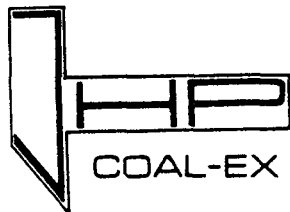


062171



COAL-EX CONSULTING LTD.

REPORT ON THE WHITEHORSE  
COAL PROPERTY, YUKON TERRITORY  
FOR  
WHITEHORSE COAL CORPORATION

by

JHP COAL-EX CONSULTING LTD.  
Suite 806-402 West Pender Street  
Vancouver, B.C. V6B 1T6

March 28, 1984

This report has been examined; de-  
clared acceptable as Representation  
Work under Section 32 and Schedule  
B of the Canada Mining Regulations  
and valued in the amount of \$       

for Chief, *Thlaine*

Date: *April 11, 1984.*

*DIAND Document  
# 062171*

## SUMMARY

The Whitehorse Coal Property is located in south-central Yukon approximately 30 kilometres southwest of Whitehorse. The property consists of three coal leases and one coal exploration licence which cover an area of approximately 19,987 hectares (49,389 acres). The coal-bearing strata are essentially covered by the three leases and the northwest quarter of the exploration licence; the rest of the licence contains rocks that are not coal-bearing.

The coal-measures are found in the Tantalus Formation of Upper Jurassic to Lower Cretaceous age. The coal is thinly interbanded with carbonaceous to coaly shale which makes precise definition of coal seams difficult. Consequently, the coal-bearing sections are referred to as coal zones. Two coal zones (A and B) have been located. Coal Zone A has been traced discontinuously over 10 kilometres while Coal Zone B represents a new discovery and has not yet been traced for any great distance.

The structure of the exploration area is characterized by moderate to steep ( $30^{\circ}$ - $50^{\circ}$ ) north-northeasterly dips. On cursory examination the sequence appears homoclinal but mesoscopic folds are present which suggest unidentified major folds may exist. If this is so then beds along the southwestern edge of the exploration area may be inverted repetitions of those to the northeast and Coal Zone B may be the upside-down equivalent of Coal Zone A. The coal zones exhibit the effects of strong deformation and structural poding of coal along major fold hinges is a possibility. Minor normal faults cut through or into the coal zones.

The coal is of anthracite to meta-anthracite rank. The best coal sections of any reasonable thickness (1.75 and 1.30 metres) have dry ash and heat contents of 40% and 7,700 Btu/lb, respectively. At Fisher Creek a 5.05 metre section (which includes the 1.75 and 1.30 metre sections) provides a heat content of 6000 dry Btu/lb at 50% dry ash. An 8.5 metre

section at the same location has a dry ash content of 59% and a dry heat content of 4400 Btu/lb. The coal is very low in sulphur (less than 0.5%). Preliminary washability tests suggest that cleaning this coal by water-only or heavy media cyclones may be impractical.

Potential coal resources have been estimated based on assumptions regarding the areal extent and lateral continuity of the coal zones. Tonnage estimates range from 26 to 85 million tonnes for in situ dry ash contents of 40% and 59%, respectively. These estimates are for Coal Zone A and do not include additional tonnage available from Coal Zone B or from any structural repetitions.

Utilization of this high-ash coal should focus on Yukon, itself. Opportunities exist to supplant diesel oil used for domestic and industrial heating. The greatest potential, however, lies with mine-mouth power generation using the fluidized-bed combustion process. An exportable product is not foreseen for this property unless cleaner coal is located. The property is well situated with regard to infrastructural requirements to support the exploitation of this coal resource.

It is concluded that this property warrants further exploration.

## TABLE OF CONTENTS

	<u>Page No.</u>
1.0 INTRODUCTION	1
2.0 LOCATION, ACCESS & PHYSIOGRAPHY	3
3.0 COAL LEASES AND LICENCES	6
4.0 SUMMARY OF EXPLORATION WORK	7
4.1 Pre-1983 Exploration	7
4.2 1983 Exploration Activities	8
5.0 GEOLOGY	9
5.1 Stratigraphy	9
5.2 Coal Zone Stratigraphy	12
5.3 Structure	17
6.0 COAL QUALITY, RESOURCE AND UTILIZATION POTENTIAL	20
6.1 Coal Quality	20
6.2 Resources	23
6.3 Utilization	26
7.0 CONCLUSIONS AND RECOMMENDATIONS	28
8.0 REFERENCES	30
9.0 CERTIFICATE	31

LIST OF TABLES

<u>Table No.</u>		<u>Page No.</u>
1	Stratigraphy of the Whitehorse Coal Property	9

LIST OF FIGURES

<u>Figure No.</u>		<u>Page No.</u>
1	Location Map	2
2	Map of Coal Lease and Exploration Licence	4
3	Schematic Geology Map	11

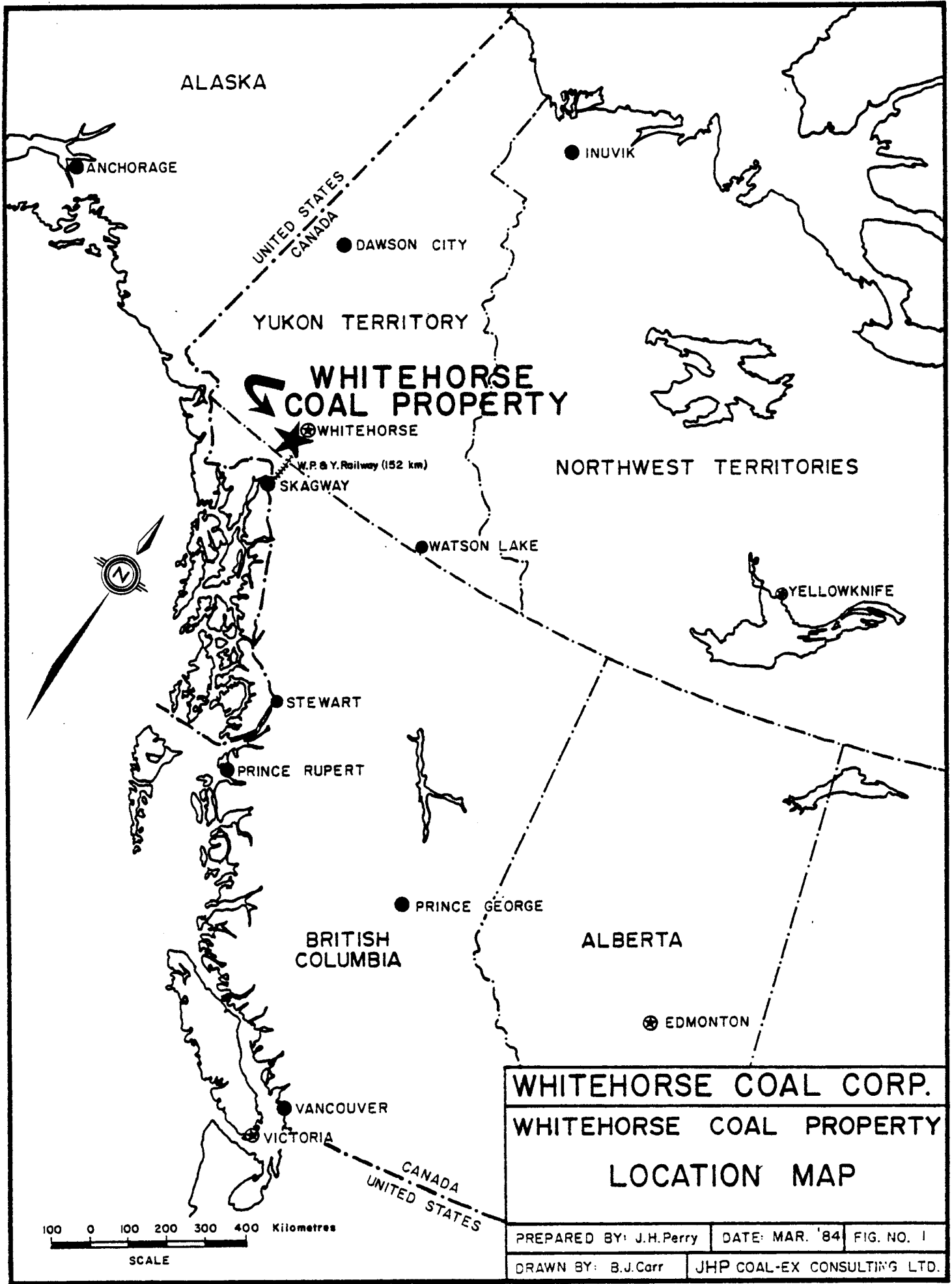
LIST OF APPENDICES

<u>Appendix No.</u>	
I	Generalized Description of Sampled Sections
II	Trench Sample Analyses
III	Coal Petrography and Washability Data
IV	Coal Quality Data from Cairnes (1908) and Taylor (1969)

## 1.0 INTRODUCTION

In early August, 1983, Coal-Ex Consulting Ltd. was requested by Mr. P. Poggenburg (President, Whitehorse Coal Corp.) to undertake a brief reconnaissance of the Whitehorse Coal Property (Figure 1). A visit to the property was undertaken during mid-August 1983 by Mr. J. Perry, P. Geol., who spent approximately three days on reconnaissance geology, which included the examination of several cat-trenches and the taking of samples. This report is based solely on observations made during the reconnaissance and on reviews of published and unpublished data which are listed in Section 8.0

The purpose of this report is to summarize the information that is available on the geology of the area, particularly with respect to the coal resource potential.



**WHITEHORSE COAL CORP.**  
**WHITEHORSE COAL PROPERTY**  
**LOCATION MAP**

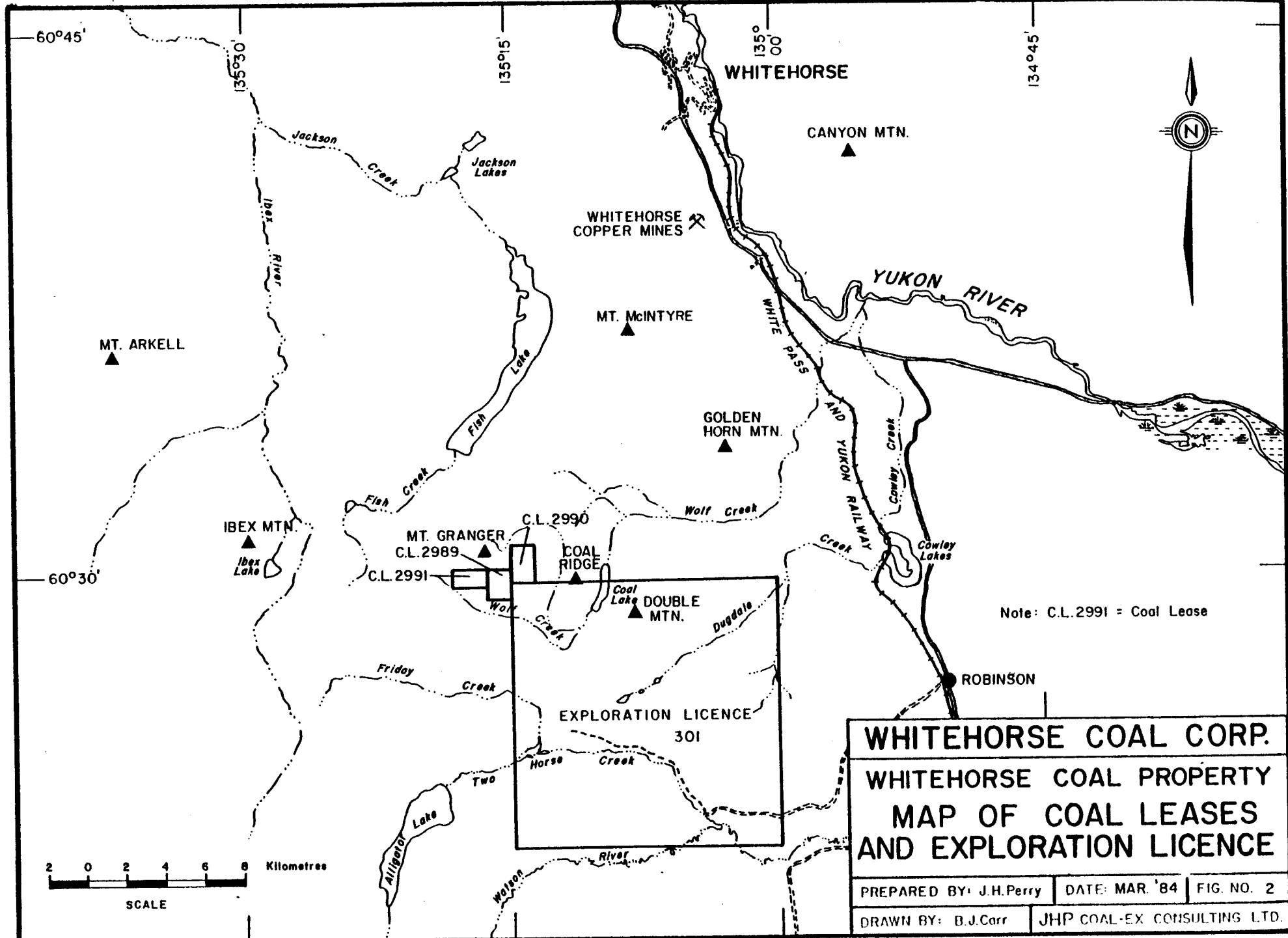
PREPARED BY: J.H.Perry	DATE: MAR. '84	FIG. NO. 1
DRAWN BY: B.J.Carr	JHP COAL-EX CONSULTING LTD.	

