OPEN FILE

PR-PEACE RIVER COAL PROJECT 7#(1)A.

PEACE RIVER COAL PROJECT
FOR
CANADA WEST PETROLEUM LTD.

PAUL DIXON CONSULTANTS FEB. 1972

GEOLOGICAL BRANCH
ASSESSMENT REPORT

3,750

~~PR-CHRONOLOGICAL FILE~~

PR-PEACE RIVER COAL PROJECT72(1)A

(8)

OPEN FILE

PEACE RIVER COAL PROJECT

Prepared for: Canada West Petroleums Ltd.,
Vancouver, B.C.

by: Paul Dyson Consultants and
Holdings Ltd.,
Calgary, Alberta.

February 1972

CONTENTS

FIGURES

APPENDICES

8

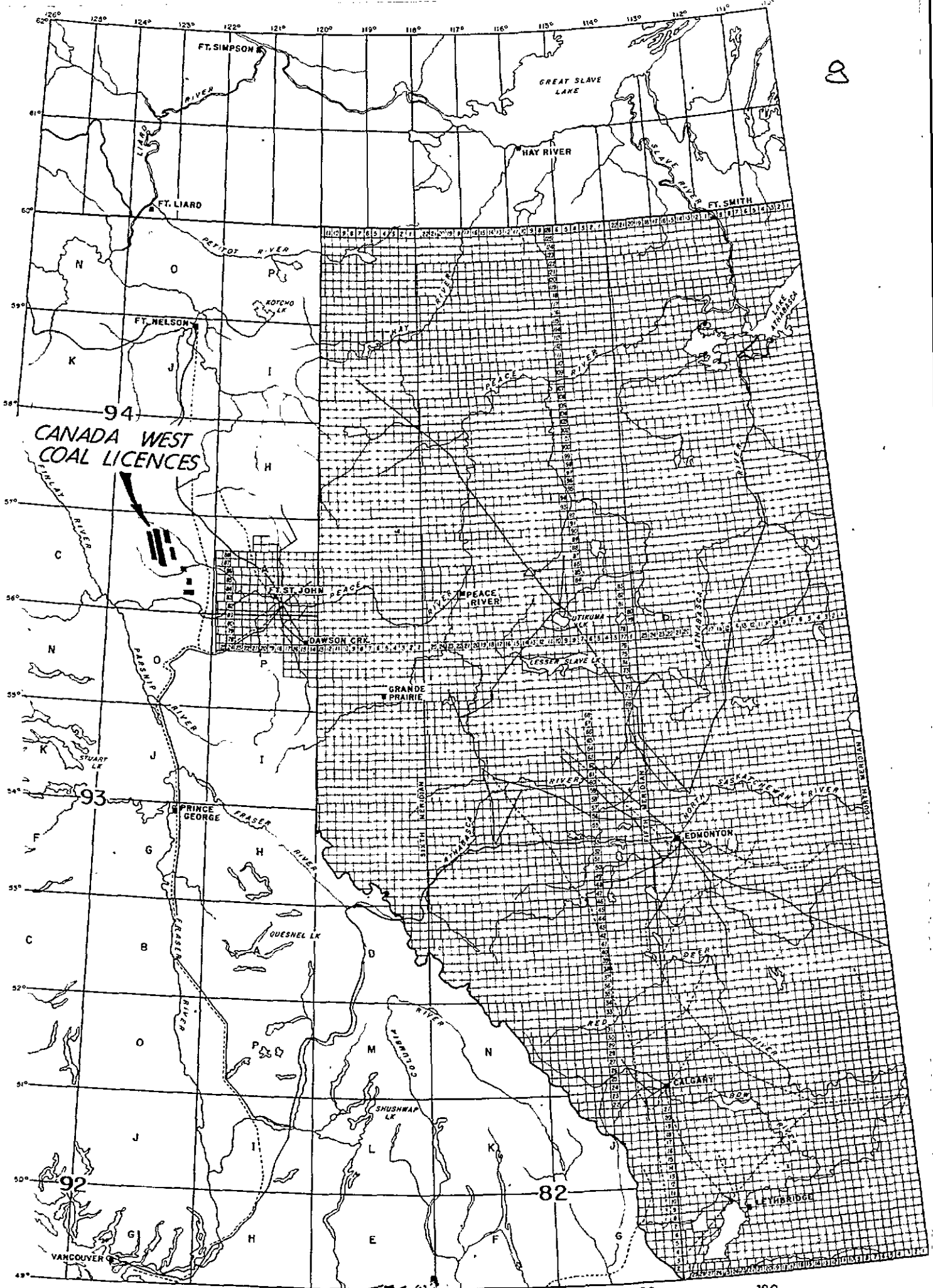
ABSTRACT

Canada West Petroleums Ltd. acquired 133 coal licences in north east British Columbia in areas considered prospective for the discovery of a viable deposit of metallurgical grade coking coal.

The prospect was based on the known presence of probable coking coal in seams within the Gething formation of Lower Cretaceous age both to the north and south of the area acquired by Canada West Petroleums Ltd. Licences were selected in areas which were believed to have the greatest mining potential based on the geological structure as known from published mapping.

Field mapping was carried out to confirm the published structure and in an attempt to locate outcrops of coal seams. Following this mapping program two drill sites were chosen to test the Gething formation for viable coal seams. At the same time further structural information would be obtained from the drilling.

The test drilling proved the absence of viable coal seams in one area. It also showed the structure to be less suitable for underground mining than had been pre-supposed. It is recommended that the licences not be renewed when they expire.



RK-PEACE RIVER COAL PROJECT 72(1)A

INDEX MAP

Figure 1

INTRODUCTION

This report describes the work carried out by Canada West Petroleums Ltd. in an attempt to locate a viable deposit of metallurgical grade coking coal in north east British Columbia. The area explored lies in the Foothills belt west of the Alaska Highway between the Peace River in the south and the Halfway River in the north.

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

REGIONAL SETTING

The area under consideration lies within the Rocky Mountain Foothills and trends northwesterly along the front of the Rocky Mountains between the Peace and Halfway rivers in northeastern British Columbia. The area is, in general, underlain by rocks varying in age from Mississippian to Cretaceous. It is these Cretaceous rocks which contain the potential coal measures under investigation. Specifically, the Bullhead group of Lower Cretaceous age was explored for viable coal seams (see Fig. 1 and 2).

The Cretaceous sequence was folded during the Laramide orogeny being deformed in elognate, plunging anticlines and synclines. Within the Foothills, this series of en echelon folds has a northwesterly trend. Major thrust faults, common south of the Peace River, are becoming unusual. In this area of the Foothills, most of the Cretaceous exposures occur on the flanks of anticlines whose cores contain Triassic and/or older rocks.

The so-called "Foothills" of this region have a mountainous character with many hills attaining elevations of over 6000 feet. The tree line is at approximately 5500 feet so the upper slopes are almost devoid of vegetation and rock exposures are common. Below the tree line exposures are very limited and are usually found only in creeks.

ACCESS

The Alaska Highway provides reasonable access along the eastern border of the area (see Fig. 4). Access to points west of the Alaska Highway is poor.

