COAL-EX CONSULTING LTD.

86-031

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

by

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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^{o}-50^{o}) 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 forseen for this property unless cleaner coal is located. The property is well situated with regard to infrastructrual requirements to support the exploitation of this coal resource.

It is concluded that this property warrants further exploration.

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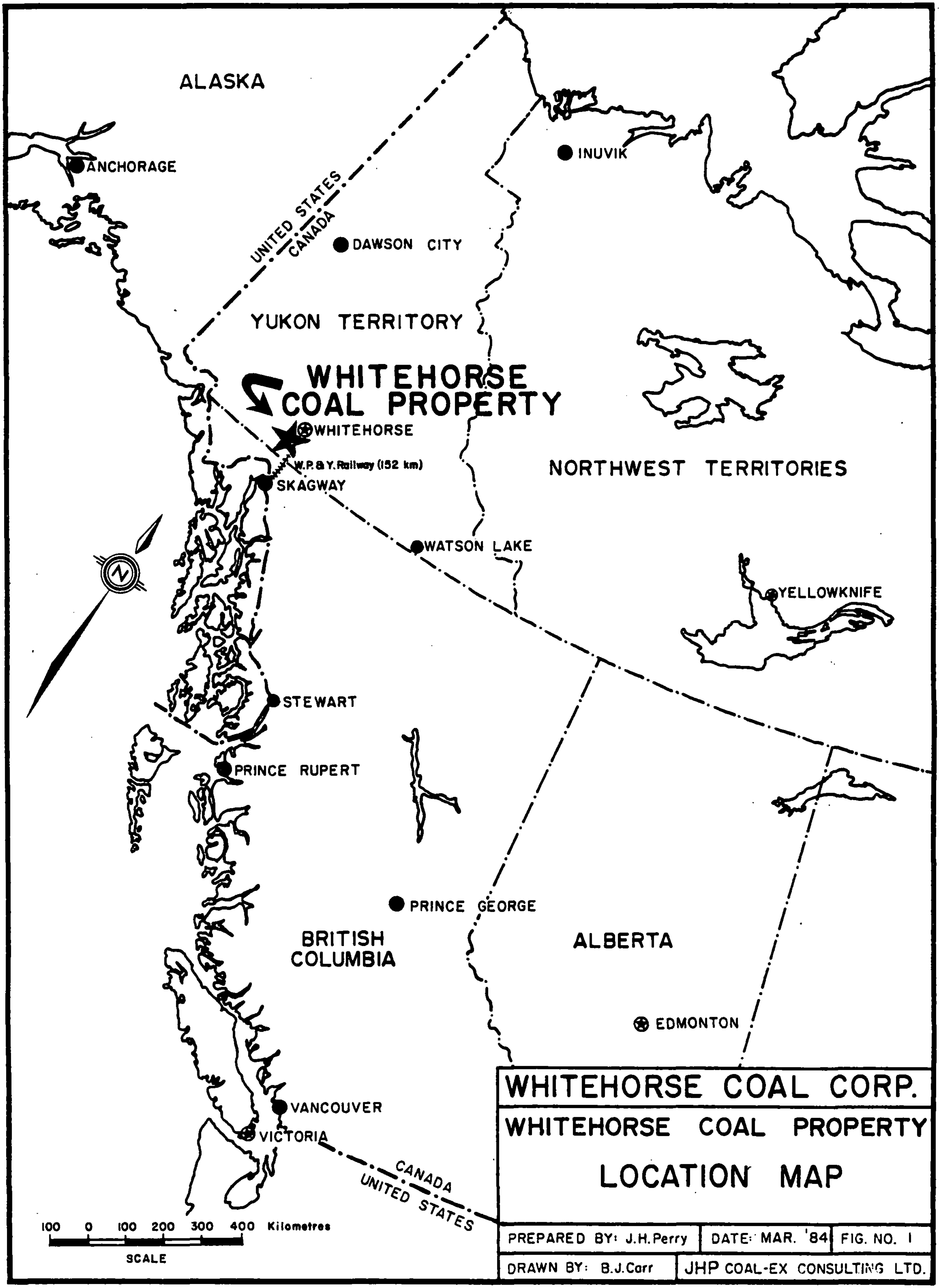
1.0 INTRODUCTION

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.