## 2.0 LOCATION, ACCESS AND PHYSIOGRAPHY

The Whitehorse Coal Property is located in south-central Yukon between latitudes  $60^{\circ}22'$  and  $60^{\circ}32'N$  and longitudes  $135^{\circ}00'$  and  $135^{\circ}19' W$  (Figure 2). The property is composed of three coal leases and one coal exploration licence. The leases are specifically located to cover coal-bearing strata, but the exploration licence extends over a pre-determined geographical area much of which contains no known coal measures. Consequently, the discussion presented in the remainder of this report will concentrate only on the portion of the property which is the focus of on-going exploration by Whitehorse Coal Corp.

The "exploration area" lies approximately 30 kilometres southwest of Whitehorse where a belt of coal-bearing strata stretches some 15 kilometres from Fish Creek in the northwest to Double Mountain in the southeast. The coal measures held by Whitehorse Coal Corp. extend from Double Mountain to the southwestern flanks of Mt. Granger, and are covered by the coal leases and the northwestern portion of the coal exploration licence.

Vehicle access is provided by a trail which links the exploration area to Whitehorse. This trail was constructed by Whitehorse Coal Corp. in 1982 and is easily travelled by 4-wheel drive vehicles. The trail enters the property along the eastern and southern flanks of Mt. Granger and extends along the southwestern flanks to Fisher Creek. No vehicle access has been established to the Coal Ridge or Double Mountain areas but they are easily reached by helicopter. A trail along the northern banks of Two Horse Creek could provide vehicle access to Double Mountain if it were extended to the northeast. This trail is accessed via the Annie Lake road near the old station of Robinson, 32 kilometres south of Whitehorse.



60°45'

135°30'

135°15'

135°00'

134°45'

WHITEHORSE

CANYON MTN.

WHITEHORSE COPPER MINES

MT. McINTYRE

GOLDEN HORN MTN.

MT. ARKELL

YUKON RIVER

IBEX MTN.

C.L. 2990

MT. GRANGER

COAL RIDGE

DOUBLE MTN.

Note: C.L.2991 = Coal Lease

60°30'

C.L. 2989

C.L. 2991

EXPLORATION LICENCE  
301

ROBINSON

**WHITEHORSE COAL CORP.**  
**WHITEHORSE COAL PROPERTY**  
**MAP OF COAL LEASES**  
**AND EXPLORATION LICENCE**



PREPARED BY: J.H.Perry	DATE: MAR. '84	FIG. NO. 2
DRAWN BY: B.J.Carr	JHP COAL-EX CONSULTING LTD.	

Whitehorse is the capital city and major population centre of Yukon. Consequently, the city is also the major hub of the transportation network for the region. Principal paved and unpaved roads connect Whitehorse with most of the other main population centres in the Territory, while the White Pass and Yukon Railroad and an all-weather road link Whitehorse to port facilities at Skagway, Alaska (Figure 1). This rail line and several major roads lie within 20 kilometres of the exploration area and could be easily reached via the existing trail to Whitehorse or by the construction of roads along Wolf or Dugdale Creeks.

The topography of the region is characterized by steep-sided mountains that rise from broad, fairly flat valleys. The valley floors lie at approximately 1,200 metres while the mountains flatten into gently rolling uplands that range in elevation between 1,500 and 1,900 metres. The highest peak in the immediate area is Mt. Granger at 2,035 metres. The exploration area is divided into three topographic highs by two northeast-southwest trending valleys. These "highs" are referred to as West Hill (which occupies the southwest flank of Mt. Granger), Coal Ridge and Double Mountain. West Hill and Coal Ridge area separated by a southwest flowing tributary of Wolf Creek while Coal Ridge is separated from Double Mountain by Wolf Creek and Coal Lake.

The main drainage in the area is provided by Wolf Creek and its tributaries. Wolf Creek and some of the major tributaries probably run all year, but many of the smaller streams only flow intermittently. Areas of marshy ground are common in the valley bottoms adjacent to the main drainage channels.

Vegetation in the region is largely restricted to grass and buck brush. Stunted spruce and willow are occasionally present on the valley floors or the lower mountain slopes. Present uses of the land in this region are restricted to hunting and trapping.

### 3.0 COAL LEASES AND LICENCES

The property consists of three coal leases and one coal exploration licence which cover an area of 19,987 hectares (49,389 acres). The coal exploration licence comprises the northeast quarter of map sheet 105 D/6, an area of some 19,210 hectares (47,469 acres). The three coal leases each cover an area of approximately 259 hectares (640 acres) and are located along the northwest boundary of the exploration licence. The coal leases and licence which comprise the property are listed below and shown in Figure 2.

<u>Coal Lease/Licence</u>	<u>Hectares</u>
C.M.L. 2989	259
C.M.L. 2990	259
C.M.L. 2991	259
Coal Exploration Licence 301	<u>19,210</u>
TOTAL	19,987

The author has not verified the legal status of the leases and exploration licence. In addition, their location as shown on the drawings which accompany this report has been taken from data believed to be reliable but not personally certified by the author.

#### 4.0 SUMMARY OF EXPLORATION WORK

##### 4.1 Pre-1983 Exploration

Very little information is available on the coal occurrences of the Whitehorse region. Coal was discovered in the Mt. Granger area in 1899 and was first reported by McConnell in 1901. Exploration proceeded and by 1906 the coal measures were reported to have been traced over a strike length of almost 20 kilometres (Cairnes, 1906). At Fisher Creek three seams were known to be present within a 60 metre stratigraphic interval. From lower to upper these seams measured 0.76, 3.15, and 2.95 metres in thickness. Several trenches were excavated and an adit approximately 18 metres in length was driven into the upper seam. In 1908 Cairnes reported four sets of analyses from the Fisher Creek coal seams, one from the face of the adit and three from outcrop. Subsequent to this, however, there is no record in the published literature of any further work, although additional prospecting undoubtedly was undertaken as evidenced by various pits and trenches along the projected outcrop of the coal seams. Taylor (1969) reported that the area was examined in 1942 by the U.S. Army Corps of Engineers who, apparently, brought out a small tonnage for use in Whitehorse that winter. The only other work in the area has been regional studies by the Geological Survey of Canada in the early 1920's and late 1940's.

Luscar Ltd. acquired three coal exploration licences in the area in April, 1969. A reconnaissance program consisting of geological mapping, hand trenching and sampling was carried out that summer under the direction of R.S. Taylor and Associates Ltd. Taylor (1969) was able to locate the old workings in Fisher Creek and trace the coal-bearing section discontinuously over a distance of 10 kilometres. While the lack of outcrop prevented precise seam correlation, Taylor considered that at least one seam was present

within the coal-bearing section over this distance. At Double Mountain and on West and East Hills he found evidence for two coal seams, while at Fisher Creek and north towards Fish Creek, three seams were reported.

Various private groups and individuals have held coal exploration licences in the region since Luscar's work, but none has undertaken major exploration. In 1981, Echo Developers assigned coal exploration licence No. 301 to Whitehorse Coal Corp. The latter group then acquired coal leases 2989 and 2990 in 1982, and lease 2991 early in 1983. Prior to 1983, Whitehorse Coal Corp. constructed access trails and several cat-trenches. Coal quality tests were performed on some samples from those trenches, and the results are discussed in Section 6.0 and presented in Appendices III and IV.

#### 4.2 1983 Exploration Activities

From mid-July to mid-August, 1983, Whitehorse Coal Corp. continued the access trail construction and cat-trench excavation which had begun in 1982, trenching six locations along the southwest flanks of Mr. Granger, from Fisher Creek to East Hill. Three days of reconnaissance were then undertaken by the author during mid-August, 1983. Most of the time was spent prospecting by foot and helicopter in an effort to establish the continuity of the coal seams and to examine the rest of the stratigraphic section for coal seam development. The remainder of the time was spent examining the trenches and collecting samples across the coal-bearing zones. No time was spent examining the portion of the property that contains no known coal measures. Discussion of the reconnaissance is presented with the results of various coal analyses in the sections following and in Appendices I and II.

## 5.0 GEOLOGY

### 5.1 Stratigraphy

Apart from some volcanics and metamorphosed volcanics of uncertain age, rocks contained within the property boundaries are of Mesozoic age. Most of the valleys and low-lying ground are filled or covered by Quaternary alluvium and glacial deposits, however. A general description of the Mesozoic stratigraphy is given in Table 1.