A road passable at most times by conventional car/truck extends from Pink Mountain P.O. (Mile 143) aouthwest to the Halfway River. Beyond the Halfway River the road is very poor to the Chowade River. This portion of the road includes a crossing of Cypress Creek which is hazardous both at highwater and in freezing conditions. Access for the drilling program was via this route to the Chowade River and thence westwards along an existing seismic trail which had to be upgraded.

The staking and geological field work were carried out from the Scobie Ranch. Access to this ranch, also known as the Beatton Ranch, is from Mile 132 on the Alaska Highway. Approximately half the distance is upgraded road to a natural gas compressor station while the remainder is very poor. It can only be travelled in dry weather when the creeks are low or in winter after freeze-up. The staking was carried out during freeze-up and the geology crew was supplied by helicopter and tracked vehicle as heavy rains made the road impassable.

Access to the remainder of the staked area is essentially non-existent. Various seismic roads extend up the Graham River but they are for the most part, impassable except during freeze-up.

8

ACKNOWLEDGMENTS

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

The staking program was carried out by Burnett & Co. Engineering Ltd. of Burnaby, B.C. under the supervision of Mr. Dave Zelmer. This company utilized a helicopter provided by Canwest Aviation Ltd. piloted by Mr. John Pridie. The staking crew were housed and fed by Mr. and Mrs. C. Scobie at the Scobie Ranch of the Halfway River.

For the field mapping the crew were based once again at the Scobie Ranch through the kind courtesy of Mr. and Mrs. Scobie. A helicopter was contracted from Rotoflite Ltd. and piloted by Mr. K. Knowles. Field assistance was provided by Mr. W. Poelman, geologist, Mr. R. Allan and Mr. J. Scobie. The willing co-operation of all the above is gratefully acknowledged.

The drilling program was carried out by Canadian Longyear Limited. The forman was Mr. H. Boman who made every endeavour to ensure the technical success of the program. Bulldozers were hired from Tompkins Contracting Ltd. of Fort St. John and while their equipment was excellent, the quality of the operator was highly variable.

Assistance with hauling equipment was provided by Mr. R. Anderson of the Upper Halfway River. Mr. Anderson also completed the necessary clean-up called for by the British Columbia Forestry Department.

8

During the drilling stage of the program, Union Oil Company of Canada Limited were partners in the program. The valuable assistance, both technical and other, provided by their geologist, Mr. B. Geisler, is gratefully acknowledged.

The co-operation of all the above named parties at all times contributed to the smooth operation of the program throughout. Many others, too numerous to mention, helped in many small ways to enable the completion of the program. Their assistance is also acknowledged.

PROSPECT

The exploration program was designed to evaluate coal rights acquired from the British Columbia government. This portion of the report deals with the thinking behind the development of the prospect and with the acquisition of the coal rights.

It describes in some detail what were considered to be the probabilities for the discovery of a viable coal deposit. Details of the selection of licences and the methods employed for the staking of these licences are described.

REGIONAL GEOLOGY

As stated in the Introduction, the area under consideration lies within the Foothills belt of northeastern British Columbia. The basic geology of most of the area is well laid out in Irish (1970). Consequently, thie report does not provide a detailed account of the stratigraphy and structure of the area between the Peace River and the Halfway River except where it directly effects the coal prospect.

Stratigraphy.

The rocks exposed in the area of the Canada West coal licences range in age from Triassic to Lower Cretaceous. The rocks of the Triassic are not of concern occupying as they do the axial cores of the anticline. The Triassic rocks are overlain by the Jurassic rocks of the Fernie group which are in turn overlain by the Lower Cretaceous succession (see Fig. 3).

The shales of the Fernie group form a distinct and easily mappable contact with the overlying Minnes Group. In the field it is very difficult to distinquish the Minnes Group from the overlying Bullhead group (Irish did not make the distinction for the G.S.C.) but the upper contact of the Bullhead group with the overlying Fort St. John Group is easily located.

The project was associated with the coals of the Gething formation of the Bullhead group. The mapping of the Gething formation is very difficult as its lower contact is not easily located especially in the northern part of the project area where the Cadomin formation no longer forms a separate unit. Full details of the complex stratigraphy of the Minnes and Bullhead groups of this area are contained in the literature (Stott 1967a, 1967b, 1969b, 1971).

