

PR-TINE PASS 73(1)A

PR-TINE PASS COAL PROJECT
OPEN FILE

P. DYSON CONSULTANTS.

JUNE 1973

583

Review - How much new data?

① Structural X section (Fig 10) does not agree with Project Map (Fig 6) -

→ Inspect much of data shown on 1/50,000 project maps re technique data

3. NTE geological - \$21,000

& petrographic - 17,000

looks excessive

\$38,000

- PAN OCEAN -

LICENCES - FORFEITED - (1978) -

- 2905, 2906, 2907, 2908, 2909, 2913,
2914, 2915, 2919, 2920, 2931, 2932,
2933, 2934, 2935, 2936, 2937, 2939,
2940, 2943, 2951
- 3560, 3561, 3562, 3578, 3585.

BORE HOLE LOCATIONS

H-1	—————	2952	→
H-2	—————	2952	→
H-3	—————	2951	
H-5	—————	2952	→
74-1	—————	2934	
75-2	—————	3587	→
75-3	—————	2915	
75-5	—————	2932	
75-7	—————	2919	

(FORFEITED - 1977-)

S T A T U T O R Y D E C L A R A T I O N

CANADA
PROVINCE OF BRITISH COLUMBIA

IN THE MATTER OF AN AGREEMENT
entered into with PAN OCEAN OIL LTD.
by PINE PASS DEVELOPMENT LTD. dated
31st March 1972 in respect to the
development of Coal Licenses.

TO WIT:-

I, DONALD BARRY MILTON OF THE CITY
OF NORTH VANCOUVER IN THE PROVINCE OF BRITISH
COLUMBIA DO SOLEMNLY DECLARE:-

1. THAT I AM TREASURER OF PINE PASS DEVELOPMENT LTD.,
AND AS SUCH HAVE PERSONAL KNOWLEDGE OF THE FACTS HEREUNDER DECLARED.

2. THAT FROM THE PERIOD MARCH 31 1972 TO MARCH 31 1973
TOTAL EXPENDITURES OF ONE HUNDRED ELEVEN THOUSAND AND NINE DOLLARS
(\$ 111,009.00) HAVE BEEN SPENT BY PINE PASS DEVELOPMENT LTD. ON FIELD
EXPLORATION AND DEVELOPMENT WORK IN RESPECT TO THE COAL LICENSES AS
CONTAINED IN THE AFOREMENTIONED AGREEMENT.

AND I MAKE THIS SOLEMN DECLARATION CONSCIENTIOUSLY BELIEVING IT TO BE
TRUE, AND KNOWING THAT IT IS OF THE SAME FORCE AND EFFECT AS IF MADE
UNDER OATH AND BY VIRTUE OF THE CANADA EVIDENCE ACT.

DECLARED BEFORE ME AT THE
CITY OF VANCOUVER
IN THE PROVINCE
OF BRITISH COLUMBIA

)
) *Donald Barry Milton*
) _____

THIS 30th DAY OF July 1973, A.D.

Dick J Sigah
A COMMISSIONER, ~~NOTARY PUBLIC~~
~~JUSTICE OF THE PEACE~~

PINE PASS DEVELOPMENT LTD.

Statement of Expenditure March 31, 1972 to March 31, 1973.

<u>Exploration Expenditures:</u>	\$	
Petrographic studies, core analysis and testwork	17,010	
Professional Consulting Geologist Fees	21,004	
Sundry Exploration Expenses	40,111	
Drilling Costs	<u>32,884</u>	\$111,009
 <u>Other Expenditure:</u>		
Licence Fees	33,783	
Bank and Audit Charges	1,762	
Legal Fees	475	
Research Costs	<u>5,369</u>	<u>41,389</u>
 TOTAL EXPENDITURES		 \$152,398

CONFIDENTIAL
OPEN FILE

PINE PASS COAL PROJECT
NORTHEAST BRITISH COLUMBIA
(PHASE I)

GEOLOGICAL BRANCH
ASSESSMENT REPORT

00 583

Prepared for: Pan Ocean Oil Ltd.
Calgary, Alberta.

By: Paul Dyson Consultants.
Calgary, Alberta.

June 1973.

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NOTE: FOR COAL ANALYSIS DATA:
REFER TO CONFIDENTIAL COAL ANALYSIS
PR- PINE PASS 73(L)A

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ABSTRACT

The Pine Pass area of northeast British Columbia has good potential for the development of a coal mine producing metallurgical grade coking coal. This conclusion is based on the probable presence of coal seams thicker than 10 feet consisting of low ash coking coal and the proximity of the area to both rail and existing townsite.

Pan Ocean Oil Ltd., recognizing this potential, acquired 67 coal licences in August 1972. An initial exploration program was carried out on these licences in the fall of 1972 and the first months of 1973. The program consisted of field mapping and an initial drilling program of approximately 3000 feet.

These exploration activities confirmed the presence of low ash metallurgical grade coking coal in the medium volatile range. At the same time the existence of some areas of relatively low structural dip was recognized.

However, no thick (10 feet plus) seams of coal of adequate grade were located. The thicker seams all contained numerous shaly partings in the area that was drilled. It is planned to extend the drilling program to other areas licenced by Pan Ocean in 1973 in an attempt to locate thicker seams of good quality coal.

