occurs as a long, narrow, north-south-trending belt extending for 56 miles, the greatest width being 6 miles and the average width $2\frac{1}{2}$ miles. The configuration corresponds to the similar north-south trends of the principal structural features of the region. Four to 6 miles east of the coalfield is a major feature, the Lewis Thrust which parallels the Provincial border. The leading edge of the thrust plate is the High Rock Range, composed mainly of Palaeozoic limestones. On the west side of the coalfield is another major feature, the Elk River Thrust. Carmichael suggests that in the vicinity of Mr. Bleasdel and Wesry Creek, the rocks to the west of the Elk River have been thrust eastward for 5 miles, overriding the underlying rocks of the Alexander Creek syncline.

The characteristic structure of the Kootenay formation in the Elk River coalfield is synclinal: in the south part of the field there appears to be a single syncline, its axis being somewhat to the east of the crest of Line Creek Ridge. The west limb of the syncline here is relatively regular, but the east limb on Horseshoe Ridge appears to be complicated by faulting. On the Fording Coal property where the formation attains its maximum east-west extent, there are two north-south-trending synclines, the intervening anticline being displaced by the north-south-trending Fording River fault. The extensive coal outcrops on Eagle Mountain are a part of one syncline, while the seams at the foot of the Greenhills Range form part of another.

Further north on the Emkay-Scurry property, there appears to be a single syncline, with the usual north-south axis, this axis underlying the Elk valley, and the east limb possibly fractured and overridden by movement along the Elk River Thrust. Carmichael reports the average dip of beds on the east limb of the syncline as being 38° west, while the average direction of strike is North 10 degrees West.

ECONOMIC GEOLOGY

In the Elk River coalfield the lower 1,600 feet of the Kootenay formation contains a large number of coal seams, many of which are of mineable width under existing technology. Where the full thickness of the coal-bearing sedimentary sequence is present there are from 12 to 15 coal seams over 5 feet thick, at least four of which are over 20 feet thick. All the mineable seams together total 150-200 feet of coal. Not all the seams are equally attractive economically: some are variable in thickness over relatively short distances, some are dirty, and tend to become split by intercalated bands of shale. But at least 50-70 feet of the coal section is being regarded by companies as readily mineable. Most of the analyses indicate the coals to be medium to low volatile, low sulphur, and to a large degree high-grade coking coals. Crabb reports that the volatile content of the coal seams tends to increase as one ascends the stratigraphic section and reports a 9% 'spread' in volatile content in the sequence of seams at Line Creek Ridge. There is also a tendency for this to occur in other parts of the coalfield but at Emkay-Scurry and Fording Coal it does not seem so clearly apparent as at Line Creek.

Little work has been done yet to correlate the various coal seams throughout the field, and in some cases correlation is difficult even on the same property. The seams have been given numbers and in some cases letters, but 'No. 1 seam' on one property does not imply correlation with 'No. 1 seam' on the neighboring property.

Exploration work over the past several years has been directed in the main to finding reserves of high grade coking coals in seams of 5 feet or more in thickness which can be mined by open pit methods with a stripping ratio of less than about 9:1. Three companies have now proved up substantial reserves:-

(1) Crows Nest Industries Ltd.

Considerable reserves have been proved on the west limb of the Fording River syncline on Line Creek Ridge, somewhat lesser reserves on the faulted east limb on Horseshoe Ridge, and to the south on Crown Mountain.

(2) Fording Coal Limited.

Substantial reserves are indicated in the Eagle Mountain syncline on the east side of the Fording valley, also in Castle Mountain to the south and Turnbull Mountain to the north.

Further reserves have also been indicated by recent drilling on the west side of the Fording valley at the foot of the Greenhills Range. The structure here is also reported to be synclinal with a north-trending axis.

(3) Emkay-Scurry.

A large number of seams (8-15) outcrop along Big Weary Ridge and Little Weary Ridge, north of Aldridge Creek. The seams strike N 10° W to N 20° W and dip from 30 to 40 degrees west beneath the Elk valley. Large reserves are mineable beneath the two ridges by open pit methods and probably beneath the Elk valley by underground methods. On the west side of the Elk valley there are further outcrops of coal seams on Bleasdell Creek. These outcrops may be an overthrust block or they may be the undisturbed west limb of the syncline. The seams dip vertically. Rocks of the Kootenay formation are known to outcrop for approximately 9 miles on the west side of Elk valley in the general vicinity of Bleasdell Creek, so it is probable that there are considerable mineable reserves of coal on this side of the valley.