8

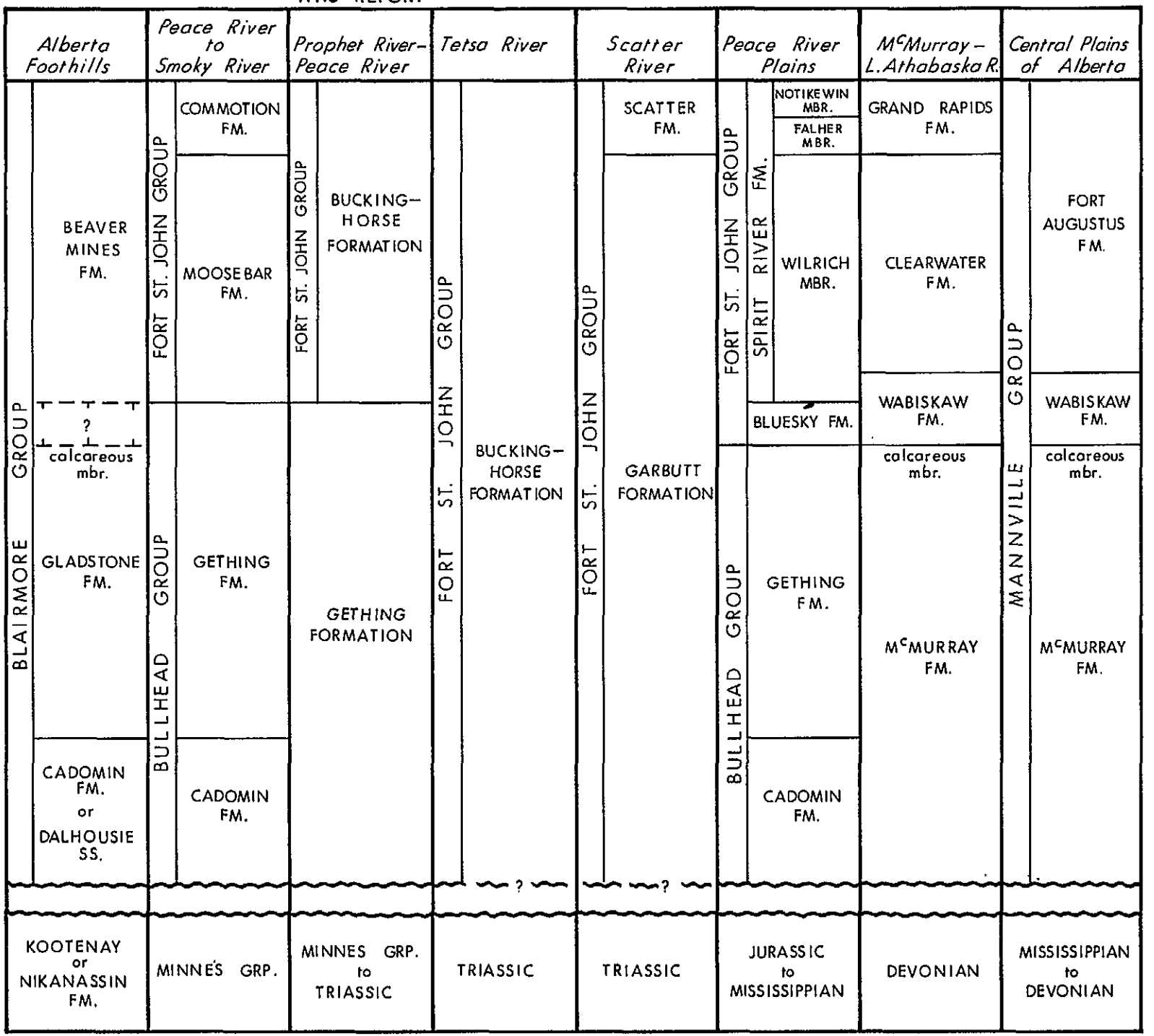
TABLE OF FORMATIONS

		Formation or Group	Thickness (feet)	Lithology
Lower Cretaceous		Fort St. John Group	3,000-5,000	Dark grey, marine shale with fine grained sandstone.
	Bullhead Group 0-2,500	Gething Formation	900 - 1,000	Fine-grained, cherty to quartzose sandstone; rusty weathering shales; carbonaceous mudstone and coal seams; minor conglomerate.
		Cadomin Formation	0 - 500	Massive chert conglomerate and coarse-grained sandstone; carbonaceous shale, minor coal.
		Regional erosional unconformity; bevels rocks of succeedingly older age northward and eastward.		
		Minnes Group	0 - 6,000	Massive, quartzose sandstone; alternating units of fine-grained sandstone and mudstone; minor carbonaceous sediments.
Jurassic		Fernie Formation	0 - 1,000	Calcareous and phosphatic shales; rusty weathering shales; glauconitic siltstone; sideritic shales; thinly interbedded sandstone, shale, and siltstone.

Structure.

The mapping of the area by Irish (1970) is the only complete structural interpretation of the area. As can be seen from this map, the structure consists of a series of sub-parallel folds and faults trending generally N25°W. It appears that the synclines are generally unfaulted and the anticlinal crests are associated with faults.

It is the synclines which were of most interest to this project as along their axes the possible coal bearing Gething formation is preserved. Details of the structure of the various folds are contained in the G.S.C. report. It should be noted that the report described the Chowade syncline - the main prospect - to have flank dips of 40°. In actual fact, field work showed these flank dips to be closer to 70° to 80° - a factor greatly influencing the prospectiveness of the area.



CORRELATION OF BULLHEAD GROUP IN WESTERN CANADA

Figure 2

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:

a. the probable coal seam distribution and likely thicknesses,

b. the probable coal quality,

c. the mining potential.

These three factors were considered separately.

Probable coal seams.

The area considered lay between Pink Mountain on the Halfway River in the north and the Peace River in the south. As mentioned previously, it is an area of generally poor rock exposure. Furthermore, it is not an area that had been subjected to intensive coal exploration either at the beginning of the century or recently. No coal occurrences were reported in the literature for this area.

To the south, along the Peace River canyon, there had been intermittent coal exploration and some coal production (from four small mines) since the early 1900's. The Gething formation contains all the known coal seams in this area. The most detailed account of the coal of this area was that contained in McLearn (1923). It is this account that is repeated in McLearn and Kindle(1950) which is probably the more familiar account. McLearn located and measured fifty coal seams in the Gething formation, but of them only three were described as being up to 5 feet thick at any one locality.

These three thicker seams are fairly variable in thickness -

one, the so-called Trojan seam, had a maximum reported thickness of 9' 2"; another, the Titan, was reported at up to 5' 0"; another, the Grant seam, at up to 4' 9".

Fifteen miles to the west of the Peace River canyon in the Carbon Creek area (Fig. 4), coal seams had been reported at up to 17 feet in thickness (Mathews 1947). Such a thickness might well be faulted but true thicknesses of 10 feet were probably factual.*

North of the Peace River a seam approximately 6 feet thick had been reported on Butler Ridge and an 8 foot seam had been reported in the Dunlevy Creek area.

At Pink Monntain, west of Mile 143 on the Alaska Highway (Fig. 4), coal had been reported (Hage 1944). This report indicated a seam in the Gething formation "more than 5 feet thick". This was the total factual information available on the Pink Mountain area.

It can thus be seen that the data available indicated the presence of several seams between 5 feet and 10 feet thick along the Peace River and at least one seam thicker than 5 feet at Pink Mountain. It was concluded that at least one seam thicker than 5 feet and possibly up to 10 feet thick was probably present in the Gething formation between the Peace River and Pink Mountain.

This conclusion was to some extent, supported by the reported presence of coal in unknown quantities on the oil/gas test wells drilled through the Gething formation along the east side of the Foothills (see Fig. 5).

* Utah have drilled thicknesses of 9 feet in the summer of 1971 in this area.

Probable coal quality.

Coal quality was somewhat more intangible than coal seam thickness as old analyses 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 the old analyses.

Those analyses for the Peace River canyon area which were available all indicated the coal to be a low ash, low sulphur, low to medium volatile coal. The ash content of the coal was perhaps the most striking quality. It commonly ranged around 5% which was extraordinarily good. The sulphur content was reported at below 0.8% and the volatile content ranged from 18% up to 26%. All these values fitted well within the parameters being sought by the steel producers of the world.

The coking quality of the coal was the least understood parameter. Today the Free Swelling Index as determined by an A.S.T.M. laboratory procedure, is used as an initial indicator of coking quality. All that was known for the Peace River coals was that the coking qualities were variously described as "poor" to "good" depending on the seam. In general, unweathered samples were reported as having "coking qualities".

Two samples of coal from the Pink Mountain area, both from outcrops, had been analyzed. One was reported as having "good" coking qualities. The other was anthracitic and non-coking.

In summary, those coals in the medium and low volatile range, where unweathered, apparently had coking qualities. The ash and sulphur contents of the coals were low. It was concluded that any

seams present in the Gething formation between the Peace River and Pink Mountain were probably of coking quality.

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.

These three factors can each be briefly discussed with respect to the area between the Peace and Halfway rivers.

The possibility of mining large volumes of coal in the area by some form of open pit was believed to be remote. This conclusion was reached as maximum seam thicknesses, in general, were anticipated to be less than 10 feet. Such thicknesses do not permit the removal of large amounts of overburden especially when the coal at shallower levels is probably oxidized. This being the case, primary consideration was given to possibilities for underground mining methods.

The most significant factor required was an area of structural simplicity containing a seam of a thickness suited to the optimum operation of modern mechanized equipment. In general, increases in dip above 15^{0} cause a rapid decrease in efficiency of modern mechanized equipment. Similarly, seam thicknesses of 6 feet to 8 feet are probably most advantageous.

The probability of a 6 to 8 foot seam was established and the potential for structural simplicity was apparent from the published geology (Hughes 1967, Irish 1970 and Stott 1969). The large synclines - the Chowade syncline in particular - appeared to have the potential for large areas of relatively undisturbed low dip strata of the Gething formation (see Fig. 5).

The potential area of low dip (less than 15^{o}) in the Chowade syncline appeared to exceed 20 square miles. If a recovery factor of 25% was assumed for one 8 foot seam then recoverable coal from this area alone would exceed 40 million tons. Together with other prospective areas the potential for a production of up to 3 million tons per annum was apparent.

