Report On

PROPOSED EXPLORATION AND DEVELOPMENT

Of the

BOWRON RIVER COAL FIELD

BRITISH COLUMBIA

Submitted to: Tanar Gold Mines Ltd. (NPL)

Coronation Building

285 - 17th Street,

West Vancouver, B. C.

December 20th, 1960   A. E. Aho

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SUMMARY

      The Bowron River coal field near Prince George,
B.C. contains an undetermined reserve of coking coal in
three or more $45°$- dipping seams, 6, 8 and $9\frac{1}{2}$ to $13\frac{1}{2}$ feet
or more in thickness, the thicker seam being the purer.
The purer coal presently indicated is high volatile B
gituminous with about 4% moisture, 11% ash, 40% volatile
combustible matter, 43% fixed carbon, 1 - 1.5% sulphur
and 11,700 B.T.U., yielding about 55% friable coke of
apparently good quality.

      The continuity, width, dip and character of the
purer, thicker seam, and the character of its roof and
floor could be determined by a 4-month exploration program
costing $75,000.-. A suitable seam could be mined with an
efficient "manless face" method which could be developed
within an additional 8 months to produce 1000 to 2000 tons
per day or more. Total capital outlay to get an efficient,
modern operation of this type into production would be
about $2 Million.

      Present preliminary cost estimates on the basis
of this type of operation suggest that 1000 tons per day
or more should be mined from a 10- or 15- foot seam on a
10-year basis in order to be economic. A 1000-ton-per-
day market at about $8.- per ton f.o.b. Prince George for
10 years is estimated to return over 10% on the initial
$2 Million investment and should be competitive with nat-
ural gas at present minimum base rates. Similar profits

could be anticipated if a market of 2000 tons per day or more at $10.- per ton f.o.b. Vancouver is developed under government subvention.

It is recommended that detailed surveys be conducted to definitely confirm one or more such markets that could make the coal profitable. Once these markets are confirmed the $75,000.- exploration program should be carried out, then more precise evaluation of the coal and its costs and markets should determine the precise nature of development.

GENERAL DESCRIPTION

The Bowron River coal field is a basin or belt of coal measures 1½- to 2-miles wide, extending north-westerly for 7 miles or more along the Bowron River, 35 miles ESE of Prince George, B.C.

The main coal occurrence on the bank of the Bowron River can be reached at present by about 40 miles of road extending east from the Pacific Great Eastern Railway at Red Rock, or by 35 miles of good road and 16 miles of rough road from Prince George. It is only four miles from the Northern Trans-provincial highway near Purden Creek and can also be reached by 24 miles of bulldozer trail from Hansard on the Canadian National Railway to the north.

Good pine, spruce and balsam timber is abundant on the coal property and a sizeable logging industry is aggressively extending roads and activities toward this area. However, no power or other facilities are yet available on the property.

Climate is typical of the Prince George area, with equitable summers and cold winters with moderate snow-fall. Good water is available from the Bowron River and nearby creeks.

The main coal seams occur on the bank of the Bowron River on Lot 9593, and extend northwest under a

timbered gravel bench some two miles in extent. Camp
buildings suitable for exploration headquarters are sit-
uated on the bench 50 to 60 feet above river level.

PREVIOUS EXPLORATION

The coal was first discovered about 1898. In
1910 A. E. Hepburn drove a 34 foot adit with 9 foot and
13 foot crosscuts to the seams.

From 1946 to 1950 the Bowron Coal Company diamond
drilled seven holes at the main coal occurrence, and drove
an adit for 50 feet on the footwall side of the main coal
seam.

In 1952 Central Industries Ltd. extended the adit
to 193 feet and drove two cross-cuts. One 40-foot cross-cut
from the end of the adit hit gravel and the other, which was
only 65 feet from the portal, was driven 83 feet and crossed
two seams of coal 8 feet and 6 feet thick. Ten keystone
drill holes were put down about 3000 feet northwest on strike
and two 4-foot seams, presumably below the main seam, were
intersected (refer to plan and section by A. J. Garroway).

PRESENT WORK

Tanar Gold Mines Ltd. (N.P.L.) of West Vancouver
optioned the property (Lot 9593) from A. J. Garroway, the
present owner, in May 1960 while negotiating for coking
coal contracts with Japanese steel interests. On this basis
an exploration shaft was started in September, about 3000 feet
northwest of the old adit on the river bank.