COAL RESERVES

It is natural that slightly different criteria have been used in computing the coal reserves on the three principal properties in the Elk River coalfield. In some cases, only potential open pit coal has been taken into account, and in others total mineable coal seams down to a certain level and within certain limits of dip. The reserves have been computed from evidence of the stripping of outcrops of the various seams, together with diamond drilling, and so they would fall under the category of "probable" or "indicated" reserves.

The following reserves have been computed to date:-

(1) Crows Nest Industries Ltd.

This information is from a report dated March 13, 1970, by J. J. Crabb, P. Eng.

A composite section derived largely from two deep drill holes indicates 16 seams of coal of four feet or more in thickness on Line Creek Ridge, aggregating 191 feet of coal in 1,500 feet of measures. Ninety-five per cent of the reserve has been accounted for in the bottom four seams (8, 9, 10A, and 10B respectively), and virtually none of the upper seams have yet been included.

None of the seams currently being explored in the Ewing Pass area have been included in the reserves.

Following is the most recent estimate of reserves of coal which could be mined by open pit methods. The figures represent raw delivered-to-plant coal and are quoted in short tons:-

Line Creek	37.7 Million tons
Horseshoe Ridge	10.0 Million tons
Crown Mountain	3.0 Million tons (plus a possible further 3.5 M. tons of non- coking coal)
<hr/>	
Total	50.7 Million tons.

In calculating the raw coal tonnage, a figure of 19% is allowed for mining losses.

Of the above total, approximately 17.2% is likely to be oxidized coal, and therefore unsuitable as high grade metallurgical coking coal. As a whole, the reserves border on the low to medium volatile (A.S.T.M.) range. Coke making ability is reported to be as good as most other seams in southeastern B. C.

(2) Fording Coal Limited

The latest detailed estimate of reserves available to the writer is that by H. G. Rushton, P. Eng., in his report of December 1, 1967. Rushton concluded that "the Permit area contains large reserves of coking coal", and that "insufficient work has been done on all areas west of the Fording River to allow calculations of reserve potential to be carried out, but indications are that similar quantities of coal per unit area are present".

Rushton's estimate of reserves includes coal seams which could be mined by either surface or underground methods. However, coal having a dip in excess of 25° or lying within minor disturbed areas has been omitted. Although, in the Eagle Mountain section, twelve seams of over 5 feet thick occur in the lower 1,600 feet of the Kootenay, totalling over 100 feet of coal (including 4 seams over 20 feet thick) only seams 2, 4, 7, and 12 have been included in the reserves of the Fording Coal property.

These seams are as follows:-

Seam 2	8' - 13'	clean coal
Seam 4	26' - 27'	clean coal
Seam 7	18' - 30'	shaly partings
Seam 12	22' - 27'	clean coal

Reserves are computed as follows:-

(a) Total reserves to 25 degrees dip.

Eagle Mt.	186 Million tons
Castle Mt.	191 Million tons
Turnbull Mt.	<u>49 Million tons</u>
Total	426 Million tons.

(b) Taking top 15 feet of seams only (up to 25 degrees dip)

Eagle Mt.	126 Million tons
Castle Mt.	124 Million tons
Turnbull Mt.	<u>31 Million tons</u>
Total	281 Million tons.

(c) Allowing 60% recovery, top 15 feet only, to 25 degree dip.

Eagle Mt.	75,600,000 tons
Castle Mt.	74,400,000 tons
Turnbull Mt.	<u>18,600,000 tons</u>
Total	168,600,000 tons.

Rushton concludes that a stripping operation of 3 million tons a year for 15 years (45 Million tons) would be perfectly feasible in Seams 4, 5, and 7 (B, D, & E on the Greenhill side of the valley).

According to a comprehensive study of the Canadian coal contracts published by the Japanese (early in 1970 or thereabouts), details of the

following reserves are quoted. It is presumed that these are open pit reserves, and represent a more up-to-date computation than that of Rushton above:-

"Coal seams to be worked and their thicknesses:-

Eagle Mountain Sector		Greenhill Sector	
No. 4 seam	30 ft.	B seam	26 ft.
No. 5 seam	18 ft.	D seam	27 ft.
No. 7 seam	25 ft.	E seam	31 ft.

Remarks:

No. 4, 5, and 7 seams are geologically identical with B, D, & E seams respectively, only separated by faults.

PROVED RESERVES (on a raw coal basis)

Eagle Mountain		Greenhill	
No. 4 seam	37,944,000 tons	B seam	23,717,000 tons
No. 5 seam	19,959,000 tons	D seam	35,550,000 tons
No. 7 seam	35,142,000 tons	E seam	33,520,000 tons
Total:-	93,025,000 tons	Total:-	92,787,000 tons
Grand Total:- 185,812,000 tons			

The above grand total accounts for the mineable reserves of about 47 million tons on a clean coal basis. The stripping ratio is 5:1".