Transportation was remote (up to 70 miles to existing railroads), but potential rail grades were good. The Pacific Great Eastern railroad serves the area and, further, this railway is noted for its aggressive development of new areas. The potential of pipeline transportation was also considered as a possible development.

In summary, the area appeared to have possibilities for the development of a large mine producing metallurgical grade coking coal.

8

STAKING PROGRAM

A staking program within the regulations as set forth by the British Columbia government was drawn up based on the potential of the area as discussed above. The principal used was that Canada West should essentially control all available prospects within the area available for staking. In order to develop this program certain basic assumptions were made:

(a) Commercial coal seams (i.e. seams thicker than 5 feet) were limited to the Lower Cretaceous Gething formation.

(b) Seams were unlikely to exceed 10 feet in thickness.

(c) Seams less than 10 feet in thickness would not lend themselves to surface mining and the prospects were mainly for underground mine development.

(d) Preferred mining areas were those where the dip of the strata was less than 15^{o}.

(e) Overburden should be less than 2000 feet.

Bearing these parameters in mind a program of staking 133 coal licences each one mile square in extent was laid out (see Fig. 5). These licences were in seven distinct block (labelled A to G on the map) and the blocks may be discussed separately as follows:

Block A (24 coal licences)

These licences covered the axial area of the Christina syncline. Both ends of the syncline were ignored as the structure narrows considerably at the end and the width of the low dip area along the axis was believed to be minimal. The unstaked areas of Gething

formation along the Christina syncline were not believed to be sufficiently large to attract a competitor.

Block B (65 coal licences)

Block B covered what was essentially the most attractive area from a structural point of view. It appeared that in excess of 25 square miles of Gething formation was dipping at 10^{0} or less along the axis of the Chowade syncline. Should only one 6 foot coal seam be present over these 25 square miles, then over 150 million tons or coal would be in place.

Block C (12 coal licences)

This block covered a low dip area adjacent to licences already staked by Nickel Hill Mines Ltd. The southern extension of the area also underlain by Gething formation was not recommended for staking in view of the increasing complexity of the structure to the south.

Block D (10 coal licences) and
Block E (7 coal licences)

These blocks both had essentially the same geological features. The licences were laid out to cover possible mine entries into the Gething formation where it dipped gently eastward under the undisturbed younger rocks. Canada West, by holding these coal licences, did in effect control all mining along the eastern edge of the Foothills in the "option area". Some interest in the area had recently been expressed by a major American coal producer (Ayrshire Coal Co.).

Block F (6 coal licences)

An area of low dipping Gething formation along the axis of a syncline was covered by this staking. It was not believed to be a high priority area, but up to 20 million tons of coal could realistically be assigned to this block.

Block G (9 coal licences)

These licences covered the extension of the staking carried out by Trend Exploration immediately to the south. Reserves were not likely to be large, but it was reliably reported that Trend had made a deal on their licences with a major mining company. These licences of Trend were subsequently transferred to Utah International Corporation.

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 & Co. Engineering Ltd. of Burnaby, B.C.

Two bids were received on the staking and this company was chosen both on the basis of the bid and its experience in staking coal licences. (The company had staked approximately 500 coal licences in 1970 and 1971).

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.

Snow 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, low temperatures and some snow, the staking which commenced on March 30th, was completed on April 11th. The applications for the licences were submitted to the government on April 20th.

OBJECTIVES

The initial exploration program for the licences held by Canada West Petroleums 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 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 consisting of one test hole on Block D and one on Block B. The objectives of the 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 deals with the field work stage and the drilling stage as two separate sections.

FIELD WORK.

The field work was carried out from a tent camp at the Scobie Ranch (Fig. 4). The crew consisted of two geologists and two assistants utilizing a Bell G3B-2 helicopter. The field work started on July 11th and was completed on July 27th with only a minimum of time lost due to bad weather. The basic plan was to traverse all the licence blocks in the search for coal outcrops and more geological detail.

It was found outcrops were almost wholly limited to the ridges above treeline and to the creeks. Complete sections of the Gething formation were non-existent. This was not surprising as the G.S.C. had failed to locate any well exposed sections of Gething formation in the area (see Fig. 6).

It was very difficult to distinquish the Gething formation from the underlying rocks of the Minnes Group in the field in the individual outcrop except in the extreme south where the Cadomin formation forms a distinct unit. In the area adjacent to the Chowade River numerous conglomerates exist within the Gething formation. It had been hoped that these conglomerates marked the base of the Gething formation but such was not the case.

These difficulties of mapping the Gething had already been recognized by the G.S.C. when Irish (1970) did not map the Gething formation separate from the underlying Minnes Group.

The results of the traverses have been plotted at a scale of 4" to 1 mile and are enclosed as Figs. 7 - 12 inclusive. Some of the

dips representative of the general structure are also shown on Fig. 6 at the scale of 1:50,000. As can be seen from air examination of these maps, ground control was obtained approximately every 2 miles on the licences. The licence blocks are discussed separately as follows:

a. Block A (Fig. 7)

Block A essentially covered all the area believed to be underlain by Gething formation along the axis of the Christina syncline. This block of licences was probably the most poorly exposed of all. It was possible to complete only three traverses which were believed to be advantageous.

In general, the traverses found all dips, even in the areas approaching the axis of the syncline, to be very high (60^{o}+). No traces of coal either in place or as float were observed. The general indications from the field work were that the Christina cyncline of Block A was extremely tightly folded. No significant area of low dip existed along the axis and the Block A licences were probably non-prospective on a structural basis.

b. Block B (Figs. 7 & 8)

Block B was by far the largest block of coal licences (65 sq. miles). It was the main prospect and covered the Gething formation outcrop area along the axis of the Chowade cyncline. This syncline had been mapped by Irish who referred to it as "canoe-shaped". Similarly, Hughes (1967) had described the synclines of the Peace River foothills as flat bottomed with steep limbs. The structure of the Chowade syncline was apparently of this type especially at the south end where it was fully exposed.

The traversing was designed to obtain more structural data over the area of the syncline to back the above interpretation. As can be seen from the maps, the outcrops were once again essentially limited to the higher areas along the flanks of the syncline and to the creeks along the axial area.

Considerable traversing was carried out (17 traverses) on the licence block and the main conclusions were as follows. The syncline probably had a very limited area of low dip along its axial area north of the Chowade river. South of the Chowade river the axial area was probably widening and flattening. An area of up to 30 square miles might exist in the southern portions of the syncline where the dip was less than 25^{0} and overburden was less than 1500' over the Gething formation.

Occasional traces of coal were noted. These were mainly "float" in the creeks although a seam of almost 4' in thickness was noted and sampled (CW3). Several other seams of 6" to 1' were also noted on this traverse. The analysis from the above sample (see Appendix I) was acceptable as a primary indicator of possible metallurgical grade coal. The volatile content (27.07%) and the sulphur content (0.86%) were perhaps higher than ideal, but nevertheless satisfactory for an outcrop sample.