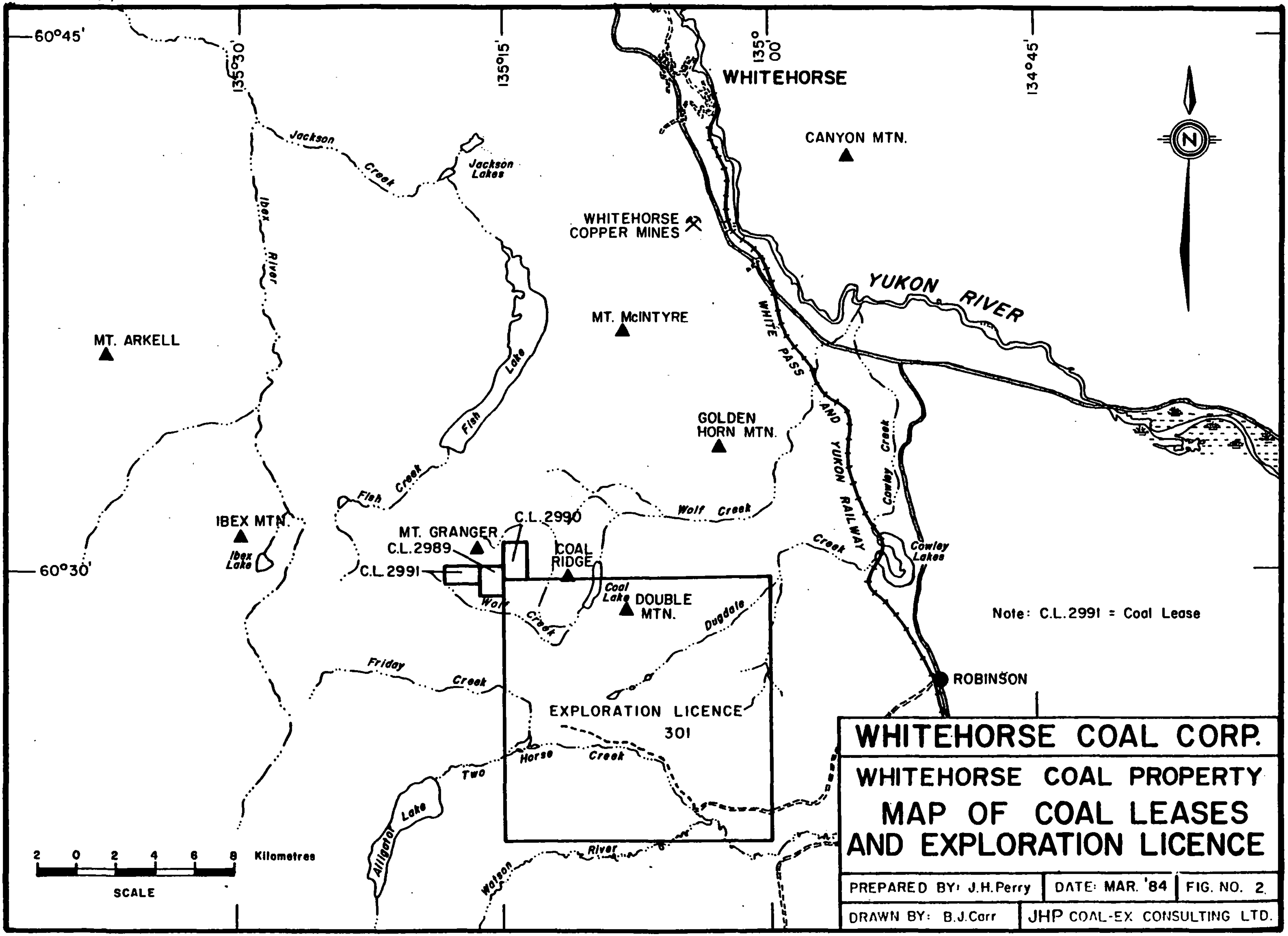

ALASKA
ANCHORAGE
UNITED STATES
CANADA
DAWSON CITY
INUVIK
YUKON TERRITORY
WHITEHORSE
COAL PROPERTY
WHITEHORSE
W.P.& Y. Railway (152 km)
SKAGWAY
NORTHWEST TERRITORIES
WATSON LAKE
YELLOWKNIFE
STEWART
PRINCE RUPERT
PRINCE GEORGE
BRITISH
COLUMBIA
ALBERTA
EDMONTON
VANCOUVER
VICTORIA
CANADA
UNITED STATES
100 0 100 200 300 400 Kilometres
SCALE
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°22' and 60°32'N and longitudues 135°00' and 135°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.



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 topgraphic 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.

Coal Lease/Licence	Hectares
C.M.L. 2989	259
C.M.L. 2990	259
C.M.L. 2991	259
Coal Exploration Licence 301	19,210
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 futher 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 Meszoic 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 Meszoic stratigraphy is given in Table 1.