(Note: It is not understood why the clean coal mineable reserves should be so far below the total reserves, since this is presumably open pit mineable coal.)

The report also mentioned that a further minimum 37 million tons on a clean coal basis is indicated in No. 2 seam and in five seams above No. 4 seam.

If we combine Rushton's minimum estimate with the recent figures quoted by the Japanese we arrive at the following estimate of raw coal reserves:-

Eagle Mountain	93,025,000 tons (Japanese report)
Castle Mountain	74,400,000 tons (Rushton)
Turnbull Mountain	18,600,000 tons (Rushton)
Greenhill	92,787,000 tons (Japanese report)
	<hr/>
Total	278,812,000 tons.

(3) Emkay-Scurry

The latest estimate of reserves on the Emkay-Scurry holdings is contained in a report dated July 30, 1969, by John T. Boyd Company, mining engineers of Pittsburgh, U.S.A.

The following criteria are used:-

- (1) All the reserves are considered as mineable by open pit methods.
- (2) Raw recoverable coal is defined as coal mined from the strip pits at 95% recovery.
- (3) It is assumed that 75% of the raw recoverable coal will be of metallurgical grade.
- (4) Seams of less than 5 feet thick were not taken into account.
- (5) Areas underlying landslide debris on Big Weary Ridge were not considered in the reserve estimates.
- (6) No reserves were estimated below the 5,200-foot level (the level of the Elk valley).
- (7) No reserves were estimated on the west side of Elk valley.

The area underlain by reserves is on the east side of Elk valley and extends for approximately 5 miles north of Aldridge Creek.

The following are the reserve estimates:-

<u>Area</u>	<u>Recoverable Raw</u> <u>short tons</u> <u>(000's)</u>	<u>Overburden</u> <u>cu. yds</u> <u>(000's)</u>	<u>Ratio</u>
Little Weary Ridge	24,900	129,480	5.20
Big Weary Ridge - North	21,000	122,850	5.85
Big Weary Ridge - South	94,000	841,300	8.95
Total	139,000		

Total Reserves

It is difficult at present to provide even a geological estimate of the total potentially mineable coal reserves of the Elk River coalfield. However, it might be possible to make a very crude estimate, based on fairly conservative assumptions. The total extent of the coalfield from north to south is 56 miles. Let us assume that only 20 miles of this total length contains mineable coal seams. The average width of the field is $2\frac{1}{2}$ miles, but let us assume that seams extend over 2 miles of this width. It may also be assumed that there is an aggregate thickness of 40 feet of mineable seams. This results in a total inferred reserve of approximately 2 billion short tons. If we assume that only half of this can be recovered, we are left with the figure of one billion tons - not a particularly large reserve. However, the present indications seem to be that this figure is extremely conservative and may well be greatly exceeded.

The total indicated reserves mineable by open pit methods are now 240 million short tons, and that of total estimated recoverable reserves (both open pit and underground) about 360 million tons.

Coal Analysis and Quality

The coals at present most in demand are high grade metallurgical coking coals with low volatile content, low sulphur, and high free swelling index. As an example the following is a list of the agreed specifications for the current Kaiser Resources Ltd. contract with the Japanese steel mills (the figures quoted are on air-dried basis):-

Inherent moisture	1.5%
Total moisture	6.0% (on a natural basis)
Ash	8.75% (Tolerance - 0.5%)
Volatile matter	19-22%
Sulphur	0.4% max.
Free swelling index	6-8
British Thermal units	14,000
Sizing	$\frac{1}{2}$ " minus - 90% minimum. max size $1\frac{1}{2}$ ".

Information obtained so far indicates that large reserves of coal exist in the Elk River coalfield which would meet the above specifications after suitable treatment in a preparation plant.

On the C.N.I. licences at Line Creek, the following analyses were obtained from raw coal samples sent to Ottawa (metals reduction and energy centre):-

Proximate analysis (dry basis):-

	Seam 8	Seam 9
Ash	15.2	11.0
Volatile matter	20.1	19.7
Fixed carbon	64.7	69.3
Sulphur	0.43	0.32
Gross calorific value (B.Th.U.)	15,570	15,670

Crabb reports that tests to date confirm that "the proven coal reserves (essentially the bottom four seams) is borderline on the low to medium

volatile (A.S.T.M.) range. Coke making ability is as good as most other seams in southeastern B.C." He also notes that the volatile content increases stratigraphically upward and reports that "In Line Creek Ridge there appears to be about a 9% volatile spread (A.S.T.M.) in about 1,500 feet of measures".