I. INTRODUCTION

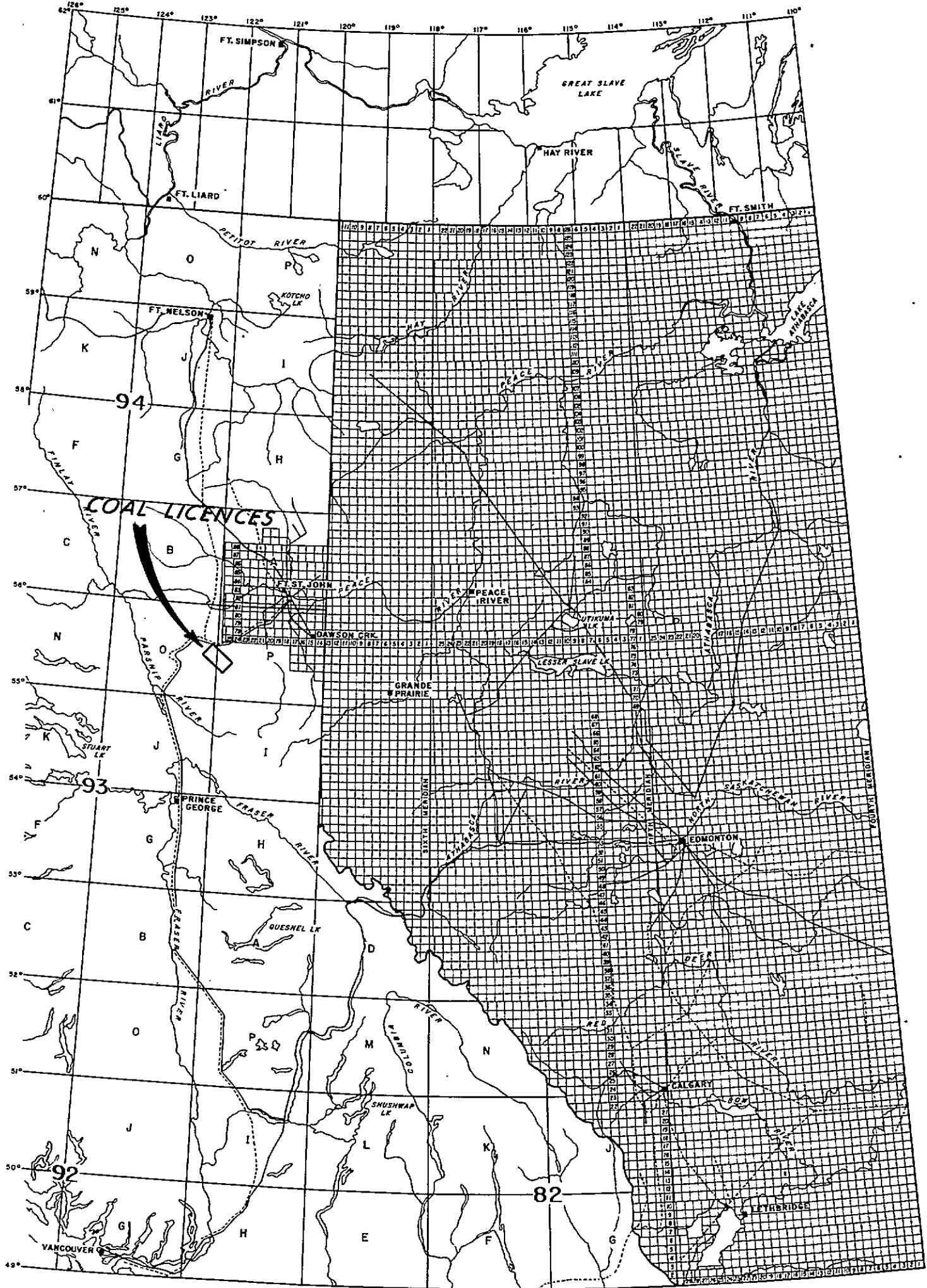
This report describes the initial work carried out by Pan Ocean Oil Ltd. in an attempt to locate an economically viable coal deposit of metallurgical grade coking coal on coal licences acquired in 1972 in northeast British Columbia. The area explored lies immediately south of the Pine Pass in the Foothills belt west of Dawson Creek (Fig. 1).

The report is divided into several main sections: the introduction, the prospect, the exploration program and the conclusions. Numerous maps, figures and tables accompany the report which is designed to present a comprehensive picture of the project from inception to its present stage.

(a) Regional Setting

The area under consideration lies within the Rocky Mountain Foothills and trends northwesterly along the front of the Rocky Mountains between the Sukunka and Pine Rivers in northeastern British Columbia. The area is underlain by Lower Cretaceous sediments which contain the potential coal measures under investigation. Specifically, the Gething formation of Lower Cretaceous age was explored for viable coal seams (see Fig. 2 and 3).

The Cretaceous sequence was folded during the Laramide orogeny being deformed into elongate plunging anticlines



PR-PP 73(C)A
Figure 1

PAN OCEAN OIL LTD.

PINE PASS COAL PROJECT
NORTHEAST BRITISH COLUMBIA

LOCATION MAP

0 90
SCALE: 1 INCH = 90 MILES

PAUL DYSON CONSULTANTS

and synclines with associated faulting. This series of en echelon folds and faults has a northwesterly trend. In this area of the Foothills most of the Cretaceous exposures occur in creeks as almost the whole area is covered by vegetation.

The "Foothills" of this region have considerable relief with elevations within the area under consideration varying from lows of approximately 2000 feet above sea level to slightly over 5000 feet above sea level. As the tree line at this latitude is at approximately 5500 feet above sea level, the hills are totally covered with a dense vegetation.

(b) Access

The Hart Highway provides excellent access along the northern side of the area (see Fig. 4). It is an all weather paved highway.

A road passable to pick-ups in good weather extends up Hasler Creek from its junction with the Pine River to a point adjacent to the old Hasler Mine. Other than this, no access was available to vehicular traffic within the area of interest.

During the exploration program additional access was established and will be discussed in that section of the report.

(c) Acknowledgments

The completion of the exploration program would not have been possible without the co-operation of the numerous technical personnel and contractors and the help of numerous local persons.

The staking program was carried out by Burnett Resource Surveys Ltd. of Burnaby, British Columbia, under the supervision of Mr. Dave Zelmer. This company utilized an Alouette II helicopter provided by Canwest Aviation Ltd. piloted by Mr. John Pridie. The crew stayed in Chetwynd.

The field checking of the area was again based in Chetwynd. A helicopter (Bell 47 Series G3B-1) was contracted from Rotoflite Ltd. Field assistance was provided by Mr. Blake Brady, geologist, Mr. Gary Morrison and Mr. Rick Cox, field assistants. The willing co-operation of all the above is gratefully acknowledged.

The drilling program was carried out by Canadian Longyear Ltd. of Vancouver. The foreman was Mr. Elmer Russel who made every endeavour to keep an efficient operation running despite a strike by the diamond drillers. Bulldozers were hired from Roller Bros. Construction Ltd. of Chetwynd who made every effort with excellent personnel but indifferent equipment.

Supervision of the drilling program was aided by Mr. T. Yoon, geologist, who spent approximately three weeks in the field.

