PR-MT. SPIEKER 75(1)A

REPORT

ON

THE GEOLOGICAL EXPLORATION

THE ~~EAST BULLMOOSE~~ MT. SPIEKER AREA

(NTS 93 P/3W)

COAL LICENCES: 3027, 3030-3032 incl., 3034-3037 incl., 3039-3042 incl., 3044-3047 incl., 3049-3060 incl.

by

MR. T. SHIMA
MR. T. NISHIO
MITSUI MINING CO.LTD.

for

NICHIMEN RESOURCES LIMITED

and

BRAMEDA RESOURCES LIMITED

December 1975

TELEX 04-507846

TELEPHONE (604) 689-7011

NICHIMEN CANADA LTD.
2020 ROYAL CENTRE
1055 WEST GEORGIA STREET
VANCOUVER, CANADA V6E 3P3

15th December, 1975.

The Minister of Mines,
Douglas Building,
Victoria, B.C.

Dear Sir:

During the period July to October 1975, Nichimen Resources Ltd. conducted an exploration programme on the East Bullmoose (Mt. Spieker) Licences of Brameda Resources Ltd. Nichimen Resources Ltd. was incorporated as a Company to undertake obligations imposed on it pursuant to an agreement made with Brameda dated 12th June, 1975.

As Project Manager for Nichimen, the undersigned organised and supervised a programme of geological exploration and drilling to determine the potential of the area for mining. The results of this programme are set out in the enclosed Report on the Geological Exploration of the East Bullmoose Area prepared by our consultants Mitsui Mining Co., Ltd.

At all stages the information obtained was verified by the undersigned who hereby certifies that the enclosed Report is a true and accurate representation of the information obtained as a result of that programme.

Yours truly,

N.E. Roberts, P.Eng.

NER:ls

FOREWORD

This report is prepared for Nichimen Resources Ltd. and covers the results of the geological exploration carried out in the East Bullmoose area, B.C., Canada in 1975.

The purpose of the exploration was to assess the geological situation of the said area, such as the distribution, thickness and quality of the coal seams and approximate reserves, required to evaluate the coal potential of the area.

The geological exploration took about two months and this report was compiled by Mr. T. Shima and Mr. T. Nishio of Mitsui Mining Co. Ltd.

The writer wishes to express his appreciation to the staff of Teck Corp. Ltd., especially to Mr. R.S. Verzosa who gave us useful advice and information on the exploration of the area.

Grateful acknowledgement is also made to Mr. N.E. Roberts and to Mr. S. Hirota. These investigation results would not have been achieved without their cooporation.

TABLE OF CONTENTS

LIST OF ILLUSTRATION

TABLE

MAP

Map No. 75-07-1 Structure Contour Map (Gates B Seam)

Map No. 75-07-2 Structure Contour Map (Bird Seam)

ANALYSIS REPORT

(Commercial Testing & Engineering Co.)

I. INTRODUCTION

I-1 Location and Access

The East Bullmoose area is located in the eastern foothills of the Rocky Mountains in the northeast of British Columbia.

Access to the area is available from Chetwynd, the nearest town, by gravel road of approximately 55 miles.

I-2 Topography

The investigated area is bordered by the Bullmoose Creek to the west and by the ridge of Mount Spieker to the northeast. Tributaries of Perry Creek run along the southeastern part of the area.