Driven in overburden, the old adit and coal exposures
are presently covered by slumped boulder clay and were not
visible at the time that the writer first examined the property
on October 8, 1960. Work on the shaft was subsequently sus-
pended due to weather conditions and pending seasonal holidays.

This present report roughly estimates the costs
of production for different seam widths and production
rates, but markets must still be evaluated carefully before
work is resumed.

LITERATURE

The coal occurrences have been reported on by
William Blakemore in 1911, J.F.J. Galloway in 1912 and
James Ashworth in 1913, all for A.E. Hepburn of Vancouver;
by D.B. Dowling for the Geological Survey of Canada (Memoir 69) in 1915; by W.A. Ralston for the Canadian National
Railways in 1943; and by Charles Graham in 1946 and 1947,
E.J. Hughes in 1948 (examined by R.S. Holland), and A.R.C.
James in 1954 for the B.C. Department of Mines (See Minister
of Mines Annual Reports).

GENERAL GEOLOGY

The Bowron River coal field lies in a moderately-
to steeply-dipping series of early Tertiary (Cretaceous ?)
sandstones and shales which form a belt 1½ to 2 miles wide,
striking northwesterly for some 7 miles or more along the
valley of Bowron River; outcrops of the coal measures have
been observed only where the river has cut through the
gravel benches or rolling irregular topography of boulder
clay, gravel, and alluvium which overlies most of the
measures to a depth of several tens of feet or more. More
resistant underlying volcanic rocks form higher hills to
the sides of the valley.

FORMATIONS

The coal formation consists of more than several
hundred feet, perhaps two or three thousand feet, of grey
and buff sandstones interbedded with light to dark shales,
sandy shales, &carbonaceous shales, with several thin beds
of conglomerate. Two or three mineable seams and several

thinner seams of coal occur in about 50 feet or more thickness of this section. Other coal outcrops have been found elsewhere along Bowron River. Overburden on the river bank shows the following section living on the eroded surface of the coal: 15 - 30' gravel (top), 0 - 5' silt, 20 - 30' boulder clay.

Beneath the coal is a section of 50 to 70 feet of greyish shales with interbeds of sandstone, lenses of conglomerate, thin seams of coal and coal and wood fragments up to log size. About 30 feet statigraphically beneath the adit and 125 feet south of it on the river bank is a 10 foot thickness of this section carrying abundant yellow stain, reported to be radioactive, and to have given a sample which assayed 0.14% U_3O_8 and 0.25% V_2O_5. The writer cleaned off this section carefully and cut the following channel samples across it:

#1	2.35 feet	across conglomerate with coaly shale fragments (yellow coating)
#2	2.70 feet	across grey to black shale with coal seams and stringers to 2 inches thick (much yellow stain)
#3	3.90 feet	across grey shale, lesser coaly material (some yellow stain)

Chemical analysis by J. R. Williams & Sons showed no uranium and spectrographic analysis by Dr. R. M. Thompson showed no vanadium, germanium, or other constituents in unusual concentrations. In the Keystone drill holes 3000 feet to the Northwest radioactive carbonized wood fragments are reported from the section underlying the coal measures. These drill holes also show, as reported by Garroway, that the 50 to 70 foot section below the coal is underlain by thicker dark chocolate-brown shale and minor grey shale which may extend down to the greywacke base, perhaps 1500 feet stratigraphically below.

STRUCTURE

The coal seams strike about N 40° W and dip 43° NE at the outcrop on the river. The coal basin is inferred

by Holland to be faulted against the older volcanics on
the northeast side, and the southwest side may be similarly
faulted in part (See Minister of Mines Annual Report 1948,
Fig. 18). Damsite investigations farther down Bowron
River also show steep to vertical dips, so moderate to
steep dips can be expected throughout most of the coal
measures, although they are not generally severely dis-
turbed. Variations in strike exposed along the river
suggest that such variations may be found in the unexpos-
ed coal measures.

COAL SEAMS

Three seams of coal have been found in the work
done on the river bank. The lowest seam, 8 feet thick,
and an overlying one 6 feet thick were encountered in the
adit. An upper seam is reported to have been exposed over
a width of 10 feet by trenching in the river bed during
low water.

The 8-foot seam, exposed in a 9-foot crosscut
driven left at 22 feet inside the old adit (See Minister
of Mines report 1948, p. A237-8) showed thin interbeds of
shale throughout it. The 6-foot seam was similar to the
8-foot seam. Neither seam has a well defined roof or floor.