The other sample (CW7) collected from this licence block consisted of float picked up from a creek bed. This coal was quite extra-ordinary both in appearance - a waxy, ashphaltic coal - and in analysis. It certainly was not a potential coking coal.

c. Block C (Fig. 9)

This block of licences was the most poorly exposed of all. Five traverses were made in the area but outcrop was mostly restricted to the edges of the block and to the southern portions of the block. The available data indicated a possible dip slope of Gething formation along the eastern side of the licence block. No coal was observed on this licence block.

d. Block D (Fig. 9)

Block D was designed to control access from the Gething formation outcrop into a potentially large area of low dipping coal measures. The geological traversing generally confirmed the dip of the Gething formation to range from 25^{o} - 30^{o} where it dipped under the Buckinghorse formation of the "plains". The dips measured at surface were mostly obtained on the top of the Gething formation which forms the topographic surface where it dips eastward.

No coal samples were obtained from this licence block. The only coal observed on this licence block was that excavated by a burrowing animal at the location shown on Fig. 9. This coal was apparently recovered from a seam less than 1' in thickness.

e. Block E (Fig. 10)

This licence block covered the plunging nose of an anticline in the Gething formation. Two traverses were made which, in general, confirmed the published mapping. A coal seam (3.5' thick) was sampled (CW6) and analyzed. The high moisture content (4.04%) of the sampled showed it to be weathered. However, the volatile content

(30.92%) was much higher than desirable.

f. Block F (Fig. 11)

This block of licences covered an isolated area of Gething formation preserved in the axis of a syncline. Two traverses were made on the block and it became apparent that only the lower Gething formation was preserved. The structure was very gentle with most dips being below 15°.

Several thin coal seams (less than 1.5') were observed and a sample (CW5) collected. The analyses of this sample showed the volatile matter (39.52%) to be much higher than desirable. No reason was suggested for this anomalous value.

g. Block G (Fig. 12)

This block of licences covered the north end of the Dunlevy syncline controlled by Trend Exploration (now controlled by Utah). The dips found on the two traverses were found to be low (less than 15°) but only the lower part of the Gething formation was believed to be present. Numerous thin coal seams (6" to 2') were observed and three samples (CW1, 2 and 4) were collected. All three samples were apparently weathered but analyses generally indicated the coal to be of potential metallurgical quality.

The field work could be summarized as follows:

1. The general structure of the area was as mapped and published by the G.S.C.
2. The major synclines were probably more tightly folded than implied by the published data.

3. Coal outcrops were very scarce. In general, they were more numerous in the south than the north. This might well reflect a decreasing amount of coal in the Gething formation to the north.
4. Coal quality is indeterminate from outcrop samples but it may well be of coking quality.

DRILLING PROGRAM

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.

Various alternate methods for drilling test holes are available. These range 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 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.

Two drill sites were chosen based on the geological information received from the field work and on the relatively low cost of access. These two drill sites are shown on Fig. 6 and labelled No. 1 and No. 2.

Drill site No. 1 is located on Block D adjacent to the eastern edge of the foothills belt. The location was chosen so that the drill hole would commence in the Buckinghorse formation and then penetrate all or most of the Gething formation at this locality. A complete

evaluation of Block D would result from this hole and at the same time valuable information would be gained towards an evaluation of Block C.

The second drill hole was located on Block B. It was situated immediately west of the probable axis of the Chowade syncline and the location was believed to be underlain by perhaps 250' of Buckinghorse formation. It was hoped that this drill hole would penetrate the Gething formation and yield structural and stratigraphic information for the evaluation of Block B, the main prospect. It would perhaps have been better to have located this second drill hole further south on the block, but access to a location perhaps 5 or 6 miles further south would have created direct costs of $20,000 to $25,000 in road building plus numerous indirect costs in obtaining the necessary permission from various government agencies.

The results of the drilling of the above two holes are described in turn.

Drill Hole No. 1.

All pertinent geological and mechanical data with regard to the drilling of this hole is included as Appendix IIA of this report. In summary, the hole was drilled to a depth of 1523'. The hole commenced in gravels, entered the Buckinghorse formation at a depth of 316' and penetrated the Gething at a depth of 750'. The hole remained in the Gething formation to its total depth of 1523'.

The drilling of the 316' of gravels, sand and boulders presented numerous drilling problems. However, once the bedrock was reached drilling proceeded most satisfactorily to a total depth of 1523'.

The hole was drilled at an angle selected so that the borehole

would penetrate the stratigraphic section as near as possible at right angles. Details as to the direction and angle are included in Appendix IIA.

The contact of the Buckinghorse formation with the Gething formation was deeper than had been anticipated, but as can be seen on Cross Section EF, this contact appears to be a direct extension of the outcropping dip slope immediately to the west. There is apparently no flattening of the dip from the outcrop to the sub-surface at this location.

From a stratigraphy point of view, the Gething section penetrated proved to be much more conglomeratic than had been anticipated from a study of the adjoining wells (Hudson's Bay Chowade b-18-J and Security Freehold Cypress a-92-K). While some coal had been indicated in the upper part of the Gething formation in the sample descriptions for these two wells, no coal was recognized in the upper 500' of the Gething formation as penetrated in the drill hole. In fact, in the total 773' of Gething that was drilled no coal seam thicker than 1' was recognized. As core recovery was excellent it can be stated with certainty that no coal seams thicker than 1' exist in the Gething formation at the located drilled on Block D. The Gething formation at this location probably is less than 900' thick (see data on Fig. 6) so only the very lowest portion of the Gething was untested. It was decided to abandon the hole without testing this portion of the section as mining coal under more than 1500' of overburden is difficult in the Rocky Mountain Foothills belt. The possible recoverable reserves in areas with less than 1500' of cover on Block D for any seam occuring in the lower 100' in the Gething formation are so small that it was decided to cease drilling at 1523'.

Drill Hole No. 2.

All pertinent and mechanical data for Drill Hole No. 2 are included as Appendix IIB of this report. The drill hole commenced in the shales of the Buckinghorse formation and remained in the Buckinghorse formation to a total depth of 1548'. No core description is included for this as all the core consisted of a heavy dark grey to black shale. No bedding was visible at any point in the core.

It had been hoped that this hole would penetrate only about 250' of the Buckinghorse formation, but this was not the case. The drill hole, which had been primarily designed as a stratigraphic test of the Gething formation on Block B, turned out to be a structure test hole. No data was obtained regarding the possible coal seams in the Gething formation. An examination of Cross Section AB shows that this drill hole necessitated the drawing of a very deeply faulted syncline at the location of the drill hole. This being the case, there is no area along the axis of the syncline at this location that has any potential for coal mining. If the information from this drill hole is extrapolated along the axis of the syncline to the south, it becomes apparent that the syncline plunged rapidly northwards. A cross section further south on the syncline (CD) helps to illustrate this plunge.

It can be seen that the total area where dips may realistically be expected to be less than 25^{o} in the Gething formation and where the total cover of any coal seam would be less than 1500' is perhaps only 10 to 12 square miles at the most. An 8' coal seam, if present, and there is considerable doubt about this in view of Drill Hole No. 1, would probably only have recoverable reserves of perhaps 20 million tons. Such reserves at a location far removed from transportation are unlikely to be viable in the foreseeable future.

In summary the two drill holes showed the main prospective blocks, i.e. Blocks B and D, to have very limited potential. Block B is not a wide broad bottomed syncline and the area suited to underground mining is very limited. The Gething formation underlying Block D certainly does not contain any viable coal seams in the upper 773'. Even if a seam is present in the lower 150' of Gething under Block D, the total recoverable reserves under less than 1500' of cover would not present a viable proposition.