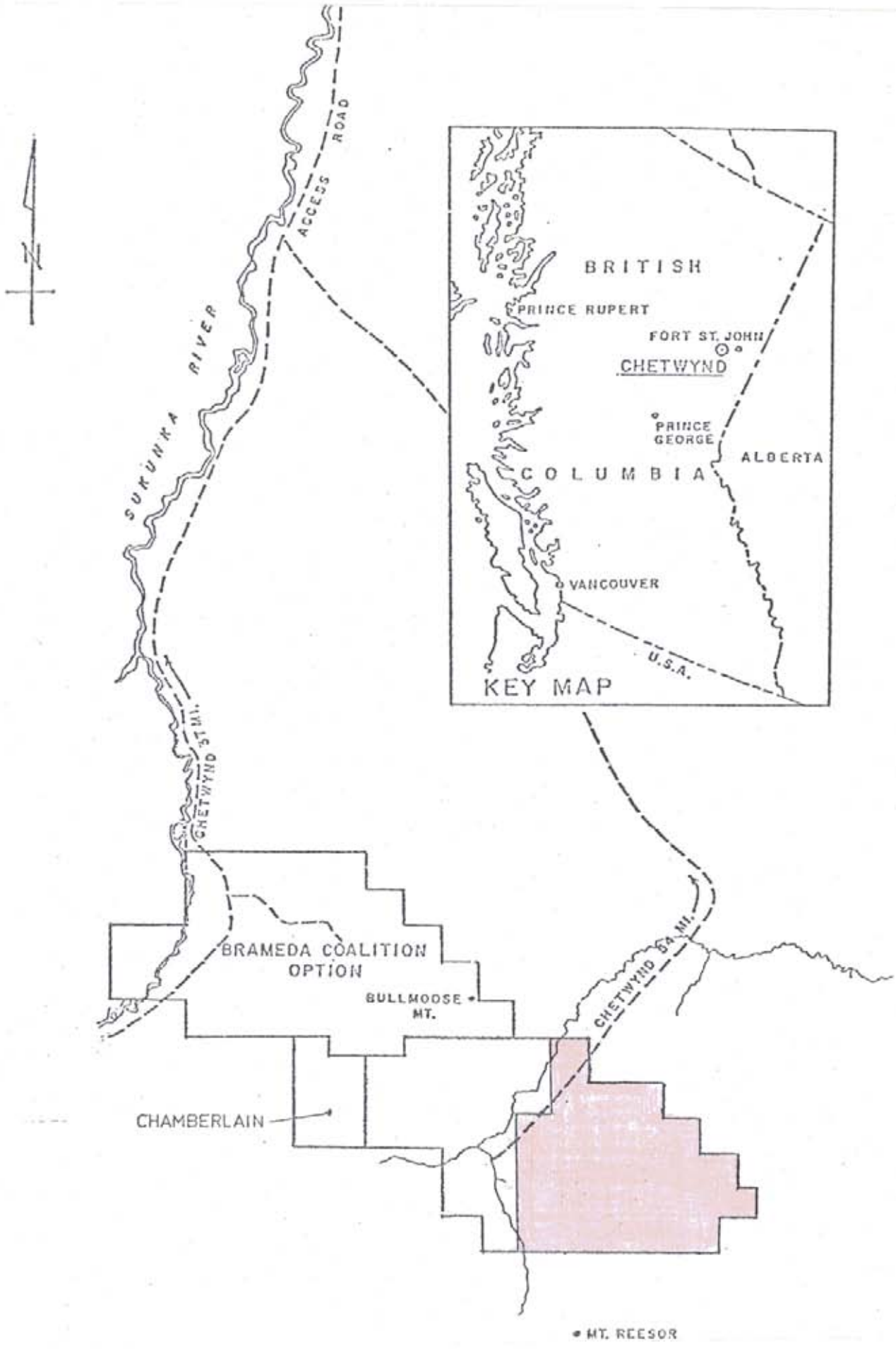
Elevation of the area ranges from 3,500 to 6,500 feet above sea level and the timber line is approximately 5,500 feet.

The mountains show a flat top structure and steep cliffs are exposed in the high elevation area while the low elevation area is covered by dense forest.

I-3 Exploration

I-3-1 Scope of the Exploration

Previous exploration of the area was carried out by Teck Corp. Ltd. in 1971 by surface mapping. This work sketched the general geological structure



EAST BULLMOOSE AREA

PROPERTY LOCATION MAP

Scale: 1 in. = 4 mi.

of the area and gave good basic information for this year.

Following the results of this previous work, the exploration plan for this year was set up as follows.