TABLE 1  
STRATIGRAPHY OF THE WHITEHORSE COAL PROPERTY

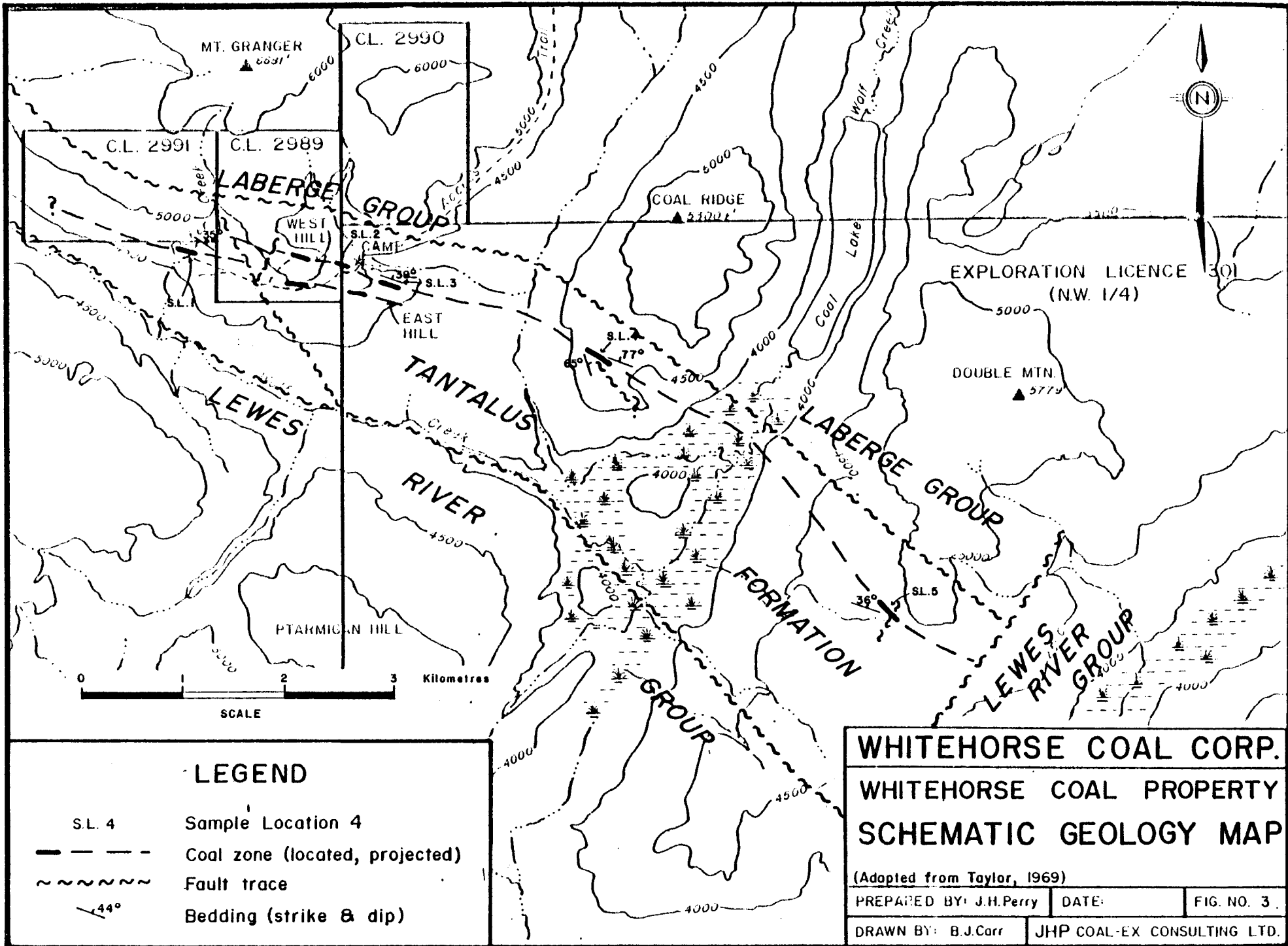
"Period"	Group of Formation	Rock Type
Cretaceous	Coast Intrusions	Granodiorite, granite, quartz monzonite, quartz diorite and allied rocks
Lower Cretaceous and Upper Jurassic	Tantalus Formation	Arkos, siltstone, conglomerate, argillite, COAL
Lower Jurassic and Later	Laberge Group	Greywacke, arkose quartzite, conglomerate siltstone, argillite
Upper Triassic	Lewes River Group	Greywacke, siltstone, argillite, conglomerate, limestone, limestone breccia, andesite, basalt flows and associated pyroclastic rocks.

The non-marine Tantalus Formation is the only coal-bearing sequence. Within the property, the Tantalus strata occupy a fault-bounded wedge, which trends northwest-southeast and abuts against older Laberge and Lewes River Group rocks to the northeast and southwest, respectively. The geology of the coal-bearing portion of the Whitehorse Coal Property is presented in Figure 3.

Plant fossil evidence suggests an early Lower Cretaceous age for the Tantalus Formation in the Whitehorse region. The contact between the Tantalus and Laberge strata is usually unconformable or faulted. To the north however, in the Carmacks area, the Tantalus Formation conformably overlies nonfossiliferous Laberge Group sediments; at this location Upper Jurassic strata may be present in the Tantalus Formation. Consequently, the formation is regarded as Upper Jurassic to Lower Cretaceous in age (Wheeler, 1961).

Little is known about the total thickness of Tantalus sediments within the property due to the lack of detailed studies. Wheeler reported approximately 244 metres of Tantalus strata in a wedge northwest of the exploration area on the eastern side of Ibex River. Taylor (1969) considered the formation to be at least 500 metres thick in the vicinity of West Hill. Approximately 1,500 metres of Tantalus strata are present on the southwest spur of Double Mountain (Figure 3), but Wheeler believed that this section was repeated by folding or faulting.

The Tantalus Formation is a sequence of coarse clastic sediments composed mainly of interbedded conglomerates, arkoses and sandstones with occasional horizons of siltstone, shale and coal. The conglomerates are generally massive and clast size ranges from small pebble to pebble. The clasts vary from rounded to sub-rounded and are composed predominantly of cherts, quartzite and