Later work by Central Industries in the 83-foot
cross-cut exposed a big seam of 9 feet or more of pure coal
which is reported on only by A.R.C. James (Minister of Mines
Report 1954, p. A247-248), who gives the following section,
from the 83-foot cross-out driven to the right:

Gravel (top of seam eroded off)	--
Coal	9'0"
Fine grained sandstone	0'5"
Dirty Coal	2'11"
Mudstone	0'7½"
Coal	0'6"
Bone	0'5"
Coal (with thin interbeds of shale)	8'2"

The bottom seam in this cross-cut is probably the 8-foot seam described above.

Diamond drill hole #1, about 100' north of the portal of the adit, intersected the following section at 11'7" depth:

Coal	4'5"	)
Shale	0'6"	)
Coal	3'0"	) 14' of coal
Shale	0'6"	) 1' of shale
Coal	6'6"	)

At a depth of 31'6" the hole also intersected 9'5" of coal, which may be the big seam in the 83'cross-cut.

In 1915 Dowling had reported 9'2" of coal in this upper seam, and a further reported thickness of 3 to 4 feet of clean coal higher up in this seam, which may indicate a total thickness of 13 feet of clean coal.

Continuity of the seams is yet to be determined since it is reported that the logs of diamond drill holes Nos. 3 to 7 were purposely tampered with after some disagreements, and this probably resulted in the statement by Hughes (Minister of Mines Report, 1954, p. A236) that "Despite the close spacing of the holes, it is not possible to correlate an individual seam from one drill hole to another or with those exposed on the surface".

The keystone drilling 3000 feet to the northwest was carried out almost entirely in the section which apparently lies below the coal measures and only one hole (#1) is reported to have cut two seams of coal. The lower seam in this hole is 3'6" wide and the one above, intersected in the upper part of the hole, was 4 feet wide. The drilling apparently did not extend far enough northeast to test the upper part of the coal horizon in which the thicker and purer seam or seams occur at the river bank, and which may exceed 10 feet in thickness.

CHARACTER OF THE COAL

The coal is clean, bright and fairly hard, with numerous small masses of yellow resin and closely-spaced fractures perpendicular to the bedding. The 3- and 6-foot seams contain shale and bone which increases the ash content, but the large seam is relatively pure, as shown by the analyses from channel samples taken by previous writers:

	% H_2O at 105°C	% Ash	% Vol.comb. Matter	% Fixed Carbon	% Sulphur	B.T.U.
Upper 7' of 8-foot seam	5.0	14.3	34.0	46.7	1.6	10,989
Bottom 4' of 6-foot seam (excluding 10" of partings)	6.0	18.0	31.0	45.0	1.0	10,120
9-foot seam	3.8	11.2	41.9	43.1	1.6	11,700
10 analyses by Blakemore, Ashworth,and Bowron Coal Co.	3.0 5.5	2.0 8.0	37.8 45.0	47.6 51.2	0.5 1.1	10,849 12,517
Average of 2 CNR samples (coal only)	2.02	12.31	41.43	43.18	0.91	11,189

The sample of the 9-foot seam made coke; Galloway reports an excellent hard and firm coke; and Ralston of the CNR reports the coal to be of good coking quality. Blakemore's samples yielded 54.5 - 57.0% coke. The CNR laboratories reported the fusion point of the ash to be 1950 - 1970° F, the coke to be very friable, the ash to be light brown in colour, and the swelling index to be 1½.

The A.S.T.M. qualification of this coal is high volatile B bituminous.

POTENTIAL RESERVES

No estimate of reserves can be made on the basis of available data until continuity and average width of seams is established. Early estimates given were as follows:

Blakemore   189 million tons under 9000 acres

Galloway   150 million tons under 6720 acres

Ashworth   over 40 million tons under 3840 acres.

PROPOSED EXPLORATION

The continuity, width, dip, and character of the best seam or seams and the character of their roofs and floors must be determined over an area sufficient for production before development can be planned. The following program should adequately test the vicinity of the main coal occurrence:

4000' diamond drilling at $10 per foot
to test continuity, dip, and width over
5,000 - 10,000' in length   ....$ 40,000.-

100' shaft, 100' crossout and drifts to
determine character of main coal seam,
its roof, and floor 35,000.-
                                             _____
                                             $ 75,000.-

This program could be completed in 4 months and would determine the nature of further justifiable development.