THIS REPORT

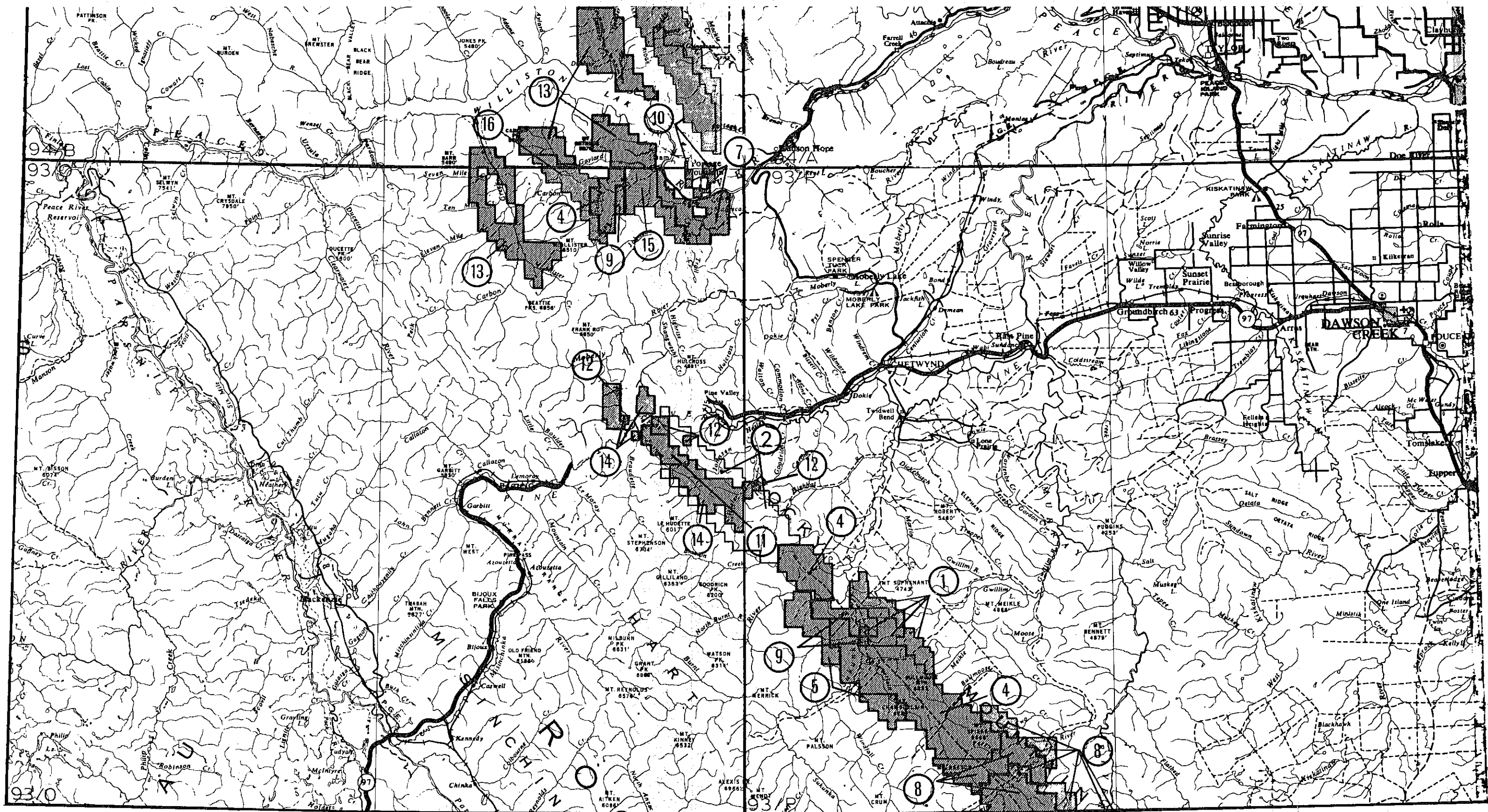
		Alberta Foothills	Peace River to Smoky River	Prophet River- Peace River	Tetsa River	Scatter River	Peace River Plains	McMurray- L. Athabaska R.	Central Plains of Alberta
BLAIRMORE GROUP		BEAVER MINES FM.	COMMOTION FM.	BUCKING-HORSE FORMATION	BUCKING-HORSE FORMATION	SCATTER FM.	NOTIKEWIN MBR. FALHER MBR.	GRAND RAPIDS FM.	FORT AUGUSTUS FM.
		GLADSTONE FM.	MOOSEBAR FM.			GARBUTT FORMATION	WILRICH MBR.	CLEARWATER FM.	
	?	calcareous mbr.						WABISKAW FM.	WABISKAW FM.
								calcareous mbr.	calcareous mbr.
BULLHEAD GROUP		CADOMIN FM. or DALHOUSIE SS.	GETHING FM.	GETHING FORMATION	GETHING FORMATION	GARBUTT FORMATION	BLUESKY FM.	WABISKAW FM.	MCMURRAY FM.
		CADOMIN FM.							
									MCMURRAY FM.
		KOOTENAY or NIKANASSIN FM.	MINNES GRP.	MINNES GRP. to TRIASSIC	TRIASSIC	TRIASSIC	JURASSIC to MISSISSIPPIAN	DEVONIAN	MISSISSIPPIAN to DEVONIAN

CORRELATION OF BULLHEAD GROUP IN WESTERN CANADA

Figure 2

TABLE OF FORMATIONS

	Formation or Group	Thickness (feet)	Lithology	
Lower Cretaceous	Fort St. John Group (includes Moosebar fm.)	3,000 - 5,000	Dark grey, marine shale with fine grained sandstone.	
	Butthead Group 0-2,500	Gething Formation	1,000 - 3,000 (?)	Fine-grained, cherty to quartzose sandstone; rusty weathering shales; carbonaceous mudstone and coal seams; minor conglomerate.
		Cadomin Formation.	100 - 500	Massive chert conglomerate and coarse-grained sand- stone; carbonaceous shale, minor coal.
Jurassic	Regional erosional unconformity; bevels rocks of succeedingly older age northward and eastward.			
	Minnes Group	0 - 6,000	Massive quartzose sand- stone; alternating units of fine-grained sand- stone and mudstone; minor carbonaceous sediments.	
	Fernie Formation	500 - 1,000	Calcareous and phosphatic shales; rusty weathering shales; glauconitic silt- stone; sideritic shales; thinly interbedded sand- stone, shale, and silt- stone.	



— LEGEND —

- ① Master Exploration Ltd.
- ② Pan Ocean Oil Ltd.
- ④ Bromeda Resources Ltd.
- ⑤ Bromeda Resources Ltd., Teck Corporation Ltd.
- ⑦ Cinnabar Peak Mines Ltd.
- ⑧ Denison Mines Ltd.
- ⑨ Bow River Resources Ltd.
- ⑪ McIntyre Porcupine Mines Ltd.
- ⑫ Pine Pass Coal Ltd.
- ⑬ Utah International Ltd.
- ⑭ Canada West Petroleum Ltd.
- ⑮ Bow River Resources Ltd., Texaco Resources Ltd.
- ⑯ Ayrshire Coal Co. Inc.