**LEGEND**

- S.L. 4      Sample Location 4
- — — —      Coal zone (located, projected)
- ~~~~~      Fault trace
- 44°      Bedding (strike & dip)

**WHITEHORSE COAL CORP.**  
**WHITEHORSE COAL PROPERTY**  
**SCHEMATIC GEOLOGY MAP**

(Adopted from Taylor, 1969)  
 PREPARED BY: J.H.Perry      DATE:      FIG. NO. 3.  
 DRAWN BY: B.J.Carr      JHP COAL-EX CONSULTING LTD.

quartz. The matrix of the conglomerates consists of smaller grains of the same lithologies that comprise the clasts, with the addition of sodic plagioclase and white mica. Interbeds of arkose and arkosic sandstone occur throughout the conglomerates and vary from less than a metre to over ten metres in thickness. The conglomerates and arkoses are often highly fractured and generally well cemented; they are the most resistant lithologies within the formation and therefore comprise the major outcrops.

Outcrops of the other lithologies are relatively sparse. However, thick siltstones are exposed on the south-facing slopes of Coal Ridge. Elsewhere, Taylor reported shale units up to 23 metres thick. The shales are usually black and, where associated with coal, often highly carbonaceous and "coaly". In places the shales are somewhat silicified (argillitic). A penetrative cleavage within the shales contributes greatly to their highly friable nature.

Coal has been located throughout the length of the Tantalus wedge. The development of coal-bearing zones within the exploration area is discussed below.

## 5.2 Coal Zone Stratigraphy

The use of the term "coal seam" presents some difficulty in the exploration area, because the coal is usually present within a zone where it is thinly interbedded with other lithologies. Although sections that consist predominantly of coal are present, the precise definition of the roof and floor of any particular coal seam (sensu stricto) is somewhat problematical. Consequently, the term "coal seam" is not used in the following discussion, and those sections of the stratigraphy which contain single or multiple layers of coal are referred to as "coal zones". Although a coal zone may contain one or more coal seams, such definition will have to await future, more detailed work.

The coal zones usually consist of coal and rock bands interlayered on a scale of several centimetres to 0.40 metres. The predominant interbedded rock lithology is a highly carbonaceous, somewhat coaly shale. Other lithologies such as argillite, siltstone and sandstone also occur as thin interbeds within the coal and shale, although at Fisher Creek a siltstone approximately 6 metres thick is present near the base of the exposed portion of the coal zone.

Coal has, at present, only been described from the upper half of the Tantalus Formation in the exploration area. The locations of coal-bearing zones are presented on the Geology Map (Figure 3) along with their projected outcrop traces. One zone links the coal occurrences at Fisher Creek, West Hill, East Hill, Coal Ridge, and Double Mountain. Another zone extends along the base of West and East Hills but has not yet been traced further. These coal zones are referred to as A and B, respectively.

Coal Zone A is equivalent to the seam(s) described by Taylor which extend from Double Mountain to beyond Fisher Creek. A brief summary of each of the occurrences examined by the writer is provided below. Brief descriptions of the sampled sections are included in Appendix I.

- a) Double Mountain The coal zone occupies a gulley approximately 16 metres wide between two thick conglomerate beds. Most of the gulley is waterlogged and marshy but coal bloom is present along both sides (Taylor's two seams). A shallow hand-trench in the bloom along the southern edge of the gulley indicated 1.7+ metres of "coal", (this study). This "coal" is extremely high in ash (see Appendix II) but, because of the very

shallow nature of the trench, some of this ash may result from contamination. Lack of time prevented more substantial trenching or the trenching of the bloom at the top of the coal zone.

- b) Coal Ridge The coal zone again occupies a steep-sided gully between two conglomerate beds. Coal bloom was located along the stratigraphic base of the section (southern edge) where Taylor described finding approximately 1.8+ metres of "coal seam". The structural relationship here may be somewhat more complicated than at Double Mountain, however, as indicated by a significant change in strike between the conglomerates and adjacent beds to the south.
- c) East Hill This occurrence is similar to the two previous locations in that the coal zone lies in a shallow gully between two conglomerate beds. A cat-trench on the top of the hill only adequately exposed a portion of the upper part of the coal zone, where 1.0+ metres of crushed coal and shale lie beneath a 1.5 metre layer of shale (with coal), which in turn is overlain by conglomerate.
- d) West Hill The coal zone is exposed in trenches on the southeast side and crest of the hill. The best exposure is in the trench at the base of the hill near the camp, where 2.55 metres of coal and carbonaceous shale are overlain by between 0.30 and 0.75 metres of black siliceous shale, which in turn is overlain by conglomerate. This coaly section is also underlain by black siliceous shale. The lower conglomerate was not visible. This occurrence is very similar to that described by Taylor from his trenches higher on the slope where a 2 metre "coal seam" was exposed.

The trench on the crest of West Hill is similar to that described for East Hill. Once again the coal zone is defined top and bottom by conglomerate beds.

- e) Fisher Creek At this location Taylor described three "coal seams" dipping regularly to the northeast over a 60 metre stratigraphic interval which was topped by a thin shale band and then conglomerate. The seams reported by Taylor are undoubtedly the same as those described by Cairnes (1906) even though there are some slight differences in seam thicknesses.

However, a recently excavated trench on the northwest bank of the creek indicated that the section is complicated by a large fold and a minor fault (see Section 5.3). It would appear that coal occurrences southwest of the fold axis (Taylor's and Cairnes' lower and middle seams?) may be overturned portions of the coal zone section exposed in the trench.

This trench provides the best coal zone exposure on the property. The coal-bearing section is overlain by one metre of shale which is, in turn, overlain by conglomerate. Time did not permit the detailed logging of this, or any, of the trenches, and the descriptions that were made recorded only the gross lithological nature of the exposed sections (see Appendix I). However, the coal zone at Fisher Creek can be summarized as:

Shale and Coal Sequence	8.5 metres
Siltstone	6.0 metres
Shale and Coal interlayered with Siltstone and Shale	3.5 metres

The lower shale/coal and siltstone/shale sequence lies at the core of an anticline and, hence, the base of the coal zone is not exposed.

Taylor (1969) estimated the true thickness of strata between the conglomerates on Double Mountain, Coal Ridge, East Hill and West Hill (Coal Zone A of this report) to be between 15 and 18 metres. While no more precise measurements were taken by the author, this estimate appears to be somewhat thick for East and West Hills. The thickness of Coal Zone A strata above the anticline at Fisher Creek is approximately 18 metres (this study). The estimate of 60 metres by Taylor appears to have included structurally repeated strata.

Coal Zone B does not appear to have been described by either Cairnes or Taylor and, as such, represents a new discovery. It is only exposed at one site, in a trench adjacent to the main access road on the southwest slope of West Hill. There, it is exposed in a face approximately 2.5 metres in height and dips into the hill at approximately 40°. There are no outcrops immediately above or below the trench. Coal Zone B is projected to the southeast along the base of East Hill where coal bloom is present alongside a small lake. It is not known whether Coal Zone B is stratigraphically separate, or is a structural repetition of Coal Zone A.

Two other small patches of coal bloom were found on the upper, southwest slopes of East Hill between Coal Zones A and B. These were marked for later trenching to be performed by Whitehorse Coal Corp. personnel.

### 5.3 Structure

Tantalus Formation strata of the Whitehorse Coal Property comprise a fault-bounded wedge on the western limb of the Fish Lake syncline. This wedge trends northwest-southeast and is downfaulted between older Laberge Group sediments to the northeast and Lewes Group rocks to the southwest. The coal measures are, in general, characterized by moderate to steep ( $30^{\circ}$ - $60^{\circ}$ ), north-northeasterly dips, but variations to this trend occur due to localized deformation. The general geological structure of the exploration area is presented in Figure 3.

Taylor reported that some beds dip up to  $80^{\circ}$  while others dip to the northwest and southwest, but provided no description or explanation of the structures that account for these variations. The only structure that appears on his map of the exploration area (Map II) is a faulted fold, postulated to explain an apparent offset in coal seam outcrop projection, between Fisher Creek and West Hill. While this structure is retained on the Geology Map presented in this report, it is as Taylor (p. 10) states "... probably not the correct solution." Indeed, there is a possibility that the coal zone exposed at Fisher Creek is an extension of Coal Zone B.

Two mesoscopic-scale folds were found by the author; one at Fisher Creek and the other due west of West Hill. Both folds are anticlines (on the assumption that the strata to the northeast are right-way-up). At the southern end of the cat-trench at Fisher Creek, the first anticline is exposed in a 5 metre high cut-bank. This fold is defined by a series of shale/coal layers interbanded with shale/siltstone beds. The fold axis plunges (gently?) northwesterly while the axial plane dips steeply northeast. The beds forming the northeastern limb dip between  $32^{\circ}$ - $45^{\circ}$  northeast

while the southwest limb is vertical to overturned. This relationship suggests that coal zones further down the creek, indicated by coal bloom in the creek bank, are inverted. Some tectonic thinning of the coaly layers on the limbs of this fold, accompanied by thickening in the hinge zone was observed. The second anticline is located at the junction of two steep-sided gulleys, one trending northwest and the other northeast, approximately 300 metres due west of the top of West Hill. This fold is defined by two beds of conglomerate which dip steeply to the northeast and southwest. The hinge zone was not observed but it may well be disrupted by minor faulting as the conglomerate contained many sub-vertical shear planes. The fold axis trends northwesterly.