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 and the likelihood of being able to mine these same seams.

The extensive program of field mapping failed to locate any coal seams exceeding 4' in thickness. While it is quite possible that seams exceeding this thickness do exist under some of the licences, this is not believed likely. Drill Hole No. 1 penetrated almost the whole Gething section. No coal had been recognized in the lower portion of the Gething at the nearby well drilled in the search for oil and/or gas. It is confidently concluded that no seams thicker than 4' exist under licence blocks C and D.

While complete sections of Gething were not exposed on licence blocks A and B, no significant coal exposures were noted. On licence blocks E and F some thin coal seams were noted but, once again, no significant seams were located. Licence block G in the extreme south is not underlain by the upper Gething which contains the thicker seams in the Peace River canyon area. Once again, it is believed that thick seams are not present in this area.

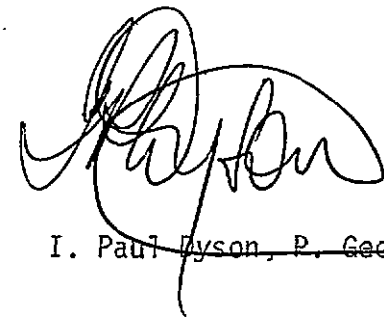
Should a seam exceeding 6' thick be present on Block B despite the failure to find it in the field, then the area over which this seam would be mineable is severely limited by the sharp folding of the Chowade syncline as indicated by Drill Hole No. 2.

It is concluded that the coal licences of Canada West Petroleums Ltd. lying between the Peace River and the Halfway River do not contain sufficient coal in potential mineable areas to support a

mine. It is possible that small scale production could be undertaken at the south end of Block B should a significant coal seam be discovered by drilling in that area. However, the long distance involved in transporting the coal ti existing transportation networks precludes the consideration of such small scale mining activities in this area.

RECOMMENDATIONS

In view of the conclusions reached regarding the coal licences of Canada West Petroleums Ltd. in the Peace River area, it is recommended that no further exploration be carried out on the licences. At such time as the rentals become due on the licences, then they should be relinquished.



February 1972.

I. Paul Dyson, P. Geol.

SELECTED REFERENCES

Alberta Study Group,
1954: Lower Cretaceous of the Peace River Region; Western Canada Sedimentary Basin, Rutherford Mem. Vol; Am. Assoc. Petrol. Geol, Tulsa, Okla.

Beach, H. H. and Spivak, J,
1944: Dunlevy-Portage Mountain map-area, B.C.; Geol. Surv. Can., Paper 44-19.

Dickson, J.,
1948: Analyses of British Columbia Coals; B.C. Dept. of Mines, Bull. 14.

Dolmage, V. and Campbell, D.D.,
1963: The geology of the Portage Mountain damsite, Peace River, B.C.; Bull, Can. Inst. Mining Met., Vol. 56, No. 617, pp. 711-723.

Dowling, D. B.,
1915a: Coal Fields of British Columbia; Geol. Surv. Can., Mem. 69.
1915b: The Cretaceous Sea in Alberta; Trans. Roy. Soc. Can., 3rd ser., Vol. 9, Sec. 4, pp. 27-42.

Fitzgerald, H.L.,
1968: Structure of British Columbia Foothills, Canada, Bull. Amer. Assoc. Petrol. Geol., Vol. 52, No. 4, pp. 641-664.

Galloway, C.F.J.,
1913: The coal measures of the Peace River canyon; B.C. Minister Mines, Ann. Rept. 1912, pp. 125-136.
1915: Peace River coal area; cola fields of British Columbia; Geol. Surv. Can., Mem. 69.

Galloway, J. D.,
1924: Carbon River field; B.C. Minister Mines, Ann. Rept. 1923, pp. 140-141.

Hage, C. O.,
1944: Geology adjacent to the Alaska Highway between Fort St. John and Fort Nelson, British Columbia; Geol. Surv. Can., Paper 44-30.

Hughes, J.E.
1964: Jurassic and Cretaceous strata of the Bullhead succession in the Peace and Pine River Foothills; B.C. Dept. Mines and Petrol. Res., Bull. No. 51.
1967: Geology of the Pine Valley, Mount Wabi to Solitude Mountain, northeastern British Columbia; B.C. Dept. Mines and Petrol. Res., Bull. No. 52.

Irish, E.J.W.
1961: Halfway River, British Columbia; Geol. Surv. Can., Map 37-1961.
1963: Halfway River, British Columbia; Geol. Surv. Can., Map 22-1963.
1970: Halfway River, British Columbia; Geol. Surv. Can., Paper 69-11.

McLearn, F.H.
1918: Peace River section, Alberta; Geol. Surv. Can., Sum. Rept. 1917, pt. C, pp. 14-21.
1919b: The Cretaceous of Peace and Athabaska valleys (Alberta); Geol. Surv. Can., Mem. 11y, pp. 25-33.
1921: Mesozoic of upper Peace River, B.C.; Geol. Surv. Can., Sum. Rept. 1920, pt. B, pp. 1-6.
1923: Peace River Canyon coal area, B.C.; Geol. Surv. Can., Rept. 1922, pt. B, pp. 1-46.

McLearn, F.H. and Irish, E.J.W.
1944: Some coal deposits of the Peace River Foothills, British Columbia; Geol. Surv. Can., Paper 44-15.

McLearn, F.H. and Kindle, E.D.
1950: Geology of northeastern British Columbia; Geol. Surv. Can., Mem. 259.

Mathews, W. H.
1947: Geology and coal resources of the Carbon Creek-Mount Bickford map-area, 1946; B.C. Dept. Mines, Bull. 24

Muller, J.E.
1961: Pine Pass, British Columbia; Geol. Surv. Can., Map 11-1961.

Nicolls, J.H.H.
1952: Analyses of Canadian Coals and Peat Fuels; Mines Branch, Publ. #831.

Spivak, J.
1944: Geology and coal deposits of Hasler Creek area, British Columbia, Geol. Surv. Can., Paper 44-7.

Stott, D. A.
1960a: Cretaceous rocks between Smoky and Pine Rivers, Rocky Mountain Foothills, Alberta and British Columbia; Geol. Surv. Can., Paper 60-16.
1961a: Dawson Creek map-area, British Columbia; Geol. Surv. Can., Paper 61-10.
1963: Stratigraphy of the Lower Cretaceous Fort St. John Group, Gething and Cadomin Formations, foothills of northern Alberta and British Columbia; Geol. Surv. Can., Paper 62-39.

Stott, D. A.
1967a: The Fernie and Minnes strata north of Peace River, foothills of northeastern British Columbia; Geol. Surv. Can., Paper 67-19.
1967b: Jurassic and Cretaceous stratigraphy between Peace and Tetsa Rivers, northeastern British Columbia; Geol. Surv. Can., Paper 66-7.
1968a: Lower Cretaceous Bullhead and Fort St. John Groups, between Smoky and Peace Rivers, Rocky Mountain Foothills, Alberta and British Columbia; Geol. Surv. Can., Bull. 152, 279 pp.
1969b: The Fernie and Minnes strata north of Peace River, Foothills of northeastern British Columbia; Geol. Surv. Can., Paper 67-19B.
1971: Lower Cretaceous Bullhead Group between Bullmoose Mountain and Tetsa River, Rocky Mountain Foothills, northeastern British Columbia; Geol. Surv. Can. Open File Report.