On the Fording Coal property, the same tendency is also apparent. A sample taken from Seam 4 contained 21.65% volatiles, while one taken from Seam 12, 750 feet stratigraphically higher contained 27.33% volatiles.

The following is a series of proximate analyses of samples of seams which will be the first priorities in an open pit operation. These figures are from a report by H. G. Rushton in 1968:-

<u>Seam</u>	<u>Average width</u>	<u>Moisture</u>	<u>Ash</u>	<u>Volatile matter</u>	<u>Fixed carbon</u>	<u>Sulphur</u>	<u>Free Swelling Index</u>
4	30'	0.77	12.61	21.65	64.97	0.35	5-8
5	18'	1.09	14.17	21.88	62.86	0.38	3-8
7	25'	0.99	14.84	23.08	61.09	0.44	5-9
B	26'	0.85	17.63	20.51	61.01	0.30	2-7
D	27'	0.92	12.07	21.62	65.39	0.31	3-8
E	31'	0.77	16.99	22.78	59.46	0.37	3-8

At Emkay-Scurry the following are some raw sample analyses on an air-dried basis.

<u>Seam</u>	<u>Moisture</u>	<u>Ash</u>	<u>Volatile matter</u>	<u>Fixed carbon</u>	<u>Sulphur</u>	<u>Free swelling Index</u>
7	0.69	16.13	17.78	65.40	0.58	2½-3
8 (upper portion)	0.71	11.12	19.09	69.08	0.41	5-5½
8 (lower portion)	0.65	13.89	19.85	65.61	0.41	3½-4
1	0.41	7.02	22.22	70.35	0.74	9-9

These seams are mainly classified as low volatile coals on the A.S.T.M. classification. According to the Boyd report it is considered, in the light of the rather limited amount of sampling data available, that a

preparation plant could produce a low volatile metallurgical coal to the following specifications:-

Ash	8%
Sulphur	0.6% max.
Moisture	6.0% (natural basis)
F.S.I.	5 minimum

A considerable amount of the coal adjoining the outcrops on all the properties will be oxidized and therefore unsuitable for metallurgical coke. On Line Creek this amounts to over 17% of the reserve of potential open pit coal. However any coal unsuitable for coking may find a market as a low-sulphur high-heat coal for thermal electric power generation.

While visiting the Kaiser Resources plant recently, the writer was informed that three grades of coal are currently being produced depending on the free swelling index. These are : high grade coking coal - F.S.I. 6 or more; medium grade - F.S.I. $2\frac{1}{2}$ - 6; non coking coal - F.S.I. $2\frac{1}{2}$ or less.

The projected preparation plants to date for the Elk River field will be of similar general design. The raw coal will be crushed in a breaker to minus 4" or 5". Coal in excess of $\frac{1}{2}$ " or $\frac{3}{8}$ " is treated in a dense medium washer (the medium being a magnetite suspension). The sizes between $\frac{1}{2}$ " or $\frac{3}{8}$ " and 28 mesh is treated in dense medium cyclones, while the -28 mesh coal goes through froth flotation cells. The moisture is reduced to the specified limits by passing the coal through a thermal drier, which would probably be a gas-fired drier of the fluid bed type.

APPENDIX 1

Current holdings of Coal Licences and Crown grants
in the Elk River coalfield (Oct. 1970).

Although a number of different companies hold coal licences in the Elk River field, in effect there are three major holders of coal property and two somewhat less important ones. The major holders are:-

- (1) Crows Nest Industries Ltd.
- (2) Fording Coal Limited and the parent organizations (Canpac and Cominco).
- (3) Scurry Rainbow Oil Ltd. and Emkay Canada Natural Resources Ltd. ($\frac{1}{2}$ interest each).

The minor holders are:-

- (1) Rio Tinto Canadian Exploration Ltd.
- (2) Kaiser Resources Ltd.

Company	Coal Licences Nos.	Total No. of Licences held.
Crows Nest Industries	264-284	
	285-313	
	365-373	
	1299-1302	
	408	63
CanPac Minerals Ltd.	314-364	
	419-420	
	507-511	
	536-538	
	554-560	68
Fording Coal Limited	801-804	
	943	
	944	
	964	7
Cominco Ltd.	12 Crown-grant Lots	
	539-553	
	805-807	17
Kaiser Resources Ltd.	260-263	4
Scurry Rainbow Oils Ltd. & Emkay Canada Natural Resources Ltd.	64	
	65	
	421-434	
	481-489	
	515	
	771-779	34
Scurry Rainbow Oil Ltd.	951-957	7
Rio Tinto Canadian Exploration Ltd.	572-575	
	800	
	576-587	
	798-799	
	1012-1018	26
TOTAL		226

APPENDIX 2

Reports and References

Report on the Elk River Coal Project, 1967 by H. G. Rushton, P. Geol.
(Canadian Pacific Oil and Gas Limited).