Other minor structures are evident where the coal zones are exposed by trenching. These "flow-type" structures are indicative of strong deformation resulting from the squeezing of the coal zone lithologies between the more competent conglomerates and arkoses. Such deformation can produce rapid changes in thickness of individual lithologies within the coal zone although the overall thickness of the zone may remain relatively constant. Alternatively, the coal zones can be squeezed into lenses or pods such that they will pinch out in some places and become greatly thickened in others. Almost all of the Tantalus lithologies exhibit a cleavage. This cleavage usually maintains a high angle to the bedding and is pervasive throughout the shale units and coal zones. Within the more competent lithologies, the cleavage planes are more widely spaced.

Little is known about the faults which define the boundaries of the coal measures. They were not examined in any detail by Taylor, nor during the reconnaissance by the author. Two faults have been postulated by Taylor and this author to account for apparent bed displacements between West Hill and Fisher Creek,

but neither of the structures has been confirmed. The fault proposed by Taylor has been referred to previously in the discussion on folding, while that proposed by the author occupies a steep-sided gully which trends northeast across the strike of the beds (Figure 3).

Observations made by the author on Coal Ridge also indicate structural disturbance at or just below the base of Coal Zone A. This is suggested by the extremely steep dips of the lower conglomerate ( $60^{\circ}$  to  $80^{\circ}$ ) and a distinct variation in strike in the adjacent, structurally lower (southwestern) beds. The strike of the conglomerates that define the top and bottom of the coal zone is the same as the regional trend, N.  $110^{\circ}$ . However, below the coal zone the strike varies between N.  $140^{\circ}$  to N.  $160^{\circ}$ . It is proposed that this variation be explained by the presence of a fault (see Figure 3) although, again, this needs to be confirmed.

Minor faults were observed to cut Coal Zone A on Double Mountain, East Hill and at Fisher Creek. On Double Mountain two high-angle faults are well defined by offsets in the lower conglomerate (see also Taylor, 1969, Figure 3). These faults displace the floor of the coal zone by approximately 3 metres along the direction of the dip. A similar fault was observed in the trench on East Hill. There, however, the fault was in the roof of the coal zone and the displacement was approximately 1 metre. At Fisher Creek a normal fault cuts through the coal zone a few metres northeast of the anticline. The fault plane strikes to the northwest and dips between  $50^{\circ}$ - $60^{\circ}$  to the southwest; the throw on the fault is approximately 3 metres.

## 6.0 COAL QUALITY, RESOURCE AND UTILIZATION POTENTIAL

Although the presence of coal in the Mt. Granger area has been known since the early 1900's, it is evident from the preceding sections that very little detailed information is available upon which to base meaningful estimates of coal resources and quality. The problem is further complicated by observations made during the recent reconnaissance regarding the highly interbedded nature of the coal-bearing zones and the resulting difficulty in precise definition of the roof and floor of any particular coal "seam". Some generalized comments relating to the quality and resource potential are, however, presented below.

### 6.1 Coal Quality

The data used to evaluate the quality of coal from the Whitehorse Coal Property has come from this study, earlier work commissioned by Whitehorse Coal Corp., Taylor (1969) and Cairnes (1908). Most of the samples have been obtained from trenches excavated across Coal Zone A. The majority of these samples have undergone basic analytical tests such as proximate, sulphur and heat content determinations, while others have been subjected to washability testing and petrographic analysis. The detailed analytical data for samples taken during the 1983 reconnaissance are presented in Appendix II. The petrographic and coal washability tests comprise Appendix III and a summary of the data reported by Cairnes and Taylor form Appendix IV.

The results of these analyses indicate that the coal is of anthracite to meta-anthracite rank. The samples are high, to extremely high in ash but exhibit low sulphur content.

Examination of the data presented in Appendices II and IV shows that the samples taken by the author are, in general, higher in ash than those taken by Taylor and substantially higher than those taken by Cairnes. It is not possible to make a direct

comparison between the various results as there is no way of correlating the sample intervals of one worker to those of another. The analyses of the samples taken by the author are, however, considered to be the most reliable as they represent channels through as much of the coal-bearing portions of the coal zones as were exposed at the various localities (except on Coal Ridge). The somewhat lower ash values of Taylor are explained by the fact that in most of his samples he omitted "in-seam" rock bands. It is suspected that the relatively low ash values reported by Cairnes from Fisher Creek are also due to a similar selection of sampled material. Taylor believed that his samples contained more ash than those of Cairnes because they were taken from shallower trenches. While samples obtained from near the surface are subject to oxidation and could exhibit rock-particle contamination or concentration, these effects are considered insufficient to explain the magnitude of difference between their ash values. It should be noted, however, that samples obtained by the author from Coal Ridge and Double Mountain were from a shallow pit and shallow trench, respectively, and thus the excavation of deeper trenches in these areas may provide samples which contain slightly less ash. The samples obtained from Fisher Creek and West Hill were from bed-rock exposed by cat-trenches, and although those samples are considered to be representative of the exposed sections, the friable nature of the coal-zone lithologies made careful and precise sampling somewhat difficult.

For samples taken by the author, on an air-dried basis, moisture contents vary between 1.70% to 6.52%, ash values are between 38.62% and 74.40% and the sulphur content is consistently less than 0.5%. Calorific values were only determined for samples with a dry ash content of less than 65%. Two samples (Fisher Creek 4 and 6) with dry ash contents of approximately 41% contain 7836 and 7474 Btu/lb. Five other samples with dry ash contents between

59.79% and 65.14% have dry calorific values ranging between 3222 and 4092 Btu/lb. Fisher Creek sample #1 has dry ash and calorific contents of 62.54% and 3222 Btu/lb, respectively. The latter value is rather low in comparison to samples of similar ash content (by some 600 Btu) and this rather anomalous result is considered to be due to incomplete combustion of the coal on testing, a phenomenon which is prevalent in the laboratory testing of high-ash coal. Regression analysis indicates a calorific value of 1463 Btu/lb for the sample with the highest ash content (Fisher Creek #2, 76.39%).

The rank of the coal was first established by Cairnes (1908) from determinations of the fixed carbon and volatile matter content. Recent petrographic analyses have confirmed the high rank of this coal. Dr. M. Bustin (University of British Columbia) considers the coal to be of meta-anthracite rank based on mean maximum vitrinite reflectances of 3.64 to 4.52. Somewhat higher values between 3.74-5.00 were obtained by Dr. F. Goodarzi (Geological Survey of Canada) on samples from the same localities. Stach et al. (1975, Table 4) consider that coal exhibiting similar reflectance values is of anthracite rather than meta-anthracite rank. Application of the Parr Formula to the proximate analyses, for rank determination by the ASTM method, suggests that the coal varies from low-volatile bituminous to anthracite rank. This variability, however, is accounted for by the fact that the Parr Formula does not work well for coals with high ash contents. Two samples were tested for % CO<sub>2</sub> in the coal to see if carbon dioxide contributed to the relatively high volatile content; those samples emitted only small amounts of CO<sub>2</sub>, however.

The samples selected for petrographic analysis were obtained from Fisher Creek (samples 1 and 2) and the top of West Hill (sample 3). Both Bustin and Goodarzi concluded that the anthracitic rank of the coal in this area results from thermal

alteration of lower rank coal due to igneous intrusions in the stratigraphic sequence. Bustin attributed the higher reflectances of samples 1 and 2 to closer proximity to the heat source than sample 3. It is interesting to note that Taylor (1969, Map II) mapped a small intrusion approximately 1.4 kilometres northwest of the Fisher Creek sample locations.

Ash and calorific values reported by Bustin range from 34.1% to 43.2% and 9650 Btu/lb to 7452 Btu/lb, respectively. Bustin noted that the ash might be difficult to remove from the coal as much of it is highly disseminated in the organic fraction. As a result of Bustin's observations a series of washability tests were commissioned by Whitehorse Coal Corp. These tests were undertaken by Cyclone Engineering Sales Ltd. and their report is included in Appendix III. Unfortunately, it is not known precisely where the samples were taken or what part of the coal zone was sampled; however, the tests do show how the trends of the washability curves vary for coals of approximately 62.5% and 43% ash content. The results suggest that beneficiation of the coal by water-only or heavy-media cyclones would be impractical due to the very small yields obtainable and to the large amounts of discard material that would be generated. Additionally, heavy-media cyclones would have to operate near their specific gravity limit (around 1.75) and would at best (sample 3) recover no more than 37% of material with an ash content of 17% (dry basis).

## 6.2 Resources

Two coal zones have been identified within the Tantalus Formation of the Whitehorse Coal Property. While both have not been proven to exist throughout the entire exploration area, one (Coal Zone A) has been traced discontinuously over a distance of almost 10 kilometres. Taylor calculated a recoverable reserve of 2.386 million tonnes for the area between Double Mountain and a