1) to limit the mapping area to the middle and western portion of the property where the coal structures appeared to have most potential for mining
2) to investigate the coal outcrops by trenching
3) to undertake surface mapping along the main creeks to establish the seam correlation
4) to confirm the thickness and the quality of coal seams by two or three drill holes

I-3-2 Actual Exploration Work

The exploration work was carried out during August and September in accordance to the above plan.

Mapping was done primarily on the coal-bearing sections along the main creeks, using hand trenching on coal seam outcrops.

The northeastern and the southern part of the area were excluded from this year's work, because the former area shows more complex structure and the latter has poor outcrops.

The field work was made in a scale of 1 inch to 400 feet, however maps were compiled on a scale of 1 inch to 1,000 feet.

The following three drillings of 2,874 feet in total footage were carried out by Connors Drilling Ltd.

Hole No.	Depth	Objective Formation
EB-1	1,668'	Gates and Gething
EB-2	658'	Gates
EB-3	548'	Gething

Each hole was tested by gamma ray-neutron and sidewall density logging which were helpful in estimating the thickness of Gething coal seams, of which the core recoveries were poor.

Caterpillar D8 and D6 bulldozers were employed for road building, moving the drill rig and it's associated equipment, trenching and other work. The road, approximately ten miles long, was constructed during the exploration period.

II. GEOLOGY

II-1 Stratigraphy (Refer to Map No. 75-04-01, 75-04-02)

The east Bullmoose area is underlain by the Bullhead and Fort St. John Groups of Lower Cretaceous. The former is subdivided to the Cadomin and Gething Formation and the latter is subdivided into the Moosebar and Commotion Formations in ascending order respectively. The Commotion Formation is also subdivided into three member, i.e. the Gates, Hulcross and Boulder Creek Members.

The exploration work was concentrated on the Gething Formation and the Gates Member of the Commotion Formation, which are the main coal bearing formations.

II-1-1 Cadomin Formation

This is the lowest formation exposed in the area which consists of massive conglomerate. It is exposed at the north-western corner of the area along the Bullmoose Creek. Another exposure of conglomerate was observed at the south-western corner of the area along the Bullmoose Creek. This is believed to be a portion of this formation from it's stratigraphical elevation.

Neither the top nor the base of the formation was confirmed.

II-1-2 Gething Formation

This is the lower coal bearing formation of the area and widely distributed in the low elevation area. It is mainly composed of sandstone in the upper

portion and of carbonaceous shale interbedded with sandy shale in the lower portion.

Four coal seams are present in the upper portion of the formation which are customarily named the Chamberlain, Skeeter, Middle and Upper Bird Seams in ascending order.

The formation is overlain by the Moosebar Formation with basal glauconitic sandstone. The interval between the basel glauconitic sandstone and the upper Bird Seam changes from two to more than twenty-five feet and the lithofacies of the interval varies from shale to sandstone. This may suggest the existence of unconformity between the Moosebar and this formation.

Thick cross laminated sandstone which lies below the Chamberlain Seam is identifiable and traceable across the area.

The thickness of the formation is more than 700 feet.

II-1-3 Moosebar Formation

The formation consists of grey or dark grey fissile marine mudstone with sideritic concretion. As mentioned in the previous section, this formation overlies the Gething Formation with a glauconitic sandstone or conglomerate of two to four feet thick at its base.

The thickness of the formation is 300-350 feet.

II-1-4 Commotion Formation

The formation is subdivided into three Members; the Gates, Hulcross and Boulder Creek Members in ascending order.

a) Gates Member

This is the main coal bearing formation of the area which is subdivided into upper and lower sections. This division is made at the base of A seam which is the lower most coal seam of the formation. The division separating these two sections is solely one of convenience.

The lower section consists mainly of fine to medium grained sandstone in the upper part and hard platy shale intercalating with sandy shale in the lower part.

The Gates Member is divided from the underlying Moosebar Formation by the lowermost sandy shale layer but this may vary in adjacent areas.

The upper section consists mainly of wide alternation of fine to medium grained sandstone and shale. Four relatively thick coal seams are present in the lower half of the section, while several thin seams occur near the top of this section. These coal seams are designated A, B, C and D seam in ascending order.

b) Hulcross Member

This member conformably overlies the Gates Member and consists of fine grey silty shale with sideritic concretions.