PR-PP 73(1A)

PAN OCEAN OIL LTD.

PINE PASS COAL PROJECT
NORTHEAST BRITISH COLUMBIA

COAL LICENCE LOCATIONS

0 10
SCALE: 1 INCH = 10 MILES

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Figure 4

(c) Acknowledgments (Cont'd.)

The co-operation of all the above named parties at all times contributed to the completion of the program as did valuable help received in many ways from local people. The assistance of all the above is gratefully acknowledged.

II. PROSPECT

The exploration program was designed to evaluate coal rights acquired from the British Columbia government in 1972. This section of the report explains the thinking behind the development of the prospect and the acquisition of the coal rights.

Details of the prospect are outlined both from a strictly geological point of view and from an economic point of view. Details of the selection of licences and the methods employed for the staking of these licences are described.

(a). Regional Geology.

As stated in the Introduction the area under consideration lies within the Foothills belt of northeastern British Columbia. The geology of the area has been mapped at a scale of 1"=4 miles by Muller (1961) and Stott (1961). These two maps are of a reconnaissance nature only.

Regional stratigraphic studies have been made by the Geological Survey of Canada and published as Stott (1968a) and Stott (1971). In addition to this Stott has from time to time given various unpublished papers at several conferences over the past two or three years.

(a) Regional Geology (Cont'd.)

Several localized stratigraphic and mapping projects have been completed within the area - both by the Geological Survey of Canada and by the British Columbia Department of Mines. These are referred to in the Selected References as Hughes (1964), Hughes (1967), McLearn and Kindle (1950), McKechnie (1955) and Spivak (1944).

(i) Stratigraphy

The rocks exposed in the area of the Pan Ocean coal licences range in age from Jurassic to Lower Cretaceous. While the Fernie group of Jurassic age does not directly underlie the coal licences it is shown on the "Table of Formations" (Fig. 3) as it marks the first major lithologic break below the coal measures of the Gething formation.

The Minnes group is not discussed in this report other than to record its presence underlying the Cadomin formation which marks the base of the Bullhead group.

The Bullhead group contains two formations - the coal bearing Gething formation, and its basal conglomeratic unit - the Cadomin formation.

The Gething formation is overlain by the basal formation of the Fort St. John group - the Moosebar formation. This is an excellent lithologic break from the sandy sequence of the Gething

(i) Stratigraphy (Cont'd.)

formation to the predominantly shale sequence of the Moosebar formation.

Full details of the complex and somewhat controversial stratigraphy of the Minnes and Bullhead groups of this area are contained in the literature - Stott (1963) and Hughes (1964).

(ii) Structure

The mapping of the area by Stott (1961) and Muller (1961) is the only complete structural interpretation of the area. As can be seen from these maps, the structure consists of a series of sub-parallel folds and faults generally trending northwest-southeast. It appears from these maps that folding is the predominant feature, however, this may not be so.

The detailed mapping by McKechnie (1955) and Spivak (1944) has indicated many more faults than are shown on the maps of Stott and Muller. This more likely reflects the scale of mapping rather than a basic difference in interpretation.

(b) Coal Potential

The "coal potential", or to put it more explicitly, the potential of the area for the discovery of a viable coal deposit was dependent on three major criteria:

(b) Coal Potential (Cont'd.)

- (i) the probable coal seam distribution and likely coal seam thicknesses,
- (ii) the probable coal quality,
- (iii) the mining potential.

These three factors were considered separately.

(i) Probable Coal Seams

The area under consideration lay between the Pine Pass and the Sukunka River. In general, it was an area of only reconnaissance mapping although some detail was available along the Pine Pass (McKechnie 1955 and Hughes 1967) and in the Hasler Creek area (Spivak 1944). These detailed mapping projects, previously aimed at acquiring knowledge regarding the coals of the area, are most valuable in this respect.

The data in the Spivak (1944) report describes the coals of the Gething formation as they were known at that time adjacent to the Hasler Mine with some references to coals along Willow Creek. Spivak makes reference to the 8' 8" seam at the Hasler mine and to seams apparently up to at least 15 feet thick in the vicinity. Seams exceeding 7 feet were reported on Johnson Creek and up to 5 feet in the Willow Creek drainage.

McKechnie (1955) wrote a comprehensive report describing a drilling program carried out in Willow, Johnson and Hasler Creek drainages. In total almost 50,000 feet of diamond drilling

(b) Coal Potential (Cont'd.)

was carried out between 1946 and 1951 by the Coal Division of the Department of Lands and Forests of the Province of British Columbia. The results of this program were inconclusive but several coal seam intersections thicker than 10 feet were recognized in the drilling.

In 1969 and 1970, Brameda Resources Ltd. and Pine Pass Coal Co. carried out some exploration along the Pine Pass immediately north of the highway. This exploration consisted of surface mapping, a drilling program and an adit. Once again, the existence of coal seams in the Gething formation with thicknesses greater than 10 feet was indicated.

From this information it was concluded that coal seams at least 10 feet thick and possibly close to 20 feet thick do exist in the Gething formation in the Pine Pass area.

(ii) Probable Coal Quality

Coal quality was poorly defined as the old analyses in the Willow Creek and Hasler areas were not primarily designed to make preliminary assessments of the suitability of the coal for the metallurgical market. Nevertheless, some indication of coal quality was obtained from these old analyses and from regional considerations.

(b) Coal Potential (Cont'd.)

The best data in the immediate area was from the Pine Pass Coal Co. project which included the driving of an adit to obtain bulk samples of coal from a 16 foot seam. Data from the coal recovered from the adit is shown on the "Project Map". As can be seen, the coal is of good coking quality (FSI 7+) and it further appears to be amenable to simple washing to reduce the ash below 6%.

Samples from the old Hasler Mine were similarly encouraging as to low ash content and probable coking quality.

Exploration by Brameda Resources Ltd. to the south in the Sukunka area had similarly found a low ash good quality coking coal.

Other parameters such as volatile matter content and sulphur content were similarly satisfactory. Volatiles content was generally recorded at the low end of the medium volatile range and sulphur content was below 0.65%.

The analyses from the drilling report by McKechnie (1955) generally fall within these same parameters, although once again no quantitative coking information was recorded.

It was concluded that the coal of the Gething formation in the Pine Pass area was probably of medium volatile, low sulphur, low ash coking coal which furthermore would be readily amenable to a relatively simple washing process.

(b) Coal Potential (Cont'd.)