POSSIBLE DEVELOPMENT

A suitable seam of coal such as the 9-foot seam, dipping 40 to 45 degrees, could be mined efficiently by a "manless face" method. In this method a main slope is driven in the footwall side of the seam, cross-cuts are driven to the seam on two levels 100 feet apart, entries are driven along the seam, raises are driven in the seam at 200- to 300-foot intervals and, with one or two long blast holes drilled up the seam, a 100-foot longe slice of coal is blasted loose and fed by gravity through chutes onto belt conveyors which service both development and production headings.

Assuming suitable seams to be proven after 4 months' exploration, surface installations could be completed and enough underground development done within 8 months to start production at 1000 tons per day, which could be quickly increased to 2000 tons per day or more as required

COSTS

Costs to develop, and produce coal assuming diffirent seam widths, developed lengths and rate of production, are roughly estimated for preliminary studies as follows:-
(closer estimates will be required when seam conditions and markets are more accurately known)

Capital Costs (surface)

Diesel or Steam plant		
600 KW cap. @ $88.-/kw	$ 52,800.-	
Installation	5,000.-	
Accessories, equiptment	5,000.-	
Building	10,000.-	
Other	2,200.-	75,000.-
Blacksmith shop, welder, lathe, etc.		
Equipment	25,000.-	
Building	10,000.-	35,000.-
Staff House		10,000.-
Change House		10,000.-
Carpenter & Electrical Shop, equipped		15,000.-
Extra Buildings (Bunkhouse, Garage, Pumphouse, Warehouse, etc.)		25,000.-
Water & Electrical wiring systems		5,000.-
Site Preparation		5,000.-
Road Improvement (16 mi. @ $3000.00 - ½ pd)		25,000.-
Generators, compressors, other equipment		50,000.-
Vehicles, (4-wheel drive and station wagon)		10,000.-
Tipple-Bunkers, screen, washing plant etc.		100,000.-
Slack disposal conveyor (500' @ $50.-)		25,000.-
Townsite and improvements		100,000.-
Contingencies		60,000.-
T O T A L		550,000.-

Capital Costs (Underground) to get to coal

assuming manless face or stoping method along 10,000'
of seam and 5,000' of seam length.

	(a) 10,000'		(b) 5,000'	
400' main slope @ $40/foot	= $ 16,000.-	main slope	= $ 16,000.-
Bottom conveyor installed 10,000' @ $40/foot	= $400,000.-	bottom conveyor 5,000' x $40	= 200,000.-
Top conveyor 5,000' x $40.	= $200,000.-	top conveyor	= 100,000.-
Extra 400' Main conveyor, surface to coal x $60/foot	= $ 24,000.-	Main con- veyor	= 24,000.-
12 drills @ $250.00 plus hoses, air lines etc.	= 3,000.-	drills, etc.	= 11,000.-
Slusher or Loader	= 30,000.-	Loader	= 30,000.-
Miscellaneous tools	= 10,000.-	Miscellaneous Tools	= 10,000.-
Contingencies 10%	= 69,000.-	Contingencies 10%	39,000.-
	$760,000.-		$430,000.-

This equips the mine for production from one block of coal to
another.

Direct Development Costs

(Contingencies included under operating costs)

First block of coal:

(a) 10,000' length		:	(b) 5,000' length	
800' main slope plus two cross-cuts (100') to top and bottom entries 1000' x $40.	= $40,000.-	:	main slope	= $ 40,000.-
1000' main conveyor $60	= 60,000.-	:	main conveyor	= 60,000.-
Top & bottom entries 20,000' x$16.50/ft.	= 330,000.-	:	Entries 10,000' x 16.50	= 165,000.-
Raises, assume 250' panels $\frac{10,000}{250}$ = 41 raises 41 x 100' x 16.50/ft.	= 67,700.-	:	Raises 21 x 100 x 16.50	=34,600.-
Room necks every 50' @ $100 per shift, 6 shifts each -- $\frac{600 \times 10,000}{50}$	= 120,000.-	:	Room Necks $\frac{5000}{50}$ (600)	=60,000.-
	$617,700.-	:		$359,600.-

Second and Successive blocks (not excessive depth)

(a) 10,000' length		:	(b) 5,000' length	
800' main slope and one crosscut 800' x $100 driven and equipped	= 90,000.00	:	main slope	90,000.-
10,000' entry 16.50 (have one from above)	= 165,000.-	:	5,000' entry @ 16.50	82,500.-
Raises as above	= 67,700.-	:	Raises	34,600.-
Room necks as above	= 120,000.-	:	Room necks	60,000.-
	$442,700.-	:		$267,100.-

Direct Development Cost Breakdown

(does not include other crews or overhead)

Main Slope

Estimated $40.00 per foot to drive heading and timber, plus $60.00 per foot installed cost for conveyor.