Report on the Fording River Project, 1968 by H. G. Rushton, P. Geol.

Fording Coal Limited - summary of 1969 operations by A. C. Taplin.

Geological report and assessment of economic potential, McIntyre
coal reservations in the Fernie area by J. W. Antal (Dec. 1967).

Report on Coal Licences 264 - 313 incl., 365 - 373 incl., and 408 (C.N.I. Ltd.)
by J. J. Crabb, P. Eng. (March 1970).

Report on the geological exploration of the Elk River coalfield. (Jan. 1969)
by Virgil W. Carmichael ✓
(North American Coal Corporation Ltd.)

Work Report for year ending Dec. 31/69. Elk River coal project,
Scurry Rainbow Oil Limited by D. M. Lane, P. Eng.

Preliminary Mining Study, Elk River Coal Reserve, for Scurry Rainbow
Oil Limited by John T. Boyd Company (June 1969). ✓

Report

APPENDIX 3

PHOTOGRAPHS

The following photographs were taken in September 1970.



PLATE 1 - NEW HOMES AT SPARWOOD NEAR THE SOUTH END OF THE ELK RIVER COALFIELD.



PLATE 2 - IN LINE CREEK VALLEY LOOKING EAST TO HORSESHOE RIDGE.



PLATE 3 - LINE CREEK RIDGE FROM HORSESHOE RIDGE

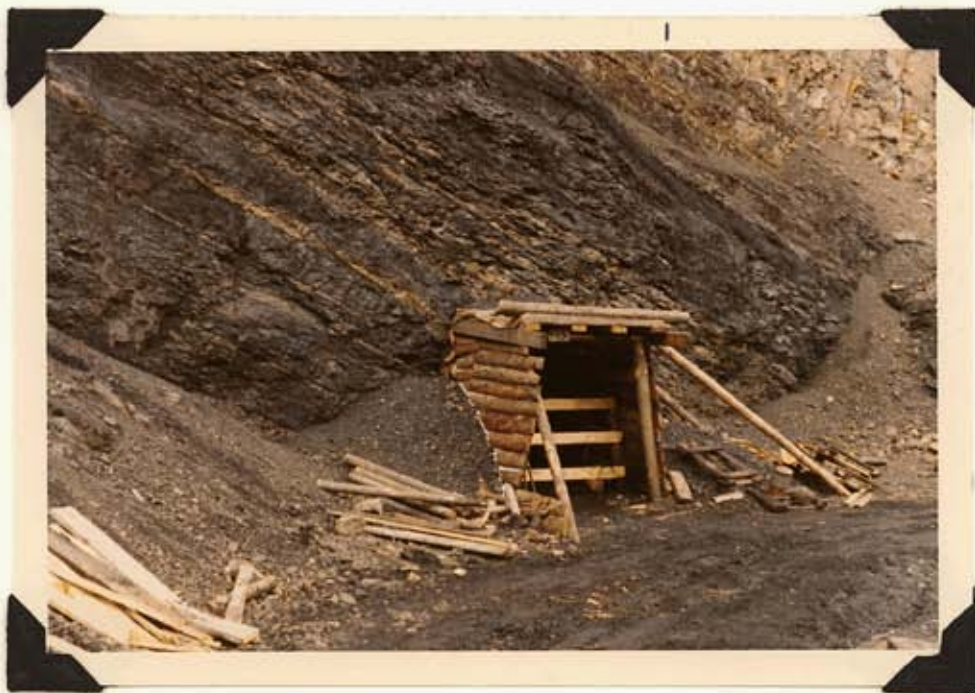


PLATE 4 - AN ADIT IN NO. 6 SEAM ON LINE CREEK RIDGE.



PLATE 5 - EXPLORATORY STRIPPING ON LINE CREEK RIDGE
SHOWING A MINOR ANTICLINE, AND THICK SEAM
AT THE BASE.



PLATE 6 - OUTCROP OF A THICK SEAM ON LINE CREEK RIDGE.



PLATE 7 - ELK VALLEY AT BOIVIN CREEK LOOKING NORTH.
PROJECTED TOWNSITE FOR FORDING COAL PERSONNEL.



PLATE 8 - ELK VALLEY AT BOIVIN CREEK.