(iii) Mining Potential

The mining potential of an area is affected by three main factors:

- (a) a suitable mining method,
- (b) sufficient recoverable reserves to support a mine; and
- (c) an adequate transportation system.

The possibility of mining large volumes of coal in the area by some form of open pit was believed to be limited. This conclusion was reached as maximum seam thicknesses, in general, were expected to be less than 15 feet. Such thicknesses do not permit the removal of large amounts of overburden especially when the coal at shallower levels is probably oxidized. Although a possibility existed for a unique relationship of topography to coal seam and/or tectonic thickening of the seam, this was largely discounted. Primary consideration was given to possibilities for underground mining methods.

The most significant factor required was an area of relative structural simplicity containing a seam of a thickness suited to the optimum operation of modern mechanized equipment. In general, increases in dip above 15° to 20° cause a rapid decrease in the efficiency of conventional mechanized equipment. Seams of 6 to 10 feet are probably preferred.

(b) Coal Potential (Cont'd.)

The probability of a seam in the above thickness range was established but little information was available on the detailed structure of the area as the only available mapping for most of the area was of a reconnaissance nature only.

However, as reserves in the order of ten million tons of mineable coal were believed to be a reasonable minimum objective*, an area of two to three square miles underlain by a 5 foot seam at suitable inclinations would be adequate. An area with low dip that would permit mining on this scale was well within the probability of the structure of the area.

One of the main advantages of the area was the proximity of the railway, the paved highway and the town of Chetwynd. Most of the prospective area lies less than ten miles from the railway and essentially all of it within twenty miles of the railway. This is a distinct advantage for any coal property as one of the major problems common to many is the need of many tens of miles of new railway. A new mine in the area would likely be within economic trucking distance of the rail.

Similarly the already existing town of Chetwynd connected to the area by all weather paved highway could be used as a townsite for persons working at any mine in the area. (Fig. 4).

* The establishment of this objective is discussed later.

(b) Coal Potential (Cont'd.)

These two factors make considerable difference to the economics of operating a coal mine in the area. Small mines (500,000 tons per year or even less) could well be feasible in the area.

In conclusion, it can be seen that the Pine Pass area had adequate potential for the development of a coal mine producing metallurgical grade coking coal.

(c) Staking Program

Having concluded that the area immediately south of the Pine Pass extending to and including the headwaters of Hasler Creek had the potential of being underlain by viable coal seams of metallurgical grade, it was decided to acquire all the available coal rights.

In order to select the area to be staked certain basic assumptions were made:

- (i) Commercial coal seams (i.e. seams thicker than 5 feet) were limited to the Lower Cretaceous Gething formation.
- (ii) Seams were unlikely to exceed 10 feet in thickness.
- (iii) Seams less than 10 feet in thickness would not lend themselves to surface mining and the prospects were mainly for underground mine development.

(c) Staking Program (Cont'd.)

- (iv) Preferred mining areas were those where the dip of the strata was less than 15° .
- (v) Overburden should be less than 2 000 feet.

As portions of the apparently prospective area were not geologically mapped, a photogeological interpretation was completed. This interpretation incorporated all the available data both published and unpublished and indicated that an area of approximately 70 square miles was available for staking.

Application was made to the Government of the Province of British Columbia for permission to stake coal licences in the area. As the area was subject to "Reservation of Coal" permission to stake was granted by Order-In-Council No. 1519 dated April 20, 1972 (see Appendix).

The "Coal Act" of the Province of British Columbia requires that two posts be planted in the ground to mark each coal licence that is requested. Following the decision to stake the above 133 coal licences the physical staking was contracted out to Burnett Resource Surveys Ltd. of Burnaby, B. C.

Two bids were received on the staking and this company was chose both on the basis of the bid and its experience in staking coal licences. (The company had staked over 700 coal licences between 1970 and 1972.)

(c) Staking Program (Cont'd.)

The method used was to plot the chosen licences at a scale of 1:50,000 on the existing government topographic maps for the area. The corners of the licences were then transferred to existing aerial photography by the "radial line plot" method. When in the field these corner locations were photo-identified by the crew chief who was very experienced in this procedure.

Tree cover made it essentially impossible to walk to the photo-identified points from the available limited helicopter landing sites. This being the case, it was decided to use an Alouette II helicopter equipped with man hoist to carry out the staking. In this way, the crew chief and "staker" were able to fly direct to the required point and then lower the staker to the ground at the point without having to land the helicopter. The system became most proficient and the crew chief was able to "leap frog" stakers around. This enabled upwards of 25 coal licences to be staked in a day by a four man party. Despite high winds, the staking which commenced on June 12th, was completed by June 20th. The applications for 67 licences were submitted to the British Columbia Government on June 26, 1972. They were subsequently issued as coal licences No's. 2686 to 2752 inclusive. (Fig. 5)

III. EXPLORATION

The granting of the coal licences to Pan Ocean carried with it an obligation to carry out exploratory work on the licences to fulfill a "work commitment". This initial program is assessed in this section of the report.

(a) Objectives

The initial exploration program for the licences held by Pan Ocean Oil Ltd. had the following technical objectives in mind:

- (a) A geological understanding of the distribution of the coal bearing rocks in the area of the licences.
- (b) The confirmation of the presence of coal on the licences.
- (c) The preliminary delineation of both seam thickness and seam distribution within the coal bearing formation.
- (d) The establishment of some initial data regarding coal quality.
- (e) An initial assessment of the mining possibilities for the properties.

These objectives were met by the following exploration program. All the available geological data for the area was reassessed to ensure the best possible understanding of the Gething formation.

Following this, a field mapping program was carried out. The objectives of this program were to confirm the reported

(a) Objectives (Cont'd.)

geological structure; to locate coal seams at outcrop if possible; to carry out hand trenching of seams located in order to determine seam thicknesses; and to check access to possible drill sites.

The above field program was followed by a drilling program in one area. The objectives of this drilling program were to test the Gething formation for the presence of possible viable coal seams obtaining, at the same time, unweathered, uncontaminated samples from any such seams for analysis. The drilling would also yield additional structural data.

This report treats the field work stage and the drilling stage of the program as two separate sections.

(b) Field Work

The field work was carried out from Chetwynd. The crew consisted of two geologists and two assistants utilizing a Bell G3B-2 helicopter. The field work was carried out during part of September and October 1972. The work was severely hampered by two early but severe snow storms which split the work into two different spells. The first was from September 16 to September 22 and the second was from October 1 to October 8, 1972. The work was curtailed on both occasions by snow rather than by a sense of completion of the project.

(b) Field Work (Cont'd.)