Entries

8 headings (4 entries, 2 raises, 2 room necks)

Wages

16 Miners @ $20.	$ 320.00
1 Fire boss	25.00
1 Timber man helper	15.00
4-man(2 Timber men	35.00
crew(2 men advancing conveyors	35.00
1 man on belts & chutes	17.50

8)447.50

wages per heading:	56.00
plus 17% welfare, vacation compensation	9.50
Powder & supplies (timber, pipe, etc.)	25.00

Total 90.50 per heading per day

Average advance 6'/day $\frac{90}{6}$ = $15.00 per foot

Assume $1.50 per foot extras = 16.50 per foot
or average $100. per shift

Raises

Assume $100.00 shift also.

Room Necks

Assume 50' centers, 25' wide, roughly triangular cross section
About 6 shifts @ about $100.00 per shift = $ 600.00 each

Direct Development Costs per ton

Assume 15-foot seam

(a) 10,000' length	(b) 5,000' length

First block   **First block**

$$\frac{10,000' \times 100' \times 15'}{25 \text{ cu.ft/ton}} = 600,000 \text{ tons}$$
  300,000 tons
  <u>60,000</u>
  240,000 tons mined

20% left as pillars,
Therefore 600,000
    <u>120,000</u>
    480,000 tons mined

Costs $\dfrac{\$617,700}{480,000} = \$1.29$ per ton   : Costs $\dfrac{\$359,600}{240,000} = \$1.50$/ton

2nd and successive blocks

Costs $\dfrac{\$442,700}{480,000} = .92$ per ton $\dfrac{\$267,100}{240,000} = \$1.11$/ton

at 1000 tons per day production
in 10 years is 10x12x20x1000

$= \dfrac{2,400,000 \text{ tons}}{480,000 \text{ tons per block}} = 5$ blocks   10 blocks

Average cost of development   Average:
over 10 year period is

```
1 x 1.29 = 1.29          1 x 1.50 = 1.50
4 x  .92 = 3.68          9 x 1.11 = 9.99
        5)4.97                   10)11.49
         = $1.00 per ton          = $1.15/ton
```

For 10 - foot seam

First Block

$$\frac{10,000' \times 100' \times 10'}{25 \text{ cu.ft/ton}} = 400,000 \text{ tons per block}$$
  200,000
  <u>40,000</u>

20% left   <u>80,000</u>   160,000 tons mined
         320,000 tons mined

Costs $\dfrac{\$617,700}{320,000} = \$1.93$ per ton $\dfrac{\$359,600}{160,000} = \$2.25$/ton

Second Block

Costs $\dfrac{\$442,700}{320,000} = \$1.38$ per ton $\dfrac{\$267,100}{160,000} = \$1.67$/ton