The thickness of the member is approximately 500 feet.

c) Boulder Creek Member

This member is the uppermost formation exposed in the area. It consists of a broad alternation of bedded conglomerate or fine to coarse grained sandstone and shale. A few thin coal seams are interbedded. The sandstones and conglomerates form cliff faces as well as the flat topographical features in the central area.

The thickness of the formation is not known.

II-2 Geological Structure (Refer to Map No. 75-02, 75-03-1-6, 75-07-1-2)

Previous work gave the indication of run of the major thrust fault with N.W. trend at the eastern part of the licences. Therefore this years exploration was concentrated to the west of this fault.

The geological structure in the mapped area is divided into two units; i.e. the north east and south west blocks. North east block has flatlying on gently dipping structure of less than 10 degrees, except in the extreme north east of the Mt. Spieker ridge, where the Moosebar and upper Gething Formation is overfolded. South west block shows broad synclinal structure with north west axial trend within the block strata are undulated by several minor folding, and the dips of strata varies from zero to 60 degrees.

III. COAL

III-1 Coal Seams

III-1-1 Coal Seams of Gething Formation (Refer to Map No. 75-04-02)

The relatively thick coal seams of the Gething Formation occur within the 150 ft. interval of the upper portion of the formation. They are named the Bird, Skeeter and Chamberlain Seam in descending order.

The geological correlation of coal seams across the mapped area is shown on the correlation chart (Map No. 75-04-02, 75-05-02). The correlation is made based on the lithologic similarity. Since the poor exposures made it difficult to measure the complete stratigraphical section, some ambiguity remains on the correlation of coal seams in the inadequately explored area such as the I Creek and the Bullmoose Creek.

Two coal seams are exposed in I Creek (c-154) which are identified as the Skeeter and an unnamed coal seam, though the interval between both seams are similar to that between the chamberlain and Skeeter seams. This is because the rock facies of the underlying section of the lower seam is different from that of the Chamberlain Seam which is usually a thick massive sandstone with worm casts in the rest of the area.

Other outcrops of coal seam are observed in the Bullmoose Creek (c-122, c-159). These coal seams are also correlated with the Skeeter Seam because of rock facies of underlying section.

BIRD SEAM

The Bird Seam consists of two seams; the upper and the lower. Both seams occur within an interval of 11 to 35 feet. The upper seam, which varies from 13.7 feet to 3 feet thick (8 feet being the average) is thicker than the lower seam across the mapped area except in EB-3 hole.

Dirt partings are rarely found in either seams.

The roof is fine grained sandstone and the floor is shale.

SKEETER SEAM

This seam is situated stratigraphically at 65-90 feet below the lower Bird Seam. The seam is 5 to 8 feet thick in the extreme west outcrops of the area, but it appears to thin, its thickness toward southeast into D Creek and EB-1 hole. In EB-3 hole, thin crushed coaly shale was penetrated at the Skeeter Seam horizon and it is assumed that the seam is missed by faulting.

A relatively thick seam is observed above the Skeeter Seam in the I Creek, but it thins out laterally and is only traceable as an horizon in the rest of the area.

The roof is shale or sandy shale, and the floor is shale.

In order to deliniate the mineability of the seam, additional drill holes would be required.

CHAMBERLAIN SEAM

The seam is well developed in the Sukunka River area and in neighbouring north-east area, therefore it was one of the main targets of the exploration.

However, it thins within the explored area and has only a maximum thickness of about two feet in E Creek; it is not workable.

MIDDLE SEAM

It is situated approximately 400 feet below the Chamberlain Seam in the stratigraphical column. Only one record of the seam of 4.2 - 5.3 feet thick was available in the mapped area.

III-1-2 Coal Seam of the Gates Member (Refer to Map No. 75-04-01, 75-04-02)

The main coal seams of the Gates Member exists with an interval of 250 feet in the lower part of the upper Gates Member.