It quickly became a^pparent that there is a general lack of outcrop in the area and that the interpretation of the detailed geology would be time consuming if not impossible from surface mapping. Traversing was essentially limited to the creeks. All the readily traversable tributaries of Hasler, Johnsen and Falling Creek were checked. Some work was also carried out at the headwaters of Willow Creek and on a tributary of the Brazion River. All the data that was recorded has been plotted onto a base map (Fig. 7). As can be seen, the overall interpretation of the geology as shown on the Project Map (Fig. 6) has not been changed. The main reason for this is that further field work will be carried out in 1973 to investigate some of the areas mapped in 1972. In many cases it is not possible at this time to make meaningful changes to the Project Map.

A traverse was made of Hasler Creek beginning east of the Hasler mine westward to approximately the headwaters of Hasler Creek. Except for minor changes in contacts, the mapping near the Hasler mine as shown on Fig. 6 is essentially correct. West of the mine where a broad anticline is indicated within the Gething formation, the beds are actually very highly folded, displayed by tight anticlines and synclines, thus making it unattractive for coal exploration.

(b) Field Work (Cont'd.)

Near the headwaters of Hasler Creek, immediately north of a small lake, a dip slope of resistant beds is overlain by a less resistant unit. This may represent the contact between the Gething and the Moosebar formations. If so, the Gething would occur on the west flank of a syncline, probably with relatively low dips. Large blocks of massive chert conglomerate occur along the creek for a distance of over one half mile. These conglomerate blocks are probably basal Gething or Cadomin formation.

On a side branch of Brazion Creek on the southern block of licences, a five foot coal seam was observed in a predominantly shale/siltstone unit approximately 12 feet above a more resistant, predominantly sandstone unit. All outcrops along Brazion Creek and its tributary appear to be pre-Gething in age.

The Gething formation indicated on the project map (Fig. 6) near the head of a small tributary entering Hasler Creek from the northwest two miles west of the mine proved to be all Moosebar formation except possible Gething formation near the mouth of this tributary.

Traverses of Falling Creek were most unproductive as outcrop in the licence area was very poor. Several strikes and dips were recorded on isolated outcrops believed to belong to the Moosebar formation. At the headwaters of the creek a series of interbedded

(b) Field Work (Cont'd.)

shales, sands and minor coals was assigned to the pre-Gething but this assignment is questionable. More detailed work must be completed to confirm the presence of the coal bearing Gething formation between the pre-Gething rocks and the post-Gething Moosebar formation in this area.

Most emphasis was placed on the area of the divide between Johnsen Creek and Willow Creek for two reasons. An outcrop of coal over 7 feet thick had been reported by Spivak (1944) and thick coal seams were apparently present in the well known ~~well~~ as Texas Gulf Sulphur Sun Falls a-64-B. Furthermore, access to this area for a drilling program would be relatively inexpensive.

The outcrop at the head of Johnsen Creek was hand trenched and found to be approximately 20 feet thick. It did, however, contain almost 3 feet of readily apparent partings. (This presence of these partings was later confirmed by the drilling program).

The structure was confirmed to be essentially a series of west dipping beds with dips generally in the 20° to 30° range. A fault was inferred to exist immediately below the coal outcrop at the headwaters of Johnsen Creek. This fault was later confirmed by the drilling program.

While the field work did not produce the definitive results hoped for, sufficient data was obtained to plan a valid drilling program.

(c) Drilling Program

i) Planning

The objectives of the drilling program were to test the Gething formation for viable coal seams, to obtain unweathered samples of coal for quality control; and to aid in the structural interpretation of the coal licences.

The choice of a location for this initial drilling program was based on several criteria. These were:

- (a) An area where the structural dip was below 30° . Such an area might well lend itself to an initial limited mining program should viable coal seams be present.
- (b) An area with known coal occurrences.
- (c) Good access from existing access road. In this way maximum monies would be expended on drilling rather than on road building.

Bearing these parameters in mind an area on the divide between Willow Creek and Johnsen Creek was chosen. Field work had confirmed the structural dip to be essentially less than 30° and no major faulting or folding had been recognized. From a structural point of view, it was a suitable area. Coal seams had been recognized both at the northwest end of the area and at the southeast end. A well, Texas Gulf Sulphur Sun Falls a-64-B, drilled in 1966, indicated several coal seams in the upper portion of the Gething formation. In fact, the Sonic Log (Fig. 8) indicates two coal seams thicker than 10 feet in the

(c) Drilling Program (Cont'd.)

upper 1200 feet of Gething formation. At the south end of the proposed drilling area a coal seam previously reported by Spivak (1944) as "over 7 feet" had been hand trenched in 1972 and found to be approximately 20 feet thick (see Field Work). While this seam could not be directly correlated to the seams in the TGS well, it did indicate the area to have potential for being underlain by a substantial coal seam.

Access to the area was relatively good by the road built to service the TGS well (Fig. 9). This road was in relatively good repair with the exception of a few washouts at some culverts. New road building would be minimized.

Having decided on the area to be drilled, various alternate drilling methods were available. These ranged from the use of a conventional seismic drill to the use of a diamond drill which retrieves continuous core throughout the interval being drilled. It was decided that the extra costs involved in obtaining a continuous core were well worthwhile when only a limited drilling program was to be undertaken. This method of drilling further ensures that samples of coal recovered are uncontaminated. A frequent problem with other drilling methods - reverse circulation, double-wall drill pipe, etc. - is that the resultant chip samples of coal contain excess ash as a result of chips from non-coal zones being included in the sample. Furthermore, the continuous core enables the top and bottom of the seam and all

(c) Drilling Program (Cont'd.)

partings within the seam to be accurately measured. Bids for this type of drilling were received from three reputable contractors and Canadian Longyear Limited were chosen both on the basis of price and on the basis of experience.

Before proceeding with the upgrading of the road, permission was obtained for a crossing both of the P.G.E. railway and the gas transmission line of Westcast Transmission Ltd. Ploughing of snow for the drill program got underway in mid-January and the drill crew moved in approximately one week later.

ii) Drillhole Summaries

(a) Drillhole No. 1 (H1)

The hole was drilled approximately one half mile up dip and across strike from the TGS test hole (Fig. 9 and 10). Its purpose was to test the seams penetrated by this well and at the same time to provide structural data between the two locations. It was scheduled to be a 1300 foot hole which depth would penetrate the stratigraphic interval equivalent to the 20 foot plus coal intersection found at approximately 2320 feet in the TGS well.