Average Cost
1000 tpd $\dfrac{2,400,000}{320,000}$ 7.5 blocks   15 blocks

```
1   x 1.93    1.93          1  x 2.25    2.25
6.5 x 1.33    8.97          14 x 1.67   23.40
        7.5)10.90                   15)25.65
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    $1.45 per ton $1.71 per ton

For 7.5' Seam

$$\frac{10,000 \times 7.5 \times 100}{25}$$

$$\begin{array}{r} 300,000 \text{ tons} \\ 60,000 \\ \hline 240,000 \text{ tons per block} \end{array}$$ 120,000 tons

$$\frac{\$617,700}{240,000 \text{ tons}}$$ $2.57/ton

$$\frac{\$359,600}{120,000 \text{ ton}}$$ $3.00/ton

$$\frac{\$442,700}{240,000 \text{ ton}}$$ $1.85/ton

$$\frac{\$267,100}{120,000 \text{ tons}}$$ $2.23/ton

10 blocks to mine for 1000 tons per day

$$\begin{array}{r} 1 \times 2.57 \\ 9 \times 1.85 = 16.60 \\ \hline 10) \overline{19.17} \end{array} \text{ (\$1.92/ton Ave.)}$$

Too deep to mine efficiently?

20 blocks
$$\begin{array}{r} 1 \times 300 = 3.00 \\ 19 \times 2.23 \quad 42.40 \\ \hline 20(\overline{45.40} \\ \$ 2.27 \text{ Ton Ave)} \end{array}$$

For Development costs per ton saleable coal, assume 20% waste rock and slack (fines).

Therefore costs are as follows:

	10,000 length			5000' length
15' seam				
$\frac{1.00}{.80}$	$1.25	$\frac{1.15}{.80}$		1.44
10' seam				
$\frac{1.45}{.80}$	$1.81	$\frac{1.71}{.80}$		2.14
7.5' seam				
$\frac{1.92}{.80}$	$2.40	$\frac{2.27}{.80}$		2.84

(Actually 1.25 times more blocks would have to be developed to account for waste factor).

For 500 t.p.d.   5000' length

, Mine only half as much coal, i.e. 7.5 blocks
Therefore Dev. costs 1 x 2.25
$$\begin{array}{r} 6.5. \times 1.67 \quad 10.82 \\ \hline 7.5) \overline{13.07} = \$1.75 \text{ /ton Ave.} \end{array}$$

Per ton saleable coal $\frac{1.75}{0.80} = \$2.19/ton$

Coal Produced and Developed per shift

Assume 8 headings in 10' seam 6' per shift advance

$$\frac{8x10' \text{ wide} x8' \text{ high} x6' \text{ advance}}{25 \text{ cu.ft/ton}} = 154 \text{ tons/da/shift produced}$$

For one shift per day advancing entries two ways, 12 feet of coal is developed, therefore total tonnage developed is:

$$\frac{12' \text{advance} \times 100' \text{ block} \times 10' \text{ width}}{25 \text{ cu.ft/ton}} = 480 \text{ tons/da/developed}$$

less 20% pillar loss etc.	.96
	384
plus development coal	154
	538
less 20% waste at tipple	108
Salable coal	430 tons

Thus in a 10' seam 2 shifts per day are needed to keep coal ahead even for 500 tons per day until first block or two are developed, and 3 shifts to keep 1000 tons per day ahead.

in a 15 foot seam coal developed per shift is:

$$\frac{12x15x100}{25} = 720 \text{ tons}$$

less 20% pillar loss	144
	576
plus development coal	154
	730
less 20% loss at tipple	146
Salable coal	584 tons

Thus 2 shifts per day are needed for 1000 tons/da and 3 shifts per day for 1500 tons per day production.

Direct Coal breaking Costs

(does not include other operating costs)

2 drillers - 20.00 each	40.00
1 fire boss	25.00
1 helper	15.00
Powder, detonators, water infusion etc.	35.00
17% welfare, vacation, compensation	13.60

$ 128.60 per day

Assume 20% loss in waste coal at surface

$$\frac{128.60}{80} = \$161.00/da \text{ charges against salable coal.}$$

Other Labour Costs

1 steam plant operator		22.50
2 underground maintenance (miners)		40.00
1 utility man		17.50
3 rock pickers	20.00	
	15.00	
	15.00	50.00
1 mechanic		22.50
1 blacksmith		22.50
1 timekeeper - warehouse - 1st aid		20.00
1 flunkey		15.00
1 cook's helper		20.00
1 cook		20.00
1 truck driver		20.00
plus 17% welfare, vacation, compensation		46.00

Total $ 316.00/da

Total men at mine

Surface labour	13	270.00/da
Breaking coal	4	80.00
Day development etc.	23	447.50
Engineer, Manager	2	----
Night develop,2nd shift	22	432.50
Other	1	----
Total	**65**	**$ 1,230.00 direct wages per day**
3rd shift (Develop)	22	432.50
		$ 1,652.50

Depreciation Reserve

Assume rough overall life of 10 years for surface and underground installations:

(a) 10,000'
Surface $550,000
Underground   760,000
$1,310,000

(b) 5000' length seam
$550,000
430,000
$980,000

(a)   Assume 10% salvage value, interest at 6% in Sinking Fund --

Sinking Fund Payment
per year $= (1,310,000-131,00) \times \dfrac{1}{13,1807}$

$= \dfrac{1,179,000}{13.1807} =$ $89,500 per year