point approximately one kilometre west of Fisher Creek, an area approximately equivalent to the exploration area. He stated that 0.82 million tonnes were available from Double Mountain, 0.27 million tonnes from Coal Ridge and 1.30 million tonnes from West Hill - Fisher Creek. These reserves were based on a single 1.83 metre coal "seam" with a specific gravity of 1.58 and a mining recovery factor of 50%. The estimates were made to the elevation of the valley bottoms and did not, therefore, include any coal extending beneath the valleys or deeper than the valley floors in any of the so-called reserve "areas". Even with these stated factors and conditions, it is difficult to duplicate the tonnage estimates of Taylor.

For the purposes of the following discussion, the term "resource" is used to denote the total in situ tonnage which is available for mining. The term "reserve" is not used as it is now usually restricted to tonnages which are economically recoverable.

As stated above, the tonnage estimates of Taylor were based on a single 1.83 metre "seam". The best coal sections sampled during the reconnaissance program were over 1.75 and 1.30 metres (Fisher Creek samples 4 and 6, Appendix II). If these two sections are projected over a strike length of 10 kilometres with a down-dip extension of 500 metres, and they are assigned a specific gravity of 1.70, then the total in situ resource is approximately 26 million tonnes. Based on the analyses of these coal sections, this resource can be expected to have dry ash and heat contents of approximately 40% and 7,700 Btu/lb, respectively.

A substantially greater coal resource may be estimated for the property if effective utilization can be found for very high-ash coal. Discussions with coal combustion engineers have indicated that coal from the Whitehorse property would best be utilized by

the fluidized-bed combustion process which is well suited to coals with high ash contents. Indeed, successful trials have been undertaken with fluidized-bed units on coals of up to 60% ash content. In light of this, if the total sampled section of Coal Zone A at Fisher Creek extends the length of the exploration area then, for an 8.5 metre thickness at 59.25% dry ash and 4400 dry Btu/lb, there is a potential in situ resource of 85 million tonnes (assuming a specific gravity of 2.00). If the most ash-rich sections at Fisher Creek are omitted (samples 1, 2 and 3) then samples 4, 5 and 6 would provide a continuous section of 5.05 metres at dry ash and heat content values of 50% and 6000 Btu/lb, respectively; at an assigned specific gravity of 1.86, this would represent a potential in situ resource of 47 million tonnes. These estimates do not take into account any increase in the resource due to structural repetition of Coal Zone A or the inclusion of Coal Zone B. When these two factors are taken into consideration, there could be a further substantial increase in the in situ resource base of many millions of tonnes.

In addition to the potential outlined above, it is possible that coal may have been tectonically thickened to form pods in the hinge zones of major folds. Some thickening of coal-bearing units is evident in the anticline at Fisher Creek. The disharmonic folding present in the coal zone at this and other locations indicates that the coal zones have undergone intense deformation. Hill (1982, pers. comm. 1983) described similar structures and behaviour of coal in the Tantalus Formation from Carmacks, 200 kilometres to the north. There, low levels of production were obtained by modified room-and-pillar techniques from coal seams dipping at 45° in the Tantalus Butte Mine. In a nearby small open-pit, Hill reported the presence of coal that was greatly thickened in fold cores and attenuated on fold limbs. Elsewhere in the Carmacks region, Tantalus coal seams are lenticular and vary

laterally in thickness and quality due to sedimentological considerations. If similar depositional environments for coal existed in the Mt. Granger area, there is a possibility for the presence of better quality coal.

Most of the coal resource of the Whitehorse Coal Property would only be amenable to underground mining. Taylor considered that there was no potential for open-pit mining in this area. However, several millions of tonnes (based on a mining thickness of 5 metres) could be available to open-pit mining if a major anticline is confirmed in the Fisher Creek area. Additional tonnage could also be obtained by the mining of small pits along the trend of the outcrop/subcrop.

### 6.3 Utilization

Although further work is needed to define potentially mineable sections within the coal zones and to precisely determine the physical-chemical properties of the coal, preliminary consideration has been given to the potential use of coal mined from this property. Existing data suggests that substantial reduction of the ash content by sophisticated wash-plant facilities may be impractical. Consequently, the most likely product will be a high ash (greater than 40%) anthracite. The strongest potential market lies in Yukon itself. Significant interest has already been expressed in purchasing coal for domestic and industrial heating, but the greatest potential lies with mine-mouth power generation using fluidized-bed combustion. This is an attractive scenario should metal mining go into full swing in this region of the Territory, as existing power supply may not be able to meet the demand. Should sufficient reserves be established to support a power station, the property is extremely well placed with regard to infrastructure requirements.

At this time it is difficult to foresee export potential to Pacific Rim markets for this coal. However, if sufficient reserves of cleaner (say 15% - 30% ash) coal could be established, the possibility would exist. Here again, the property is very well located with regard to rail and road access to port facilities at Skagway, Alaska, less than 150 kilometres away.

## 7.0 CONCLUSIONS AND RECOMMENDATIONS

The Whitehorse Coal Property contains known coal measures which, to date, have seen only limited exploration efforts. Recent petrographic testing on a small number of samples indicated that the coal is of anthracite to meta-anthracite rank. Precise definition of coal seams has proven difficult due to the highly interbedded nature of the coal and associated carbonaceous shales. Consequently, the coal-bearing sections are high in ash; sulphur content, however, is low (less than 0.5%). The total in situ coal resources for one coal zone (Coal Zone A) are estimated to range between 26 to 85 million tonnes. The former tonnage is based on two separate coal sections of 1.75 and 1.30 metres thickness each with dry ash and heat contents of approximately 40% and 7700 Btu/lb, respectively. The latter tonnage is based on one 8.5 metre section with 50% dry ash and 4400 dry Btu/lb. A continuous 5.05 metre section which omits the highest-ash portions of Coal Zone A generates an estimated resource of 47 million tonnes at 50% dry ash and 6000 dry Btu/lb. These estimates make no allowance for additional tonnage due to structural repetition of Coal Zone A, nor do they include estimates for tonnages contained in the recently discovered Coal Zone B.

Despite the work performed to date, the property must still be considered at the grass-roots stage in terms of its overall potential. Future work will need to include detailed mapping, drilling, sampling and testing to substantiate the concept of widespread coal development, establish the overall coal quality and identify areas favourable to mining. Such work should focus on the following:

- 1) Identify specific coal seams or mining sections and establish their lateral continuity.
- 2) Conduct extensive and careful sampling of all the coal-bearing sections.
- 3) Clarify the overall structural geology with particular emphasis in the Fisher Creek and Double Mountain areas.

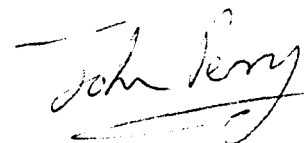
- 4) Trace Coal Zone B and clarify its status with respect to Coal Zone A; is it stratigraphically distinct, or is it a repetition of Coal Zone A?
- 5) Confirm that the coal in the Coal Ridge and Double Mountain areas is anthracite.
- 6) Explore for pods of structurally thickened coal, and for thick lenses of better quality (lower ash) coal within the coal zones.

A comprehensive program which would enable a preliminary evaluation of the whole exploration area and which would include conceptual engineering as well as exploration work and coal testing, would cost in the order of \$1.5 million. Such a program could be staged so that funds are allocated dependent upon results.

Further consideration should be given to reducing the area held under the coal exploration licence, so that only the coal measures are covered. Extra coal leases should be acquired in the Mt. Granger area along the northeastern side of Wolf Creek, to cover additional coal-bearing strata. Also, it appeared to the writer that the trenches at Fisher Creek may lie just south of the existing coal leases.

Assuming the only coal produced from this property is high in ash (as the preliminary analyses indicate) the primary market would be within Yukon itself. Opportunities exist for supplanting oil for domestic and industrial heating. The greatest potential, however, lies with power generation at or near the mine. A fluidized-bed combustion plant, able to burn high-ash coal would have greater coal resources available to it than would a more conventional power plant.

It is concluded, therefore, that the property represents a reasonable target for continued exploration.



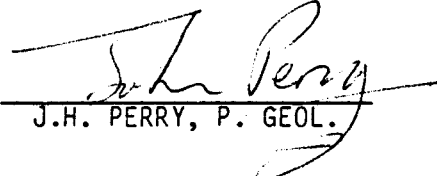
8.0 REFERENCES

- Bostock, H.S.  
1957: Yukon Territory; Geol Surv., Canada, Mem. 284
- Cairnes, D.D.  
1906: Exploration in a portion of the Yukon, south of Whitehorse; Geol. Surv., Canada, Summ. Rpt. 1906, p. 22-30 (Reprinted in Bostock, 1957)
- 1908: Report on a portion of Conrad and Whitehorse Mining Districts; Geol. Surv., Canada, Pub. No.982 (Reprinted in Bostock, 1957)
- Hill, R.P.  
1982: Various short reports (4) to Whitehorse Coal Corp. Dated April 17th, Sept. 3rd, Oct. 24th and Nov. 3rd, 1982. Unpublished.
- McConnell, R.G.  
1901: Exploration of the Stewart River from its mouth to the Fraser Falls, the Yukon between Stewart and Cliff Creek, and the Whitehorse copper deposits, Yukon; Geol. Surv., Canada, Summ. Rpt., 1900. (Reprinted in Bostock, 1957)
- Stack, E., et al  
1975: Coal Petrography; Berlin etc., Gebruder Borntraeger
- Taylor, R.S.  