The hole penetrated a portion of the Moosebar formation and entered the Gething formation at *189 feet. A 12 foot coal seam ('C' on Fig. 8) was penetrated from 330 - 342. The only other coal interval thicker than 5 feet found in the

* All depths are measured on the Gamma Ray-Neutron log. There may be minor discrepancies to the depths recorded on the lithologic logs.

(c) Drilling Program (Cont'd.)

hole to a total depth of 1542 feet was a 10 foot seam from 1053 feet to 1063 feet. As can be seen from Fig.8 this seam is tentatively correlated to the thick coal interval at 2320 feet in the TGS well. This correlation is uncertain but likely following a detailed analysis of the logs. In the field the correlation was very indefinite and Drillhole No. 1 was deepened to a total depth of 1542 feet in order to be certain that the stratigraphic interval equivalent to the TGS "thick seam" had been penetrated.

(b) Drillhole No. 2 (H2)

Drillhole No. 2 was drilled along strike to the southeast of No. 1 (Fig. 9). It was drilled to a depth of 602 feet but failed to penetrate any good coal seams. The interval equivalent to Seam 'C' in Drillhole No. 1 had essentially shaled out and a lower coaly interval - 'D' - had developed. Interval 'D' contained numerous partings and could not be classed as an economic seam as it was over 50% partings.

(c) Drillhole No. 3 (H3)

This was the next hole along strike towards the outcrop at the head of Johnsen Creek (Fig. 9). This hole encountered structural problems and faulted from the Gething formation back into the Moosebar formation at a depth of 130 feet. Only 76 feet of Gething formation was penetrated above this fault. This interval is shown separately on Fig. 8 . At a depth of 504 feet the Gething formation was re-entered

(c) Drilling Program (Cont'd.)

and the hole was continued to a total depth of 701 feet. (Fig. 11) No apparent viable coal seam was encountered in this hole. Tentative correlations were made for intervals 'A' to 'D' inclusive.

(d) Drillhole No. 4 (H4)

This hole was located near the thick seam outcrop (20 feet plus) that had been recognized in the creek at the head of Johnsen Creek and was specifically drilled to test this seam. It entered the Gething formation at 118 feet and bottomed at 302 feet. Two coal intervals thicker than 5 feet were encountered (Fig. 8). The upper seam (193 feet to 200 feet), labelled 'B', was the best seam encountered in the drilling program. It is discussed later in the section on coal quality. The lower coaly interval, 'D', was approximately 17 feet thick (265 feet to 282 feet) but contained over 6 feet of partings.

(e) Drillhole No. 5 (H5)

This hole was drilled a few hundred feet southeast of Drillhole No. 2 (Fig. 9). It was drilled at no charge by Canadian Longyear as they accepted responsibility for poor core recovery in Drillhole No. 2. It penetrated only 33 feet of Moosebar formation and was drilled to a total depth of 200 feet in the Gething formation (Fig. 11). As can be seen from the diagrams, it penetrates the Gething formation of the upper fault sheet. Very little coal was present in the hole.

(c) Drilling Program (Cont'd.)

iii) Seam Correlation

The correlation of the coal intervals found in the boreholes proved to be very difficult. A tentative correlation has been made on the basis of lithology and the mechanical logs and is illustrated as Fig. 8.

This figure shows four coal zones - labelled A - D inclusive - which are present in at least two of the drillholes. Drillhole No. 1 found some other coal zones but these have not been named on the cross-section. A few comments on each of the zones follow:

Zone A

This is the upper coal zone and nowhere does it exceed 4 feet in thickness. It is best developed at the south end of the drilling area but it cannot be considered as an economic target in the area.

Zone B

Zone B can only be recognized as a coal seam in Drillholes No. 3 and No. 4 although an equivalent marker can possibly be recognized in Drillhole No. 5. The seam thickens rapidly from Drillhole No. 3 to Drillhole No. 4 at which location it is 7 feet thick. This intersection which represents a true stratigraphic thickness of approximately 6 feet represents the best coal seam recognized in the drilling program. While only 7 feet thick, it has no partings. The roof of the seam, while not a perfect sandstone, would probably hold up. It is composed of a hard siltstone.

(c) Drilling Program (Cont'd.)

Zone C and Zone D

These two zones are considered together as the comments on one are equally applicable to the other. They both represent coaly zones which vary from zero to over twenty feet in thickness. Usually, however, over 30% of the total zone is represented by partings of shale and siltstone. While neither zone becomes an attractive prospect within the area of the drill program, these zones may improve in other areas nearby. The intervals represent prospective zones within the Upper Gething formation.

Other Zones

Several thin coaly intervals were encountered in Drillhole No. 1 and are shown on the cross-section (Fig. 8). Of these only one - 1053 feet to 1063 feet - is thicker than 4 feet. Above this 10 foot zone of good clean coal are several coaly partings resulting in 13 feet of coal within a 20 foot interval. The cross-section shows this zone to correlate to the thick coal zone in the TGS well. This correlation is believed correct as a thrust fault can be recognized in the TGS well as shown. Unfortunately the coal quality of this seam is disappointing and it is not a major prospect.

iv) Coal Quality

An extensive program of analysis was carried out on the core samples recovered from this program. Core recovery in some cases was very poor and this is noted on the appropriate seam description

(c) Drilling Program (Cont'd.)

(see Appendix). Some comments on the quality of the coals are also contained in the Appendix. They were made by Dr. D.F. Symonds of Coal Science and Minerals Testing of Calgary.

(d) Conclusions

As a result of the exploration program, certain conclusions can be arrived at with respect to the coal potential of the area. These conclusions concern both the probable presence of viable coal seams of suitable quality and the likelihood of being able to mine these same seams.

The presence of coaly zones thicker than 10 feet has been established by the program. Unfortunately, wherever these zones were encountered - at surface or in drillholes - they were characterized by numerous shaly splits making the seam as a whole non-economic.

The only seam encountered in the drilling program that appears to have economic potential is the 'B' seam (Fig. 8). This seam is thicker than 6 feet where last known and seems to be of excellent quality for a low ash metallurgical grade coking coal.

Vast areas held by Pan Ocean are as yet wholly unknown. No firm conclusions can be drawn as to their potential until test holes have been drilled at selected locations. It is not worthwhile to attempt more detailed mapping of the surface in this

(d) Conclusions (Cont'd.)

poorly exposed area until these test holes have been drilled.

From a structural point of view there does not appear to be large (over 5 square miles) flat/low dip areas. However, the potential certainly exists for mineable areas of 2, 3 or 4 square miles which might well be suited for the development of 250,000 to 500,000 tons per annum mines if a suitable seam is present.