Wickenden, R.T.D and Shaw, G.
1943: Stratigraphy and structure in Mount Hulcross-Commotion Creek map-area, B.C.; Geol. Surv. Can., Paper 43-13.

Ziegler, W.H. and Pocock, S.A.J.
1960: The Mines Formation: Edmonton Geol. Soc., Second Ann. Field Conf., Guidebook, pp. 43-71.

APPENDIX I

8

To: PAUL DYSON CONSULTANTS & HOLDINGS LTD.
950 Aquitaine Tower,
540 5th Ave. S.W.
Calgary 1, Alberta.

File No. 4377
Date August 3rd 1971
Samples Coal

Certificate of ASSAY

LORING LABORATORIES LTD.

SAMPLE No.	Inherent H20 %	Vol. Matter %	Ash %	Fixed Carbon %	S %	B.T.U. /lb.	F.S.I.
RAW COAL							
C W # 1	2.61	32.89	4.93	59.57	.87	13,365	N.A.
C W # 2	2.59	32.69	4.20	60.52	.87	13,364	N.A.
C W # 3	1.73	27.07	16.38	54.82	.86	12,059	½
C W # 4	1.17	25.47	23.77	49.59	.66	11,143	1
C W # 5	2.77	39.52	5.28	52.43	.91	12,546	N.A.
C W # 6	4.04	30.92	4.96	60.08	.80	12,113	N.A.
C W # 7	.39	61.75	6.80	31.06	9.35	15,086	N.A.

I Hereby Certify THAT THE ABOVE RESULTS ARE THOSE ASSAYS MADE BY ME UPON THE HEREIN DESCRIBED SAMPLES . . . .

Rejects Retained one month.

Pulps Retained one month unless specific arrangements made in advance.

C. L. McIsaac

Licensed Assayer of British Columbia

APPENDIX IIA

SUMMARY OF TEST HOLE

Name : Canada West #1

Date : December 1971.

Location : Zero Mtn., Chowade River, Northeastern B.C.

Co-Ordinates :

Elevations : Ground 2950' (estimated)

Operator : Canada West Petroleums Ltd. (N.P.L.)

Contractor : Canadian Longyear Ltd.

Spud In : Oct. 16, 1971

Completed Drilling : Oct. 29, 1971

Total Depth : 1523'

Coal Occurences :

1278.5 - 1278.75 (0.25')

1417.5 - 1418.25 (0.75')

1480.5 - 1481.25 (0.75')

1509 - 1510 (1')

Completion Date : Oct. 29, 1971

Formation : Gething Fm.

Surface Casing :

HW 0 - 20

NX 20 - 336

Plugs :

5' Plug (wooden)

Logs : Nil

Note: Hole angle: -64°
Direction: 245° from true north.

Cores : 326 - 1523

Core Analyses : Nil

CORE DESCRIPTIONS

Drill Hole No. 1

0 - 316	Gravel, sand, boulder, etc.
316 - 750	Buckinghorse Formation. Dark grey to black shale, uniform texture with no distinct bedding except 518.5 - 519 bentonite, light grey 693 1" bentonite as above.
750 - 758.5	Gething Formation. Sandstone, very fine grained grading to siltstone, strongly glaunotic with varying amounts of pebbles (occasionally to 50%), pebbles well rounded, black chert and clear quartz, predominantly 1/8" or less occasionally up to 1/2".
758.5 - 760.5	Shale, predominantly dark grey, very well banded with light grey, medium grained sandstone bands, mostly 1/8" to 1/4" thick.
760.5 - 761.75	Sandstone, light grey, very fine grained with a few very coarse dark grains approaching pebbles in the lowest 1", some cross bedding.
761.75 - 764.75	As 758.5 to 760.5 - overall impression is black to dark grey shale.
764.75 - 767.5	Sandstone as 760.5 - 761.75.
767.75 - 769.25	Shale as 761.75 to 764.75.
769.25 - 776.5	Sandstone, light grey, fine grained, occasionally cross bedded.
776.5 - 777.5	Shale unit containing up to 25% sandstone bands - within pyrite bed at base.
777.5 - 779.5	Sandstone unit as 760.5 - 761.75. Top 6" quite shaley.
779.5 - 780.5	Shaley unit within silt bands.
780.5 - 782	Sandstone unit.
782 - 785.5	Sandstone, fine to medium grained, light grey with dark grey, very thin (0.1") silty shale bands, occasional shale bands 1/2" - 1", abundant cut and fill structures, some burrows.

785.5 - 792.75	Sandstone, light grey, fine grained with a few dark grey to black pebbles (1/4") in lower 2". Middle of the unit marked by pebbles of white siltstone (up to 1 1/2") over a 2" zone.
792.75 - 794.5	Shale, dark grey, occasionally carbonaceous lower (1/8").
794.5 - 795.75	Sandstone, very fine grained.
759.75 - 797.5	Shaley unit as 758.5 - 760.5 with numerous burrows.
797.5 - 799.25	Sandstone, medium to light grey, very fine to fine grained with pebbles up to 1/4" in the lower 3".
799.25 - 801	Shaley unit as 758.5 - 760.5.
801 - 807	Sandstone as 797.5 - 799.25 with pebbles at 804.5 - 805.5. Upper pebble zone contains pebbles to 2".
807 - 808.5	As 758.5 - 760.5.
808.5 - 810	Sandstone, light grey, very fine grained with minor cross bedding.
810 - 811.5	As 758.5 - 760.5.
811.5 - 829	Sandstone as 797.5 - 799.25 occasionally becoming medium grained 817.5 - 6" conglomerate band predominantly 1/4" pebbles of black and white chert 819 - 3" conglomerate band as above. 820 - 6" of black shale.
825.75 - 826.5	Black shale.
	828.75 - 829 conglomerate with chert pebbles to 1/8".
829 - 836	Shale unit containing up to 25% fine grained, medium to light grey sandstone.
826 - 845	Sandstone, light grey, fine grained, gradational to conglomerate at top. 838 - 838.75 conglomeate, pebbles to 1/4" of dark grey and white chert. 838.75 - 839 shale, dark grey, carbonaceous.

845 - 870.5	Sandstone, medium to light grey, salt and pepper, overall unit predominantly sandy to numerous shale and carbonaceous shale partings less than 1/4", very occasional pebbles.
870.5 - 875	Sandstone, medium to light grey, fine grained and structural.
875 - 876.5	Shaley unit containing up to 30% sandstone as above.
876.5 - 881.5	Sandstone, light grey, very fine to fine grained, poorly banded.
881.5 - 884.5	Alternating bands of sandstone, light to medium grey, very fine grained and dark grey to black shale, individual bands up to 2".
884.5 - 890.5	Sandstone, very fine to fine grained, light grey, poorly banded, 3" shale bed at 880.5. Highly angular contact with underlying unit suggests this sandstone to be a channel fill.
890.5 - 921	Alternating bands of sandstone from very fine grained grading to siltstone and black shale. Individual bands 1" to 2".
921 - 940	Shale, dark grey to black, grading to dark grey from fine sandstone, abundant slump structures, etc.
940 - 956.5	As 890.5 - 921.
956.5 - 964	Sandstone, very fine to fine grained, light to medium grey, structureless, occasionally shaley partings up to 3".
964 - 985	Alternate bands of dark grey shale and sandstone from fine grained to silty, light grey to medium grey, increasing sandstone in the lower 10'. Individual bands generally 1/2" to 6".
985 - 986	Conglomerate, pebbles vary from 1/2" to 2" with larger pebbles concentrated in lower part of the unit.
986 - 989.5	Sandstone, medium to fine grained, medium grey, poorly banded, extensively burrowed and channelled, occasional pebbles to 1/4".
989.5 - 1003	Congomerate, numerous pebbles averaging 1/4" to 1/2", occasionally to 1" in sandstone matrix, sandstone, medium to dark grey, medium to fine grained, pebbles are light grey to black chert, sandstone, siltstone, etc.