OR   7,460.00 per month

(b)   S. F. Payment --

$= \dfrac{(980,000-98,000)}{13.1807} = \dfrac{882,000}{13.1807} =$ $67,000/year

$=$ $5,600/month

Depletion Reserve

Should also apply to some items above but not important to separate since write-off rate is the same.

Exploration expense = $75,000

Payment per year   = $\dfrac{75,000}{13.1807}$ $5,700.-/year = $475.-/month

Bond Interest

If 2/3 financed by bonds, the above will return the capital but to provide interest on bonds @ 5½%:

(a) 10,000' length of seam
Capital Costs $1,310,000
Development to Coal   617,700
10% Dev. contingencies 61,800
4 mo. working capital
assuming Dev. pays for
itself $1500/day x 20
day x 3 mo.   120,000

(b) 5000' length of seam
980,000
359,600
36,000
120,000

$2,109,500 TOTAL $1,495,600 TOTAL

(a) 2/3 (2,109,500) = $1,400,000
5½% (1,400,000)
$\dfrac{}{12 \text{ mot. x 20 days}}$ = 321.-/day

(b) 2/3 (1,495,600) = $990,000
5½% (990,000) = $227.00/day
$\dfrac{}{12 \text{ mo. x 20 days}}$

Return of Investment

Return of stockholder's investment on remaining 1/3 should be at rate of 10% per annum minimum.

(a) $\dfrac{1/3 (2,109,500) 10\%}{12 \text{ mo. x 20 days}}$ = $293.00/day (10,000' length)

(b) $\dfrac{1/3 (1,495,000) 10\%}{12 \text{ mo. x 20 days}}$ = $207.00/day (5,000' length)

Costs of Production

(a) 10,000' length 10' seam

	Per day	500 tons per day	1000 TPD	1500 TPD	2000 TPD
Development	-	$1.81	$1.81	$1.81	$1.81
Breaking Coal	161.00 est.	.25	.161	.12	.13
Other Labour	316.00	.632	.316	.24 est.	.20
Free Board $3/da/men	- $\frac{65x\$3}{500}$	.39 $\frac{87x\$3}{1000}$	.261 $\frac{87x\$3}{1500}$	.184 est	.15

Supervision & Admin.

Manager	$800					
Engineer	600					
Office	600	100.00	.20	.10	.067	.055
	$\frac{\$2000/mo}{20}$					

Maintenance & Repairs

20% total labor costs:					
.20 (1652.00)	330.00 est..60		.33 est.	.25	.20
Tipple	350.00 *	.65	.35	.233	.20
Fuel, Supplies, and Services	50.00	.10	.05	.033	.027
Depreciation $\frac{7460/mo}{20}$	373.00	.746	.373	.248	.186
Depletion $\frac{475/mo}{20}$	23.70	.048	.024	.016	.012
5½% Bond Interest	321.00	.642	.321	.214	.16
Taxes & Insurance Assume 5% of total $3500/da costs	175.00	.35	.175	.116	.09
Miscellaneous	50.00 est.	.08	.05	.033	.02
Royalty 10¢/ton	-	.10	.10	.10	.10
Overall contingencies 5%		.325	.22	.18	.17
10% Return of Investment		.60	.30	.20	.15
		$7.52	$4.94	$4.04	$3.67
Minimum price f.o.b. Mine transportation to Pr. George		1.75	1.75	1.75	1.75
Minimum Price at Prince George		$9.27	$ 6.69	$5.79	$5.42

(b)   5,000' length 10' seam

	500 TPD	1000 TPD	1500 TPD
Development	$2.19	$2.14	$2.14
Breaking coal	.25	.161	.12
Other labor	.632	.316	.24
Free board	.39	.261	.184
Supervision and Adminstration	.20	.10	.067
Maintenance & Repairs	.60	.33	.25
Tipple	.65	.35	.233
Fuel, Supplies, Services	.10	.05	.033
Depreciation $\frac{5600/mo \ \$280/da}{20}$	.56	.28	.187
Depletion	.048	.024	.016
5½% Bond interest	.454	.227	.152
Taxes & Insurance	.35	.175	.116
Miscellaneous	.03	.05	.033
Royalty	.10	.10	.10
Overall Contingencies 5%	.33	.23	.19
10% Return of Investment	.42	.21	.14
Minimum price F.O.B. Mine	$7.35	$5.00	$4.20
Transportation to Pr.George	1.75	1.75	1.75
Minimum price at Pr. George	9.10	6.75	5.95

(c)   15 - foot seam

Essential Differences:

Development costs only 2/3 as much per ton
Breaking costs only - say - 4/5 as much
Free board 65/87 as much since one less crew needed
to keep ahead.

10,000' length	500 TPD	1000 TPD	1500 TPD	2000 TPD
Development	$ .60	$ .60	$ .60	$.60
Breaking	.05	.03	.01	.01
Free board	.-	.066	.044	.03
Savings (approx.)	$ .65	$ .70	$ .654	$.64
	$ 7.52	$ 4.94	$ 4.04	$3.67
	- .65	-.70	-.65	-.64
Minimum price f.o.b. Mine	$ 6.87	$ 4.24	$ 3.40	$3.03
transportation to Pr.George	1.75	1.75	1.75	1.75
Minimum price at Pr. George	$ 8.62	$ 5.99	$ 5.15	$4.78

5,000' length	500 TPD	1000 TPD	1500 TPD
Development	$ .73	$ .73	$ .73
Breaking	.05	.03	.01
Free board	-	.066	.044
	$ .78	$ .83	$ .78
	$7.35	$5.00	$4.20
	-.78	-.83	-.78
Minimum price f.o.b. mine	$6.57	$4.17	$3.42
Transportation to Pr.George	1.75	1.75	1.75
Minimum price at Pr. George	$8.32	$5.92	$5.17

The above cost estimates do not include any distributing costs
in Prince George or points farther afield.

Markets and Competition

Prince George and other locations