There is a yet insufficient data to form any definite conclusions on the merit of the area and exploration should be continued.

(e) Recommendations

As no coal seams which were immediate prospects for development were found in the drilling program carried out in January and February of 1973, it is recommended that other areas of the licence block be tested.

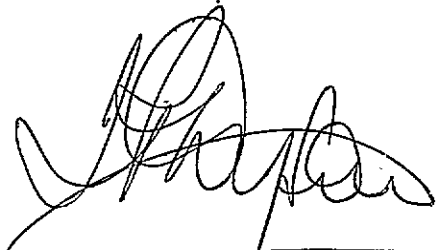
In particular, the band of Gething formation along Falling Creek should be tested for coal as should the Gething formation at the headwaters of Hasler Creek. Some time should be spent on the ground in both these areas in an attempt to locate the contact between the Gething formation and the Moosebar formation so that drillholes may be located most advantageously. At least one stratigraphic test hole to penetrate the Upper Gething formation should be located in each area.

One additional hole should be drilled southeast of the No. 4 drillhole to test the continuation of the 'B' coal seam which is the best prospect located to date.

(e) Recommendations (Cont'd.)

All the above recommendations can be completed within the budget for the 1973-74 program.

June 15, 1973.



I. P. Dyson, P. Geol.

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APPENDIX 3

ORDER-IN-COUNCIL NO. 1519

PROVINCE OF BRITISH COLUMBIA



VICTORIA

COAL ACT
NOTICE

NOTICE is given that pursuant to subsection (2) of Section 17 of the Coal Act and the authority of Order in Council No. 1519, approved on April 20, 1972, the reservation to the Crown of coal in the following described area:-

Commencing at the intersection of 55° 15' parallel of north latitude with 121° 45' meridian of west longitude; thence northerly along said 121° 45' meridian of west longitude to 55° 45' parallel of north latitude; thence westerly along said 55° 45' parallel of north latitude to 122° 30' meridian of west longitude; thence southerly along said 122° 30' meridian of west longitude to 55° 30' parallel of north latitude; thence easterly along said 55° 30' parallel of north latitude to 122° 15' meridian of west longitude; thence southerly along said 122° 15' meridian of west longitude to 55° 15' parallel of north latitude; thence easterly along said 55° 15' parallel of north latitude to 121° 45' meridian of west longitude, being the point of commencement, Peace River Land District:

is cancelled for a period of 30 days commencing May 29, 1972, and that Pan Ocean Oil Ltd. has been granted an exclusive right to select and apply for coal licences in the area during the said period.

Frank Richter
Frank Richter

Minister of Mines and Petroleum Resources

1519.

report

THAT Pan Ocean Oil Ltd., duly incorporated under the laws of the Province, has entered into an agreement to develop and operate a coal field in the Peace River Land District and to that end have deposited with the Minister of Finance a performance bond in the sum of \$50,000.00:

THAT Pan Ocean Oil Ltd. have satisfied the Minister of Mines and Petroleum Resources that exploration and development of the coal field will proceed forthwith upon approval of this Order:

AND TO RECOMMEND THAT by authority of subsection (2) of Section 17 of the "Coal Act", Chapter 60, Revised Statutes of British Columbia 1960, as amended by Chapter 9, Statutes of British Columbia, 1966, the reservation of coal created by Order in Council No. 281, approved March 4, 1943, in the following described area:

Commencing at the intersection of 55° 15' parallel of north latitude with 121° 45' meridian of west longitude; thence northerly along said 121° 45' meridian of west longitude to 55° 45' parallel of north latitude; thence westerly along said 55° 45' parallel of north latitude to 122° 30' meridian of west longitude; thence southerly along said 122° 30' meridian of west longitude to 55° 30' parallel of north latitude; thence easterly along said 55° 30' parallel of north latitude to 122° 15' meridian of west longitude; thence southerly along said 122° 15' meridian of west longitude to 55° 15' parallel of north latitude; thence easterly along said 55° 15' parallel of north latitude to 121° 45' meridian of west longitude, being the point of commencement, Peace River Land District:

be cancelled, subject to the observance and performance of the following terms and conditions:

- (1) Within ninety (90) days after the effective date of cancellation of the reservation, which date shall be the date stated in the notice required by the said Section 17 to be signed by the Minister of Mines and Petroleum Resources and published in the Gazette, Pan Ocean Oil Ltd. shall have an exclusive right to select and apply for coal licenses under the terms of the "Coal Act", covering such part of the coal field that the Company considers necessary to its proposed operations.

(2) (a) A total of \$150,000.00 must be spent on field exploration and development work to the satisfaction of the Minister in the area licensed during the three-year period following issuance of the licence or licences.

(b) (i) If \$75,000.00 or more is spent on such work during the first year following issuance of the licence, or licences, the performance bond will be returned, or

(ii) if, on or before the expiry of three years following issuance of the licence, or licences, a total of \$150,000.00 has been spent on such work, the performance bond will be returned.

(c) The licensee shall:-

(i) on demand make available to the Minister for examination by officers of the Department copies of all plans of the licence, or licences, and workings thereon, plans showing the position of all drill holes, logs of drill holes, analysis of coal, technical reports and other documents pertaining to the exploration, development or mining of coal within the licensed area.

(ii) on or before the anniversary date of the licence, or licences

(A) supply to the Minister a report by a professional engineer setting out the work done in the previous year, and giving full information on the results of exploration, development or mining, supported by such plans, drill logs, and other illustrations or supporting documents as may be necessary to portray the work done and the results thereof.

(B) supply a statement of the total expenditure on said work and on the principal subdivisions thereof.

AND TO RECORD THAT upon expiration of the 30-day period during which Pan Ocean Oil Ltd. have the exclusive right to select and apply for coal licences, all rights of Pan Ocean Oil Ltd. shall cease and determine, and this order is deemed to be rescinded and automatically cancelled as to those lands which were not at that time staked under the provisions of the Coal Act, and such lands shall immediately fall within and be included in the said reserve established by Order in Council 281/43:

AND TO FURTHER RECORD THAT all coal existing in any lands lying within the boundaries of the said reservation which have or may hereafter become vacant through the expiry or cancellation of any licence or lease issued under the said "Coal Act", shall immediately on such expiry or cancellation fall within and be included in the said reserve.

DATED THIS 20 DAY OF April A.D. 1972

"Frank Richter"

Minister of Mines and Petroleum Resources

APPOINTED THIS 20 DAY OF April A.D. 1972

"W. D. Black"

Presiding Member of the Executive Council