1003 - 1005	Shale, dark grey to black.
1005 - 1014	Sandstone, medium to fine grained, dark to medium grey, salt and pepper, occasional shaley bands up to 6".
1014 - 1026	Sandstone, fine to medium grained, medium to light grey, salt and pepper, well bedded with traces of cross bedding.
1026 - 1032	Sandstone, medium grained, medium to light grey, salt and pepper, no visible bedding or structure.
1032 - 1055.5	Conglomerate facies interbedded with pebbly sandstones as above. main conglomerate zones at 1032 - 1032.5 1034 - 1035 1036.5 - 1038 1045 - 1047 1054.5 - 1055.5 Pebbles generally 1/2" to 2".
1055.5 - 1064	As 1026 - 1032 except sandstone is fine grained.
1064 - 1070	Shale, dark grey to black with up to 10% sandstone.
1070 - 1073	Sandstone, fine to medium grained with scattered coarse grains, medium grey. Base of unit marked by 2" conglomerate bands containing pebbles to 1 1/2".
1073 - 1078	Shale, dark grey to black with up to 20% siltstone and very fine grained sandstone with numerous small scaley sedimentary structures.
1078 - 1093	Sandstone, medium to fine grained, light grey, well developed bedding and cross bedding.
1093 - 1093.75	Conglomerate of pebbles 1/4" to 1/2", occasionally to 1". Pebbles mostly sandstone and quartzite.
1093.75 - 1119.5	Sandstone, medium to fine grained and grey scattered coarse grains to 1/4" pebbles. Poorly banded 3" dark grey to black shaley parting at 1114.
1119.5 - 1129.25	Conglomerate. Pebbles 1/8" to 1/2" increasing to 1" in lower 3'. Pebbles predominantly sandstone.
1129.25 - 1135	Sandstone as 1093.25 - 1119.5.

1135 - 1138	As 1119.5 - 1129.25.
1138 - 1168	Sandstone, fine to medium grained, light to medium grey, well banded with occasional floating pebbles. 1160 - 3" conglomerate band.
1168 - 1172	Shale, dark grey to black containing up to 20% sandstone from fine grained, medium to dark grey grading to siltstone.
1172 - 1177	Sandstone, medium grained, occasionally coarse to very coarse, light grey, strongly cross bedded.
1177 - 1180	Shale, medium to dark grey to black grading to siltstone.
1180 - 1246.5	Sandstone, fine to medium grained, light grey, poorly bedded. 1202 - traces of pyrite. 1205 - 1205.5 - shale, dark grey.
1246.5 - 1247.75	Conglomerate as 1119.5 - 1129.25, pebbles averaging 1/8" to maximum 1".
1247.75 - 1258	Interbedded sandstone and siltstone, sandstone very fine grained, light to medium grey, siltstone dark grey, occasional 1/4" beds of coaly material.
1258 - 1278.5	Sandstone, medium to fine grained, medium to light grey, occasional silty bands and coarse grains.
1278.5 - 1278.75	COAL. Bright fissile apparentlylow ash coal. This 6" interval is represented by two 1" bands of coal.
1278.75 - 1320	Sandstone varying from fine to coarse grained, predominantly grained, light to medium grey, occasional silty oblique shaley bands up to 6". Scattered blebs of coal at 1297.
1320 - 1330.5	Sandstone, very fine to fine grained, light grey, structural and uniform.
1330.5 - 1352	Sandstone, very fine to medium grained, light to medium grey, well banded, little or no structure, occasional silty oglique shaley beds up to 1". Large pebble (1 1/2" x 3/4") of white siltstone at 1348.
1352 - 1355	Shale and shaley siltstone, medium to dark grey grading to very fine sandstone in occasional 3" band.

1355 - 1365.25	Sandstone, fine grained, light grey, well banded, shaley intervals 1357 to 1360 and 1362.5 to 1363.5.
1365.25 - 1378	Shale, medium dark grey to black, up to 10% silt very fine grained sandstone at 1352 - 1355.
1378 - 1390.5	Sandstone, fine grained, light grey, well banded with few dark grey to black grains.
1390.5 - 1393	As 1365.25 - 1378.
1393 - 1395.5	Sandstone as 1378 - 1390.5.
1395.5 - 1404.5	Shale and shaley siltsone, dark grey to black, very well banded.
1404.5 - 1407	Sandstone, fine grained, occasionally becoming coarse grained, light to medium grey, lowest 2" conglomerate with pebbles to 1/4".
1407 - 1414.5	Sandstone, fine grained to medium grained containing up to 20% silty sandstone and 10% shaley siltstone. This unit extensively re-worked with burrows, mud characteristics, etc.
1414.5 - 1417.5	Siltstone and shale, dark grey to black becoming carbonaceous at the base.
1417.5 - 1418.25	COAL. Bright, shiny, black, possibly containing 15% ash.
1418.25 - 1424	Sandstone, fine grained, light to medium grey, silty bands, whole unit very well banded.
1424 - 1429	Sandstone as 1407 - 1414.5.
1429 - 1432	Shale, medium dark grey to black.
1432 - 1434	Siltstone to dark grey.
1434 - 1439	Sandstone, fine grained, light grey, very well bedded.
1439 - 1440	Siltstone, medium to dark grey.
1440 - 1441.5	As 1434 - 1439.
1441.5 - 1442.5	As 1439 - 1440.
1442.5 - 1447.5	Sandstone as above.
1447.5 - 1448.25	Siltstone, medium to dark grey.
1448.25 - 1449.25	Sandstone as above.

1449.25 - 1466	Siltstone and shale, medium to dark grey, blocky - increasingly shaley towards the base of the unit.
1466 - 1479	Sandstone, fine grained, light to medium grey, becoming increasingly silty at the base.
1479 - 1480.5	Siltstone, medium to dark grey.
1480.5 - 1481.25	COAL.
1481.25 - 1493.5	Siltstone, shaley, in parts medium to dark grey containing occasional 1/4" very fine sandstone bands.
1493.5 - 1497	Sandstone, light to medium grey, fine grained, very well developed bedding.
1497 - 1498.75	Siltstone, medium grey.
1498.75 - 1500.5	Shale, dark grey to black, very carbonaceous containing 3" band of coal.
1500.5 - 1504	Sandstone, fine grained, light to medium grey with occasional siltstone bands, quartzite filled fractures at 1502.
1504 - 1513	Siltstone, medium to dark grey.
	1509 - 1510 Coal with 3" siltstone parting.
1513 - 1523	Sandstone, fine to medium grained, light grey, well banded and strongly cross bedded.