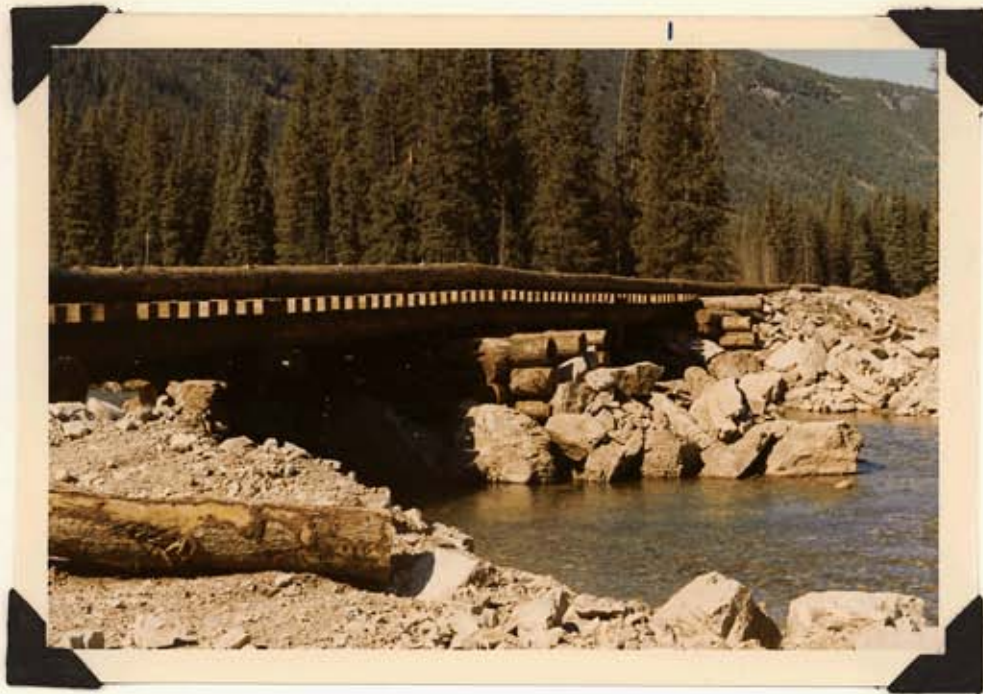


PLATE 9 - ON THE ROAD TO FORDING COAL, BRIDGE OVER FORDING RIVER.



PLATE 10 - FORDING RIVER. HILLS IN THE BACKGROUND ARE UNDERLAIN BY KOOTENAY FORMATION.



PLATE 11 - GENERAL VIEW ACROSS FORDING VALLEY FROM EAGLE MOUNTAIN, SHOWING PLANT SITE IN FOREGROUND OF CLEARED AREA AND GREENHILL PIT AREA IN THE BACKGROUND.



PLATE 12 - FORDING COAL LIMITED, TEMPORARY OFFICES. EAGLE MOUNTAIN IN BACKGROUND.



PLATE 13 - AT FORDING COAL PROPERTY LOOKING WEST TO THE GREENHILL RANGE. GREENHILL PIT AREA IN BACK GROUND OF CLEARED AREA.



PLATE 14 - GENERAL VIEW OF EAGLE MOUNTAIN FROM NORTHWEST. THIS WILL BE THE SITE OF MAJOR OPEN PIT OPERATIONS.



PLATE 15 - SUMMIT OF EAGLE MOUNTAIN. STRIPPING IN FOREGROUND.



PLATE 16 - NEAR THE SUMMIT OF EAGLE MOUNTAIN. OUTCROP OF ONE OF THE TOP SEAMS OF THE SERIES UNCOVERED BY 'CAT'.