1969: The Whitehorse Coal Area, Yukon Territory, For Luscar Limited., Unpublished.
- Wheeler, J.O.  
1961: Whitehorse map-area, Yukon Territory: 105 D; Geol. Surv., Canada, Mem. 312

9.0 CERTIFICATE

I, J.H. Perry, do hereby certify:

1. That I am a consulting geologist with a business office at 806, 402 West Pender Street, Vancouver, British Columbia, V6B 1T6, and am President of JHP COAL-EX CONSULTING LTD.
2. That I hold a B.Sc.(Hons.) degree in Geology from Exeter University (1972) and that I undertook post-graduate study at the University of Calgary (1972-1976).
3. That I am a Registered Professional Geologist in the Association of Professional Engineers, Geologists and Geophysicists of the Province of Alberta.
4. That I am a Member of the Canadian Institute of Mining and Metallurgy, an Associate Fellow of the Geological Association of Canada and a Fellow of the Geological Society (London).
5. That I have practiced my profession as a geologist for the past eight years.
6. That the information, opinions and recommendations in the attached report are based solely on a brief reconnaissance of the property and on research of published and private geological maps and reports.
7. That I own no interest in the subject property nor in the shares or securities of Whitehorse Coal Corporation.
8. This report may only be duplicated in whole or in part on written consent of JHP COAL-EX CONSULTING LTD.

  
J.H. PERRY, P. GEOL.



APPENDIX I  
Generalized Description of Sampled Sections  
- 1983 Reconnaissance

The descriptions provided below only describe the gross lithological character of the sampled sections. Detailed descriptions were not made due to time considerations and the highly interbedded nature of the coal-bearing units.

Sample Location 1 - Fisher Creek

The upper part of the Coal Zone A is exposed along a cat-trench approximately 50 metres in length.

True Thickness (m)

Lithology

	Conglomerate bedding N125°/35°NE
1.00	Shale: - dark grey, carbonaceous. Silicified. Shattered due to cleavage.
0.65	Shale (with coal): - <u>Sample #1</u> , dark grey, highly carbonaceous with much coal powder from thin coal bands.
0.80	Shale (with coal): - <u>Sample #2</u> , dark grey, carbonaceous. Not coaly in top half but has approx. 0.10m coaly band just below centre followed by a 0.15 metre orange-red, highly weathered sand unit. Carbonaceous shale at base.

continued on next page

Sample Location 1 - continued

True Thickness (m)

Lithology

- 2.00 Shale and Coal: - Sample #3, interbedded shale and coal. Have highly carbonaceous shale with many bands of bright, sheared and pulverized coal. Interbedded on scale of 0.01 to 0.15m. Have approx. 0.25 coal band at centre and a 0.10m band of argillite approx. 0.40m above base.
- 1.75 Coal and Shale: - Sample #4, interbedded coal and highly carbonaceous, coaly shale.
- 2.00 Shale (with coal): - Sample #5, as before - has 0.15m orange weathered sand at top.
- 1.30 Coal and Shale: - Sample #6, interbeds of coal and carbonaceous to coaly shale, as before. Has some thin siltstone bands.
- 6.00 Siltstone: - med. grey, massive. Bedding, N.115/32<sup>0</sup>NE
- Normal Fault - approx. 3m throw, repeats siltstone
- 3.50 Below the siltstone are a series of shale/coal and shale/siltstone units which total approx. 3.5 metres. These define an anticline (see Section 5.3). Bottom of coal zone not seen.

Sample Location 2 - Southeast base of West Hill near camp.

The upper part of Coal Zone A is exposed in a cat-trench most of which had sloughed in.

True Thickness (m)

Lithology

	Conglomerate: - Beding N.100/42 <sup>0</sup> N
0.30 to 0.75	Shale: - dark grey, carbonaceous in places with some very thin coal bands. Siliceous. Intensely deformed under conglomerate. Shattered due to cleavage.
1.87	Coal and Shale: - <u>Sample #8</u> , thin interbeds of coal and highly carbonaceous to coaly shale. Has soft, yellowy clay-silt band approx. 0.25 thick near centre.
0.68	Shale (with coal): - <u>Sample #9</u> , as above but with more shale.
	Shale: - similar to the shale that underlies the conglomerate.
	Bottom of coal zone not seen.

Sample Location 3 - East Hill

The upper part of Coal Zone A is exposed in a cat-trench. Samples were taken but, as this trench exposes the same part of the coal zone as at S.L. 2, the samples were not sent for analysis.

---

Sample Location 4 - Coal Ridge

A grab sample was obtained from a 1.5 metre deep pit near the base of the coal zone. Sample #7.

---

Sample Location 5 - Double Mountain

A sample was obtained from a very shallow trench in coal bloom near the base of the coal zone.

True Thickness (m)

Lithology

	Upper portions of coal zone are mainly covered.
0.53+	Shale: - medium grey, silty. Occasional thin coal bands.
1.68+	Shale and Coal: - <u>Sample #10</u> , mixed debris of shale and coal. Need to establish proper trench at this site.
3.5	Covered interval (approx. 3.5 metres)
	Conglomerate: - bedding N.110/36 <sup>0</sup> N. Two dip-faults present with throws of approx. 3 metres (see Section 5.3).

APPENDIX II  
1983 Trench Sample Analyses



# GENERAL TESTING LABORATORIES

A Division of SGS Supervision Services Inc.

1001 EAST PENDER STREET VANCOUVER, B.C. CANADA V6A 1W2  
PHONE (604) 254-1647 TELEX 04-507514 CABLE ADDRESS: SUPERVISE

## CERTIFICATE OF ANALYSIS

WHITE HORSE COAL CORP.  
Attn. MR. P. POGGENBERG  
6198 6TH AVE - WHITE HORSE  
YUKON TERRITORY - Y1A 1N9

NO 8311-2911-C  
FILE  
DATE DECEMBER 14TH, 1983

WE HEREBY CERTIFY TO HAVE ANALYZED THE SUBMITTED SAMPLES  
AS FOLLOWS :

NO	SAMPLE DESCRIPTION	BASIS	R.M. %	ASH %	V.M. %	F.C. %	SULFUR %	C.V. BTU/LB
1	FISHER CREEK 1	AIR DRY DRY	5.58 -	59.05 62.54	14.75 15.62	20.62 21.84	0.15 0.15	3042 3222
2	FISHER CREEK 2	AIR DRY DRY	2.61 -	74.40 76.39	8.84 9.08	14.15 14.53	0.05 0.06	- -
3	FISHER CREEK 3	AIR DRY DRY	2.98 -	66.99 69.05	9.76 10.06	20.27 20.89	0.15 0.15	- -
4	FISHER CREEK 4	AIR DRY DRY	3.40 -	39.22 40.60	8.58 8.88	48.80 50.52	0.27 0.28	7570 7836
5	FISHER CREEK 5	AIR DRY DRY	1.70 -	58.77 59.79	10.23 10.41	29.30 29.80	0.16 0.17	3899 3966
6	FISHER CREEK 6	AIR DRY DRY	5.02 -	38.62 40.66	13.34 14.04	43.02 45.30	0.25 0.26	7099 7474
7	COAL RIDGE	AIR DRY DRY	4.36 -	62.30 65.14	14.59 15.25	18.75 19.61	0.40 0.41	3794 3967
8	WEST HILL TRENCH A	AIR DRY DRY	6.52 -	56.93 60.91	14.01 14.99	22.54 24.10	0.16 0.17	3825 4092
9	WEST HILL TRENCH B	AIR DRY DRY	3.61 -	70.59 73.23	11.36 11.78	14.44 14.99	0.11 0.12	- -
10	DOUBLE MOUNTAIN	AIR DRY DRY	2.23 -	62.37 63.79	12.96 13.26	22.44 22.95	0.15 0.15	3811 3898

THIS COMPANY ACCEPTS NO RESPONSIBILITY EXCEPT FOR THE DUE PERFORMANCE  
OF INSPECTION AND/OR ANALYSIS IN GOOD FAITH AND ACCORDING TO THE RULES  
OF THE TRADE AND OF SCIENCE

L.M. LAKOSIL - CHIEF CHEMIST, Coal div.

SIGNATURE AND TITLE

Analytical and Consulting Chemists, Bulk Cargo Specialists, Surveyors, Inspectors, Samplers, Weighers

MEMBER American Society For Testing Materials • The American Oil Chemists Society • Canadian Testing Association  
REFEREE AND OR OFFICIAL CHEMISTS FOR Vancouver Merchants Exchange • National Institute Of Dried Products • The American Oil Chemists Society  
OFFICIAL WEIGHMASTERS FOR Vancouver Board Of Trade • Vancouver Merchant Exchange



# General Testing Laboratories

A Division of SGS Supervision Services Inc.

1001 East Pender Street,  
Vancouver, B.C. Canada V6A 1W2  
Telephone: (604) 254-1647 Telex: 04-507514 Cable: Supervise

TO:  
COAL-EX CONSULTING LTD.,  
Suite 312, 525 Seymour St.,  
Vancouver, B.C. Canada  
V6B 3E7

## CERTIFICATE OF ANALYSIS

No.	DATE:
FILE: 8402-0150 C	Feb. 22, 1984

WE HEREBY REPORT the analysis of the submitted samples  
as follows:

ANALYSIS (results on Air Dry Basis)

SAMPLE NO.		CO <sub>2</sub>	Calorific Value BTU/lb.
6	FISHER CREEK 6	0.05%	----
7	COAL RIDGE	-----	3794
10	DOUBLE MOUNTAIN	0.04%	----

LL:at

Bie Ong,

THIS COMPANY ACCEPTS NO RESPONSIBILITY EXCEPT FOR THE DUE PERFORMANCE  
OF INSPECTION AND/OR ANALYSIS IN GOOD FAITH AND ACCORDING TO THE RULES OF  
THE TRADE AND OF SCIENCE

for: L. Lakosil, Chief Chemist, Coal Div.

SIGNATURE AND TITLE

APPENDIX III  
Coal Petrography and Washability Data

R.M. Bustin,  
Dept. Geological Sciences,  
University of British Columbia,  
Vancouver, B.C.  
V6T 2B4  
Oct. 4/82

Whitehorse Coal Corp.  
6198 6th Ave,  
Whitehorse,  
Yukon  
Y1A 1N9

Dear Sirs:

Mr. Rod Hill of the Yukon Dept. of Mines has requested on your behalf that I provide some specific analytical analysis and opinions on three coal samples provided by him. I have herein provided a short report on these samples addressing each of Mr. Hills queries and I have enclosed an invoice covering the cost of the investigation.  
It has been a pleasure being of service to you.

Yours sincerely

  
R.M. Bustin

xc: Rod Hill

Report on Three Coal Samples Provided by  
Mr. Rod Hill

The three samples were analysed microscopically and the moisture, ash and calorific values obtained.

Sample 1.

Heating value= 22439 kj/Kg (9650 BTU/lb)  
Ash= 34.1%  
Moisture= 4.0%  
Mean Max, Vitrinite Reflectance= 4.52 ± 0.17 %

Sample 2.

Heating value= 19526 kj/Kg (8396 BTU/lb)  
Ash= 37.4%  
Moisture= 3.9%  
Mean Max. Vitrinite Reflectance= 4.34 ± 0.15 %

Sample 3.

Heating value= 17330 kj/Kg (7452 BTU/lb)  
Ash= 43.2%  
Moisture= 2.6%  
Mean Max. Vitrinite Reflectance= 3.64 ± 0.24 %

Coal Rank

Based on mean maximum vitrinite reflectance all three coals would be classified as meta-anthracites using correlations established between reflectance and rank. Samples 3 and 2 have a coke like micro-structure suggesting they may have been heated for short durations at high temperatures possibly as a result of igneous intrusion or frictional heating. If all three samples are from the same location then the higher reflectance of samples 1 and 2 maybe attributed to closer proximity to the heat source or localized frictional effects.

Heat Content

The heat content of the coal samples was determined on a moist bases (air dry only). The low values obtained for coal of this rank is a result of the high ash content.

Oxidation

The three samples show no evidence for oxidation. Massive samples rarely show evidence of oxidation. The finer fraction of the coal at the same location may still be oxidized.

## Occurance of Ash and Possibility of Cleaning

---

Much of the ash is finely disseminated in the organic fraction and will be difficult to remove without fine crushing. A relatively economic water only cyclone may clean the coal to the required 15 to 20% ash but the total coal yield will likely be low. A dense medium cyclone would give better clean coal yields but at greater expense. Quantification of coal yields using any particular method will require obtaining and sending representative samples to a commercial lab set up for coal preparation analysis.