They were designated as A, B, C and D seams upward. Another unnamed coal seam exists between B and C seams.

The geological correlation of these seams were made as shown on the Correlation Chart (Map No. 75-04-01, 75-05-01).

In general, the coal seams of the Gates Member appear to be better developed towards the southeast.

A Seam

This is the lowermost coal seam in the Gates Member and overlies the thick fine grained sandstone. The thickness of the seam ranges from 3.6 to 5.9 feet. The thickness measured in E Creek (c-148) is inaccurate due to thick debris cover.

Although this coal appears to have the best quality among the Gates coals, the thickness is insufficient for economical mining.

B Seam

It is the most prominent coal seam in this area. The seam is widely distributed through the area maintaining a minimum thickness of 11.2 feet to a maximum of 17.2 feet. Judging from its thickening trend toward the south in

the area and from the information in the Quintette area to the south, the seam may be expected to be even better developed in the southern part of the area where the mapping has not been done in this exploration.

The roof of the seam is commonly shale with moderate hardness, while the floor is shale or sandy shale.

Visually, the seam is clean except for a few thin bands of dirty coal and coaly shale in the middle part of the seam.

C Seam

C Seam is best developed around the drill hole of EB-1 so far as observed, where the seam thickness ranges from 11.2 feet to 15.5 feet. However, the seam thins toward the northwest to less than three feet at E and G Creeks but it still retains a thickness of 7.5 feet in the EB-2 borehole. The seam has a shale parting of maximum about 1.5 feet at the middle part and coaly shale band near the top. The roof, a weak shale containing carbonaceous materials, may be difficult to control and would probably contribute to a lower yield from the preparation plant.

D Seam

D Seam, like C Seam has a seam thickness of 11.75 feet in EB-1 drill hole including shale parting of 1.7 feet at the middle part of the seam.

The parting thickens towards the northwest while the coal becomes thinner in the same direction, the upper ply thinning more rapidly than the lower ply. At the EB-2 and D Creek, the lower ply is approximately 5 feet thick and the upper ply is reduced to only one foot. Also at E Creek this seam is only one foot thick.

The roof and the floor of the seam are both shale.

III-2 Coal Reserves

In the present stage of exploration, it is difficult to calculate the coal reserves accurately, particularily to determine the recoverable clean coal tonnages.

However, for the purpose to evaluate the coal potential of the area, a conservative estimation of coal reserves was made as outlined below.

The results are summarized on the Table-1. The calculation was made on the following basis:

a) Only the reserves of the Bird Seam in the Gething Formation and the B Seam of the Gates Member were taken into calculation because there are prominent seams in each formation. The other seams which are developed locally within the area have undefined limits to their thickness but with further exploration they could yield substantial tonnages.
b) The calculation was limited to the mapped area, no calculation being made for the probable extension to the southeast.
c) Coal thickness used for the calculation is the averaged measured thickness.
d) The oxidized zone is inferred down to 100 feet below the surface and was excluded from the reserves calculation.
e) The geological safety factor of between 75% and 60% was applied depending upon the seam situation.

SUMMARY OF RESERVE CALCULATION

TABLE-1

SEAM	DEPTH (ft.)	COAL THICKNESS (ft.)	PLANE AREA ($ft^2 x 10^3$)	DIP (deg)	TRUE AREA ($ft^2 x 10^3$)	THEORETICAL RESERVE (Ton x 10^3)	GEOLOGICAL FACTOR (%)	RECOVERY FACTOR (%)	RECOVERABLE RESERVE (Ton x 10^3)
B Seam	+1500	13.65	91,603	29	104,401	54,470	75	45	18,383
	-1500	13.65	18,116	17	18,988	9,907	70	40	2,774
	Total		109,719	27	123,389	64,377	74.2	44.2	21,157
Bird Seam	+1500	8.08	129,324	18	136,867	42,227	70	40	11,824
	1500-2000	8.08	22,465	25	24,865	7,672	65	35	1,745
	-2000	8.08	58,923	22	63,326	19,537	60	30	3,517
	Total		210,622	21	225,058	69,436	66.6	36.6	17,086
Total	+1500		220,837	23	241,268	96,697	71.7	42.8	30,207
	-1500		99,504	22	107,179	37,116	63.7	33.7	8,036
Grand Total			320,341	23	348,447	133,813	70.3	40.3	38,293

f) The total recovery factor of mining and preparation plant yield is subject to the mining method. However, a figure of between 45% and 30% was arbitrarily adapted in this report.

g) The specific gravity of 1.35 was used for clean coal.