No detailed market survey has yet been made but the following markets should be studied closely with a view to establishing enough industrial and domestic outlets for about 1000 tons per day local use:

> Prince George and outlying areas
> Areas served by C.N. and P.G.E. railways and
> Nearby highways.

Preliminary inquiry so far has suggested a potential market of about 400 to 500 tons per month, in the Prince George area, provided the price is suitable. Natural gas, sold by Inland Natural Gas Co. from the Westcoast Gas Co. pipeline, currently sells at a minimum industrial rate of 35¢ per 1000 cu. ft. or 1 million B.T.U. which is the equivalent of $20.00 per ton of coal assuming 11,700 B.T.U. per lb. of coal. However, interruptible rate prices for gas taken as a base rate are 45¢ per 1000 cu. ft. in Prince George, equivalent to $10.60 per ton for coal and 35¢ per 1000 cu. ft. in Vancouver, equivalent to $8.25 per ton for coal.

Since natural gas reserves are almost unlimited and the price might be dropped, coal prices would probably have to be of the order of $8.00 per ton or less in order to be competitive, considering the greater convenience of handling gas. To be profitable, then, the Prince George market would require production and sale of about 1000 tons per day.

In other areas not serviced by natural gas the coal could command higher selling prices, the final figures depending on added transportation and distribution costs. Propane sells at 20¢ per gallon at 110,000 B.T.U. or the equivalent of $42.50 per ton of coal so petroleum fuel other than natural gas would not be competitive with coal on a price per B.T.U. basis.

Vancouver region

Wholesale prices for coal delivered to Vancouver wholesalers range from 8.50 to $10.50 per ton, and shipboard prices to Japanese are of the order of $10.00 per ton if the coal is suitable.

Preliminary estimates of additional costs from the mine, f.o.b. shipboard at Vancouver are as follows:-

Trucking	$1.60
Rail freight	3.80
Handling & storage	1.60
Royalties	.15
	$7.15

Thus production of 2000 tons per day or more from a 15' seam would be required in order to be competitive on the Vancouver market.

Dominion Government subvention is granted only to export markets and to Ontario, but the possibility of Provincial as well as Dominion subvention should be investigated if Vancouver or Japanese markets are to be considered.

Conclusions and Recommendations

Preliminary estimates suggest that a 1000 ton per day market at $8.00 per ton f.o.b. Prince George, on a 10 year basis from a 10 foot seam of Bowron River Coal would be competitive with natural gas or other fuels in the Prince George area, and would return over 10% on an initial investment of about $2 million needed to develop the property efficiently and put it into production on a modern basis. Similar profits could be anticipated if a market of 2000 tons per day or more at about $10 per ton f.o.b. Vancouver is developed under government subvention.

It is recommended that detailed surveys be conducted to definitely confirm one or more such markets in the Prince George region, in other localities such as Prince Rupert, in areas tributary to the railways and highways, and with subvention in the Vancouver area.

Once these markets are confirmed $75,000 should be allotted to exploration of the property, which could be completed in 4 months.

When seam width, length and dip, character of the coal, roof and floor have been determined over an area sufficient for production, more precise cost and market estimates should be prepared on the basis of these results. With suitable conditions anticipated investment required to develop the property at this stage and get it into production would be about $2,100,000 for 10,000 of developed seam length and $1,500,000 for 5,000 length, and full production could be achieved in 8 months.

If sufficient reserves and markets are indicated the property should also be evaluated in terms of establishing a sink-float plant to produce purer coal for coking purposes. Such an installation, based on plants in Australia and Alaska, would also cost about $2 million.

Respectfully submitted,

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