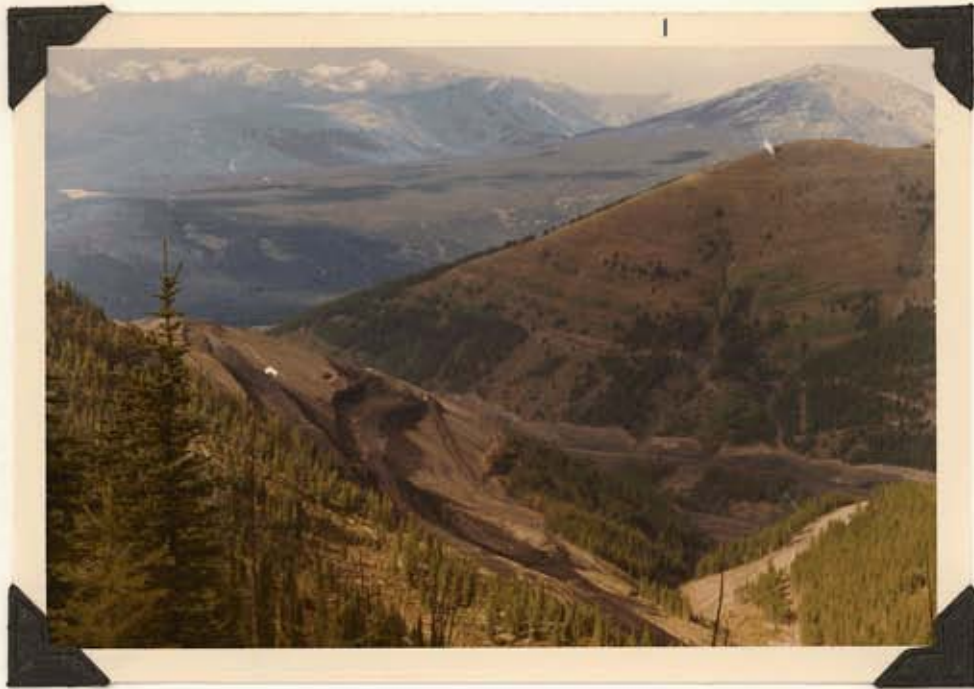


PLATE 17 - LOOKING NORTHWESTWARD FROM EAGLE MOUNTAIN INTO THE VALLEY OF CLODE CREEK. IN FOREGROUND IS MAJOR OPEN PIT. MAIN HAUL ROAD IS SEEN ASCENDING CLODE CREEK VALLEY. FORDING VALLEY, GREENHILL RANGE, AND ELK VALLEY ARE SEEN IN THE BACKGROUND.



PLATE 18 - LOOKING DOWN FROM EAGLE MOUNTAIN INTO CLODE CREEK, SHOWING THE 80-FOOT WIDE MAIN HAUL ROAD.



PLATE 19 - MAIN HAUL ROAD TO EAGLE MOUNTAIN PITS
UNDER CONSTRUCTION.



PLATE 20 - GREENHILL RANGE FROM EAGLE MOUNTAIN, SHOWING
ELECTRIC POWERLINE (CALGARY POWER COMPANY) CROSSING
RANGE TO FORDING COAL OPERATIONS FROM ELK VALLEY IN
BACKGROUND.



PLATE 21 - LOOKING NORTHEAST TOWARDS THE HEADWATERS OF
CLODE CREEK. MT. FARQUHAR IN BACKGROUND.
MT. TURNBULL IN LEFT FOREGROUND, UNDERLAIN BY
KOOTENAY FORMATION AND CONTAINING COAL RESERVES.



PLATE 22 - EMKAY-SCURRY LTD. CAMP AT ALDRIDGE CREEK.
BIG WEARY RIDGE (UNDERLAIN BY KOOTENAY FORMATION
AND CONTAINING COAL RESERVES) IN RIGHT BACKGROUND.



PLATE 23 - BIG WEARY RIDGE FROM LITTLE WEARY RIDGE,
LOOKING SOUTHWARD. WEARY CREEK IN FOREGROUND.
COAL MEASURES DIP WEST AT 35°.



PLATE 24 - EMKAY-SCURRY, WEARY CREEK. AN ADIT AT NO. 4
SEAM (39 FEET THICK).