Reserves

Total reserves of two coal seams is shown on the Table-1. There are approximately 134 million tons in place of which 30 million tons are conservatively taken as recoverable reserves above 1,500 feet coverline.

Since, so far as the limited exploration has yet shown, some other seams are workable locally within the explored area. Also the B Seam is present in extension to the south of the mapped area. Further exploration would probably increase the reserves substantially.

IV. CONCLUSION AND RECOMMENDATION

Among coal seams distributed in the area, the most outstanding seam is the B Seam of the Gates Member, which has relatively constant thickness of 14 feet and is expected to become thicker to the south of the mapped area.

Either upper or lower Bird Seam has a workable thickness of 8 feet in average, though some minor local variation of the seam is observed.

The C and B Seam of the Gates Member and the Skeeter Seam of the Gething Formation have locally workable thickness of more than eight feet.

The present exploration is preliminary but sufficient data has been assembled to indicate that approximately 134 million tons in place reserves of the B and Bird Seams are present in this area.

These reserves are mainly distributed in the synclinally structured area with the undualated dip. The dips of the strata vary from zero to 60 degrees. Therefore the minability of the reserves is an unknown factor but a mining factor of 45% to 30% has been applied in reserve calculation to provide for this. However, in view of the possible recoverable reserves, additional exploration is certainly warranted in this area.

The coal quality is of low ash, medium volatile, low sulphur and high F.S.I. with good coking properties.

Recommendation for Additional Exploration Program

It is recommended that the additional exploration of the next stage will be conducted as follows.

1. The exploration work should be directed
   a) to confirm the detailed geological situation of the Gates coals in the mapped area and also to the south of the area.
   b) to determine the mineable area of the Gething coals.
2. Detailed surface mapping should be made for the above objectives. The trenching would also be required.
3. Drill holes are needed to confirm the thickness, extent and quality of the coal seams.
4. In order to obtain bulk samples for testing coking property, at least two adits should be driven in the B Seam. Similar sampling for other seams would depend on the results of the exploration.
5. A ground survey should be carried out to control locations of geological information and boreholes etc.

f) The total recovery factor of mining and preparation plant yield is subject to the mining method. However, a figure of between 45% and 30% was arbitrarily adapted in this report.

g) The specific gravity of 1.35 was used for clean coal.

Reserves

Total reserves of two coal seams is shown on the Table-1. There are approximately 134 million tons in place of which 30 million tons are conservatively taken as recoverable reserves above 1,500 feet coverline.

Since, so far as the limited exploration has yet shown, some other seams are workable locally within the explored area. Also the B Seam is present in extension to the south of the mapped area. Further exploration would probably increase the reserves substantially.

III-3 Coal Quality

The coal samples obtained from drill holes were tested by Commercial Testing and Engineering Co. in Vancouver. The analytical results are summarized on the Table.

The general description of the coal quality is summarized as follow.

Gates Coals

a) The ash content of the clean coal washed at the specific gravites of 1.5 ranges from 6.8% to 10.0% which is relatively a low figure.

b) The separating yields at the above gravity varies from 95.6% for the A Seam to 49.1% for the C Seam. At a S.G. of 1.6 the yield is 66.5% for the C Seam with 11.31% ash. The dilution was not considered for the testing work as the samples of the C and D Seams in EB-1 were taken from the upper and lower sections separately and the shale partings in the middle of both the seams were excluded. Therefore the yield of total seam thickness including the partings will become lower if mined as one seam.

c) The volatile matter range is 22.9% to 27.6% which corresponds to 24.5% and 30.1% respectively in d.a.f. basis.

d) Total sulphur is less than 0.6% which is reasonably low and the phosphorus ranges 0.02 - 0.09% of which is relatively high.

e) F.S.I. is higher than 6½.

f) Maximum fluidity in Gieseler plastometer ranges from 63 to 291 d.d.p.m. with the exception of 1230 d.d.p.m. of the D Seam in EB-2.

g) The average quality of the B Seam which is the main seam in the area is as follows.