Because of the high ash content of the coal it can be expected that any amount of cleaning will markedly increase the value of the product for heating.



Energy, Mines and  
Resources Canada

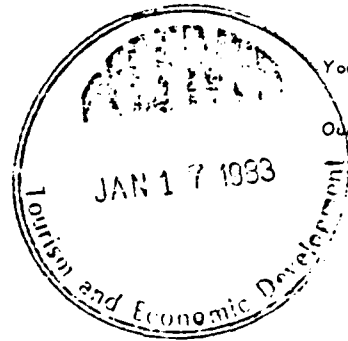
Science and Technology

Énergie, Mines et  
Ressources Canada

Science et Technologie

January 6, 1983

*R.H. 8301-18*



Your file    *Voire référence*

Our file    *Notre référence*

Mr. Roderic P. Hill  
Economic Research and  
Planning Branch

Department of Economic Development  
Box 2703  
Whitehorse, Yukon  
Y1A 2C6

Dear Mr. Hill:

Some time ago you submitted three samples of coal from the Whitehorse area to Dr. D.K. Norris at ISPG, Calgary. We have looked at these coals petrographically and enclosed is a short report on our findings. Dr. Goodarzi, who carried out the actual analysis, saw considerable evidence that these coals had been heat-affected and therefore not coalified in a normal manner. If additional samples of coal from this area are available we would much appreciate receiving some of them because our preliminary look suggests that they have had an interesting geological history.

Sincerely yours,

A.R. Cameron

AC/db

Encl.

c.c. F. Goodarzi  
D.K. Norris

# PETROGRAPHIC ANALYSIS OF THREE SAMPLES OF YUKON COALS

F. Goodarzi

Three coal samples from the Yukon Territory (Whitehorse area) were analysed using reflected light microscopy. The samples show very high ranks and appear to be thermally altered. Maximum (Romax) and minimum (Romin) reflectances in oil were measured and the bireflectance (Bro) determined. The latter is the difference between Romax and Romin and combined with other observations such as the development of vacuoles and nature of optical anisotropy (mosaic texture) can be used to determine the thermal history of a given coal. Maceral content was not determined because at this high rank and because of the thermal alteration it is nearly impossible to consistently identify particular macerals. The samples are identified as A, B and C and the results obtained are as follows:

	Romax	Romin	Bro	Your sample No.
Sample A	3.74	2.65	1.09	3
Sample B	4.71	3.91	0.80	1
Sample C	5.00	3.15	1.85	2

All 3 samples are heat affected with sample C showing many of the characteristics of natural coke. The high maximum reflectances are typical of anthracites but because of the thermal alteration this may be somewhat artificial since normal coalification does not appear to have occurred. Other observations on these samples include the following:

Sample A contains devolatilization vacuoles with a moderately high content of clay minerals.

Sample B also contains clay minerals and vacuoles, and shows signs of moderate oxidation. The outer rims of particles show lower reflectances than the interiors. Resinite in cavities of inertinite macerals (fusinite) show mosaic texture.

Sample C shows many of the attributes of natural coke with a fine-grained mosaic texture typical of a coke formed from a high volatile A bituminous coal. Macerals of the inertinite group in this sample show a burnt appearance indicating subjection to temperatures of at least 500°C.

Samples A and B were originally oxidized and were of lower rank than sample C prior to heating. Samples A and B were probably subbituminous as is evidenced by lack of mosaic texture in most of the material except some resinite bodies. Oxidation of samples A and B is evidenced by the preservation of original morphologies in some liptinite macerals (remains of spores, and cuticles).

The source of heat responsible for the thermal alteration of these coals may have been igneous rocks younger in age than the Tantalus Formation in which the coals occur.

**CYCLONE ENGINEERING**  
**SALES LTD.**

SEPARATION OF BULK MATERIALS

Manufacturing, Engineering, Testing Services

9751 - 51 Avenue  
Edmonton, Alberta T6E 4Z5  
Telephone: (403) 436-1385

Cable Address:  
Cyclone, Edmonton  
Telex: 037-3793

January 27, 1983

WHITEHORSE COAL CORPORATION  
6198 - 6th Avenue  
Whitehorse, Yukon  
Y1A 1N9

ATTN: Mr. Paul Poggenburg, President

Enclosed please find our reports of analysis performed on your three coal samples shipped to our laboratory by Mr. Richard Spencer of Norecol Environmental Consultants. If you have any questions or comments, please do not hesitate to contact me.

Cyclone Engineering Sales Ltd. has provided laboratory services to coal producers and exploration groups since 1965, and we will look forward to meeting any future coal analysis requirements you may have.

Yours truly,

Per: 

Ray Bow, Lab. Manager

CYCLONE ENGINEERING SALES LTD.

RB/cd

WHITEHORSE COAL CORPORATION

SAMPLE: #1, North Vein, West Hill

<u>Sp. Gr.</u>	<u>FRACTIONAL(DRY BASIS)</u>			<u>CUMULATIVE (DRY BASIS)</u>		
	<u>Wt. %</u>	<u>Ash %</u>	<u>BTU/lb.</u>	<u>Wt. %</u>	<u>Ash %</u>	<u>BTU/lb.</u>
- 1.5	-----	-----	-----	-----	-----	-----
1.5 - 1.6	0.73	34.24	9,505	0.73	34.24	9,505
1.6 - 1.7	70.74	37.79	8,709	1.47	36.00	9,110
1.7 - 1.8	4.49	40.23	8,531	5.96	39.19	8,674
1.8 - 1.9	8.79	42.34	8,111	14.75	41.07	8,338
1.9 - 2.0	11.95	46.89	7,313	26.70	43.67	7,879
+ 2.0	<u>73.30</u>	<u>69.41</u>	<u>3,813</u>	100.00	62.54	4,899
	100.00	62.54	4,899			

CYCLONE ENGINEERING SALES LTD.

File: S1-345

Sample: 1

Date: Jan. 27/83

COMPANY: WHITEHORSE COAL CORPORATION

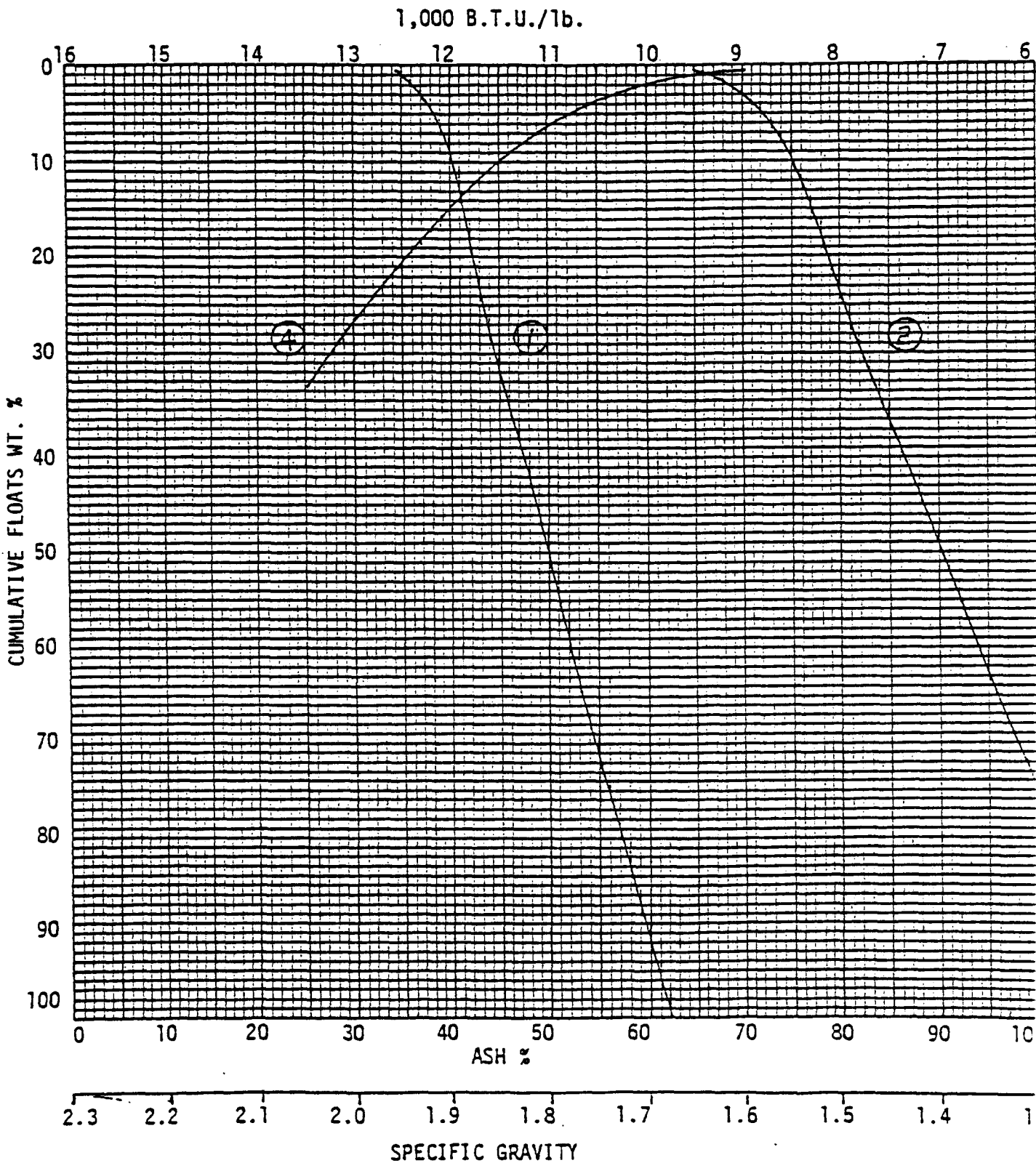
SAMPLE: #1 North Vein, West Hill

SIZE: 1/4" x 0

CURVE LEGEND

- 1. Floats Ash
- 2. Floats Calorific Value
- 3. Sinks Ash
- 4. Specific Gravity
- 5. Near Gravity Material

WASHABILITY CURVES



DATE:

CYCLONE ENGINEERING SALES LTD.

WHITEHORSE COAL CORPORATION

SAMPLE: #2, South Vein, West Hill

<u>Sp. Gr.</u>	<u>FRACTIONAL(DRY BASIS)</u>			<u>CUMULATIVE(DRY BASIS)</u>		
	<u>Wt. %</u>	<u>Ash %</u>	<u>BTU/lb.</u>	<u>Wt. %</u>	<u>Ash %</u>	<u>BTU/lb.</u>
- 1.5	----	----	-----	-----	-----	-----
1.5 - 1.6	0.29	29.58	10,267	0.29	29.58	10,267
1.6 - 1.7	1.09	31.42	10,015	1.38	31.03	10,068
1.7 - 1.8	4.57	37.58	8,941	5.95	36.06	9,202
1.8 - 1.9	11.70	41.63	8,203	17.65	39.75	8,540
1.9 - 2.0	12.70	47.53	7,336	30.35	43.01	8,036
+ 2.0	<u>69.65</u>	<u>71.12</u>	<u>3,541</u>	100.00	62.59	4,905
	100.00	62.59	4,905			

CYCLONE ENGINEERING SALES LTD.

File: S1-345

Sample: 2

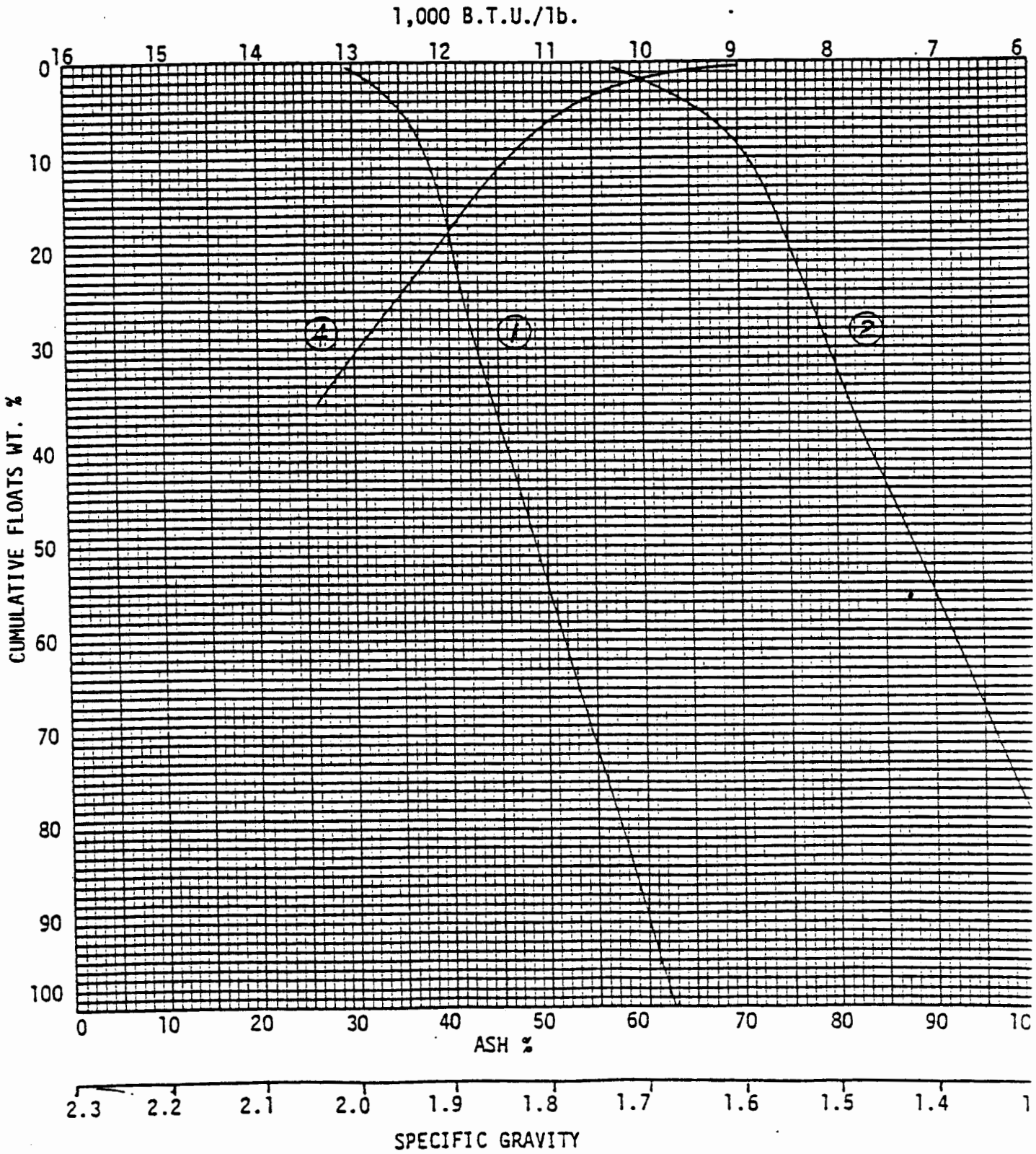
Date: Jan. 27/83

COMPANY: WHITEHORSE COAL CORPORATION  
 SAMPLE: #2, South Vein #2, West Hill  
 SIZE: ½" x 0

CURVE LEGEND

1. Floats Ash
2. Floats Calorific Value
3. Sinks Ash
4. Specific Gravity
5. Near Gravity Material

WASHABILITY CURVES



DATE:

CYCLONE ENGINEERING SALES LTD.

WHITEHORSE COAL CORPORATION

SAMPLE: #3, Hill Wash, South Vein, West Hill

	<u>As-Rec'd Basis</u>	<u>Air-Dry Basis</u>	<u>Dry Basis</u>
PROXIMATE ANALYSIS:			
Ash %	35.28	40.60	42.85
Moisture %	17.65	5.24	-----
Volatile Matter %	13.70	15.77	16.64
Fixed Carbon %	33.37	38.39	40.51
CALORIFIC VALUE:			
Cal./gm	3,022.	3,478.	3,670.
BTU/lb.	5,440.	6,260.	6,606.
SULPHUR %	0.17	0.20	0.21

CYCLONE ENGINEERING SALES LTD.

File: S1-345

Sample: 3

Date: Jan.27/83

WHITEHORSE COAL CORPORATION

SAMPLE: #3, Hill Wash, South Vein, West Hill

<u>Sp. Gr.</u>	<u>FRACTIONAL (DRY BASIS)</u>			<u>CUMULATIVE (DRY BASIS)</u>		
	<u>Wt. %</u>	<u>Ash %</u>	<u>BTU/lb.</u>	<u>Wt. %</u>	<u>Ash %</u>	<u>BTU/lb.</u>
- 1.5	----	----	----	----	----	----
1.5 - 1.6	7.07	6.55	12,887	7.07	6.55	12,887
1.6 - 1.7	14.17	13.21	11,187	21.24	10.99	11,753
1.7 - 1.8	15.90	25.18	8,884	37.14	17.07	10,525
1.8 - 1.9	15.84	36.26	7,070	52.98	22.81	9,492
1.9 - 2.0	12.35	43.59	6,067	65.33	26.73	8,844
+ 2.0	<u>34.67</u>	<u>73.54</u>	<u>2,329</u>	100.00	42.96	6,585
	100.00	42.96	6,585			

CYCLONE ENGINEERING SALES LTD.

File: S1-345

Sample: 3

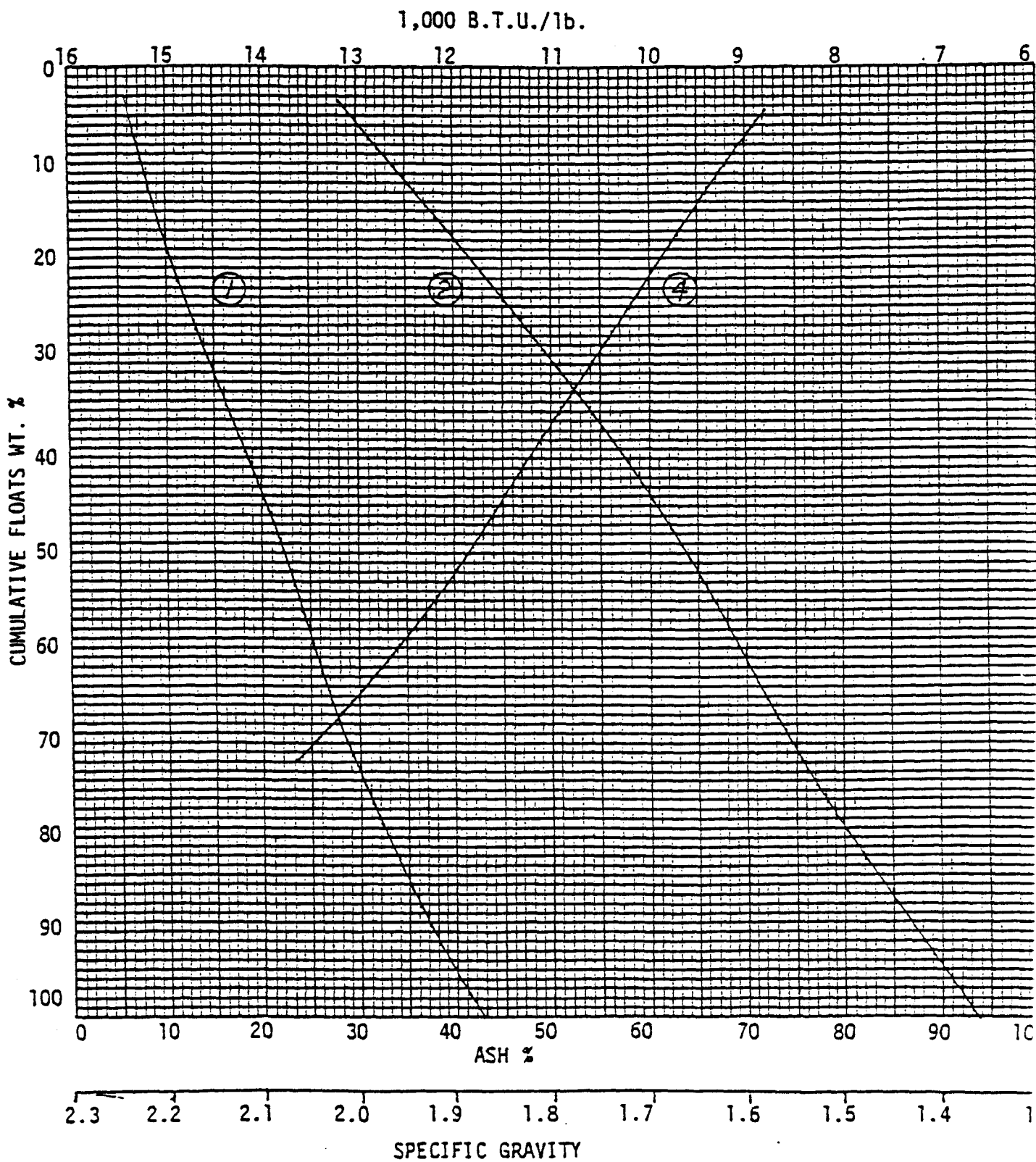
Date: Jan. 27/83

COMPANY: WHITEHORSE COAL CORPORATION  
 SAMPLE: #3, Hill Wash, South Vein, West Hill  
 SIZE: 1/4" x 0

CURVE LEGEND

1. Floats Ash
2. Floats Calorific Value
3. Sinks Ash
4. Specific Gravity
5. Near Gravity Material

WASHABILITY CURVES



DATE:

CYCLONE ENGINEERING SALES LTD.

APPENDIX IV

Coal Quality Data from Cairnes (1908)  
and Taylor (1969)

Quality Data from Cairnes (1908)

(All samples believed to be on an air-dried basis)

Fisher Creek

Sample	Moisture %	Ash %	Volatile Matter %	Fixed Carbon%
A	2.15	21.98	6.01	69.86
B	3.76	25.40	8.34	62.50
C	3.78	47.78	10.06	38.38
D	2.35	48.13	6.65	42.27

A - is an average sample of a 2.95 metre seam at the end of the 18 metre tunnel (Upper Seam).

B - is an average outcrop sample of a 0.76 metre seam (Lower Seam).

C - is an average outcrop sample of a 3.15 metre seam (Middle Seam).

D - is a sample of an outcrop found in the creek below old (1906-1908) camp. May be the same seam as one of the others.

Quality Data from Taylor (1969)

(all samples are quoted on a dry basis)

Sample No.	Sample Location	Seam Thickness* (m)	Ash %	Volatile Matter %	Fixed Carbon %	Btu/lb
1	Fisher Creek (Lower Seam)	0.66	35.4	12.7	51.8	8537
2	Fisher Creek (Middle Seam)	1.88	64.3	9.9	25.8	4479
3	Fisher Creek (Upper Seam-Lower Bench)	1.98	38.2	10.4	51.3	8501
4	Fisher Creek (Upper Seam-Upper Bench)	1.32	55.7	7.9	36.3	5901
5	West Hill	1.98	55.0	11.8	33.2	5710
6	East Hill (High Trench-Low Pit)	?	67.7	10.2	22.1	3153
7	William's Hole (East Hill)	?	63.9	13.3	22.7	4000
8	Camp 4 Trench (Coal Ridge)	1.98	39.0	11.5	49.5	7208
9	Double Mountain	?	63.5	14.2	22.2	4192

\* Taylor's notes regarding each sample

Sample

No.

1 True width of seam, 26 inches. Sample does not include a one-inch band of siltstone within seam.

2 True width of seam, 74 inches. Sample does not include one three-inch siltstone band within seam.

- 3 True width of bench, 78 inches. Sample does not include ten inches of siltstone and bone in six, 1 - 2 inch bands.
- 4 True width of bench, 52 inches. Sample does not include a six-inch band of siltstone within seam.
- 5 True width of seam, 78 inches. Sample does not include a two-inch clay-shale band 28" above the shale floor. Top 22" of seam has about 14" of boney coal.
- 6 Sample taken from bottom of new pit in old trench, 4 1/2' - 5 1/2' below original surface. Coal much weathered. Took coal from above and below two-inch clay-shale band, across horizontal width of three feet. True width of seam not known.
- 7 Took sample at depth 18" - 24" in clean-looking coaly material in patch of bloom related to spoil of old trench (?)
- 8 Trench dug in largest area of coal bloom, perpendicular to strike of adjacent rocks, to 8' x 1 1/2' x 1 1/2'. Sampled lower 6 1/2' of trench at depth 18". Upslope 1 1/2' of trench showed coal debris and brown soil inter-tongued. Coaly debris clean to downslope end of trench; probably extended farther.
- 9 Sample taken of surficial several inches of coal soil in patch of bloom immediately below cairn (Figure 3).