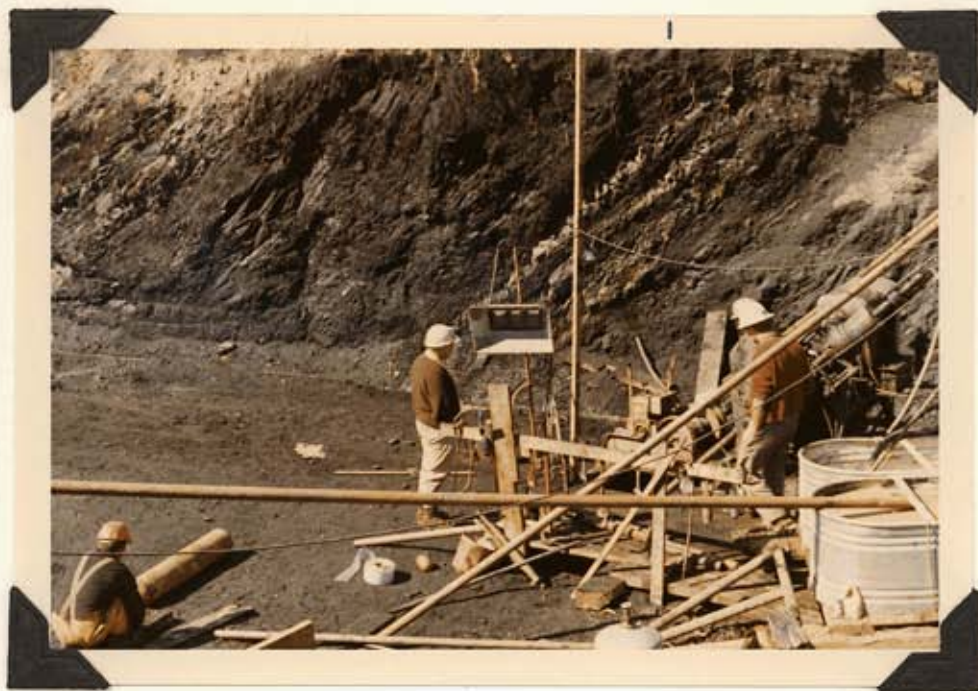
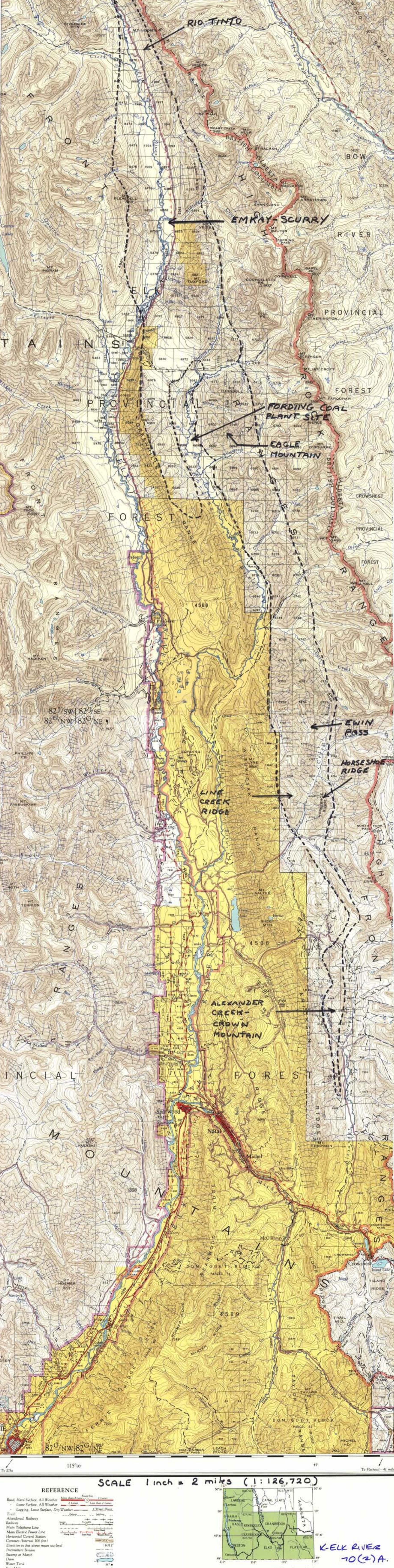


PLATE 25 - DRILLING ON LITTLE WEARY RIDGE. OUTCROP
OF NO. 8 SEAM (30 FEET THICK) IN BACKGROUND.



PLATE 26 - THE NORTH END OF THE ELK VALLEY FROM LITTLE
WEARY RIDGE. ELK PASS AND THE ALBERTA BORDER
IS AT THE DARK LOW RIDGE BELOW THE DISTANT PEAKS.
RIVERSIDE MOUNTAIN (8,500 FT.) AND CADORNA CREEK
ON LEFT.



115°00' 45' To Flathead — 41 miles

SCALE 1 inch = 2 miles (1:126,720)

REFERENCE

Road, Hard Surface, All Weather	More than 2 Lanes	2 Lanes	Less than 2 Lanes
Loose Surface, All Weather	Logging, Loose Surface, Dry Weather	Trail	Abandoned Railway
Main Telephone Line	Main Electric Power Line	Horizontal Control Station	Contours (Interval 100 feet)
Elevation in feet above mean sea-level	Intermittent Stream	Swamp or Marsh	Dam
Water Tank	Saw Mill	Gravel Pit	Spring
Glacier	Mine	Intermittent Lake or Seasonal Inundation	Water Supply Area

Note: On the above index the maps published are shown colored green.

Government Agents at Cranbrook and Fernie.

Mineral Claims are not shown on this sheet.

--- APPROXIMATE BOUNDARY OF KOOTENAY FORMATION IN THE ELK RIVER COALFIELD

K-ELK RIVER 70(2)A.