Ash	7.5%
Volatile Matter	24.5%
Fixed Carbon	68.0%
B.T.U.	14,238/lb.
Total Sulphur	0.24%
Phosphorus	0.05%
Free Swelling Index	6½
Max. Fluidity	205 d.d.p.m.
H.G.I.	85

Gething Coals

a) Although the core recoveries of the Gething Coal seams are very poor, it could be said that the analytical results could be fairly representative of seam thickness, because the density and visible loggings indicate no partings and homogenous characteristics in the seam.

b) The ash contents of less than 8% of raw coal and less than 6% of clean coal washed at the specific gravity of 1.6, are very low.

c) The washing yields at the above specific gravity are higher than 94%.

d) The volatile matter content ranges from 18.3 to 22.9% which correspond to 19.3 and 23.4 in d.a.f. basis respectively.

e) So far as analysis show the sulphur content is less than 0.6% which is reasonably low and the phosphorous is less than 0.06% which is relatively high.

Another analysis was made on the outcrop samples for reference which shows equivalent level of sulphur content.

f) The Giesler plastometer test indicates the low fluidity of about 5 d.d.p.m.

SUMMARY OF TEST RESULTS OF DRILL CORE SAMPLES

TABLE-2

SEAM	DRILL NO.	THICKNESS (ft)	RAW COAL ASH (Dry) %	CLEAN COAL (DRY BASIS) S.G.	YIELD %	ASH %	V.M. %	F.C. %	B.T.U. /lb.	T.S. %	P. %	F.S.A.	MAX FL. D.D.P.M.	H.G.I.
Gates D (u)	EB-1	4.75	15.38	1.5	78.3	7.72	24.71	67.57	14,265	0.52	0.05	7½	195	84
D (1)	EB-1	5.40	17.20	1.5	66.4	8.81	25.65	65.54	13,801	0.40	0.07	7½	85	83
D	EB-2	4.90	18.23	1.5	68.2	8.18	27.61	64.21	14,159	0.44	0.08	8	1,230	79
Gates C (u)	EB-1	6.70	27.25	1.5	49.1	7.77	23.73	68.50	14,245	0.42	0.06	7½	71	86
C (1)	EB-1	3.60	24.10	1.5	71.4	6.79	25.67	67.54	14,458	0.57	0.04	8	188	82
C	EB-2	4.90	25.65	1.5	62.3	9.98	25.26	64.76	13,809	0.47	0.05	7	275	83
Gates B	EB-1	15.30	15.80	1.5	76.8	7.17	23.89	68.94	14,339	0.23	0.09	6½	119	88
	EB-2	17.20	10.92	1.6	90.5	7.92	25.04	67.04	14,136	0.25	0.01	6½	291	82
Gates A	EB-1	4.00	12.30	1.5	82.8	6.86	22.86	70.28	14,570	0.48	0.02	7½	63	84
	EB-2	3.60	8.29	1.5	95.6	7.85	23.75	68.40	14,266	0.35	0.02	7½	155	79
Bird (Upper)	EB-1	7.90	7.92	1.6	96.5	5.56	19.17	75.27	14,715	0.53	0.02	4	-	91
Bird (Lower)	EB-1	5.00	5.17	1.6	94.4	3.97	20.60	75.43	14,916	0.41	0.04	8	4.9	88
-	EB-3	8.10	3.73	1.6	95.7	2.12	22.94	74.94	15,191	0.58	0.03	6½	3.0	94
Skeeter	EB-1	3.90	7.23	1.6	94.1	5.29	18.32	76.39	14,761	0.53	0.06	4	4.0	80