TABLE 1

STRATIGRAPHY OF THE WHITEHORSE COAL PROPERTY

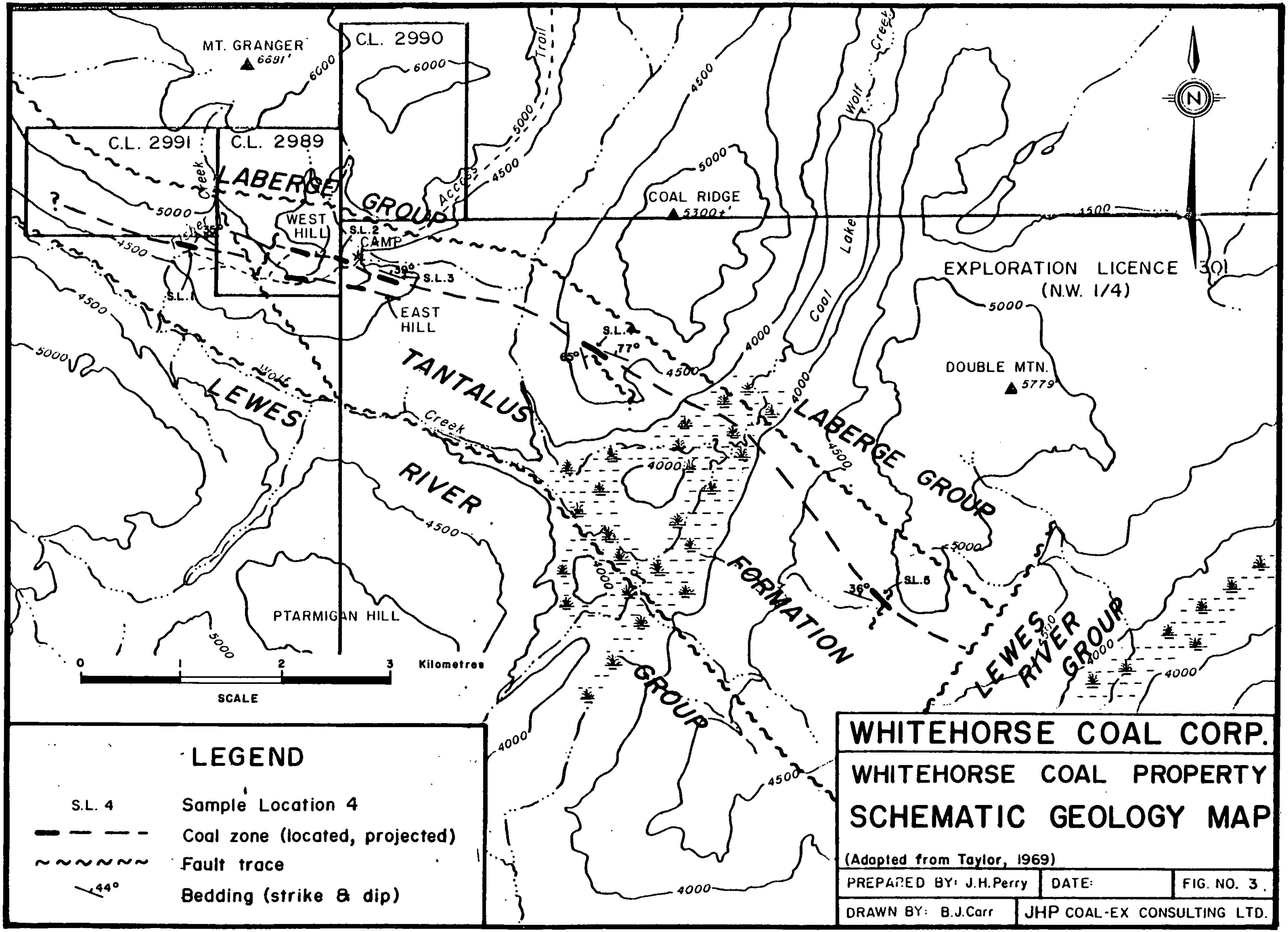
"Period"	Group of Formation	Rock Type
Cretaceous	Coast Intrusions	Granodiorite, granite, quartz monzonite, quartz diorite and allied rocks
Lower Cretaceous and Upper Jurassic	Tantalus Formation	Arkos, siltstone, conglomerate, argillite, COAL
Lower Jurassic and Later	Laberge Group	Greywacke, arkose quartzite, 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


MT. GRANGER
6691'
CL. 2990
C.L. 2991
C.L. 2989
LABERGE GROUP
West Hill
S.L.2
CAMP
S.L.3
S.L.1
EAST HILL
COAL RIDGE
5300±'
EXPLORATION LICENCE 301
(N.W. 1/4)
S.L.4
TANTALUS
DOUBLE MTN.
5779
LEWES
RIVER
LABERGE GROUP
FORMATION
S.L.5
LEWES RIVER GROUP
GROUP
PTARMIGAN HILL
Coal Lake
Wolf Creek
Trail
Access
0 1 2 3 Kilometres
SCALE
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
(Adapted 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) <u>Double Mountain</u> 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 gulley 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 gulley 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 simliar 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^{o}. 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^o-60^o), 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^o 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^o-45^onortheast 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 gulley 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 (60^0 to 80^0) 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. 110^0. However, below the coal zone the strike varies between N. 140^0 to N.160^0. 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 50^0-60^0 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 preceeding 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-dired 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_2 in the coal to see if carbon dioxide contributed to the relatively high volatile content; those samples emitted only small amounts of CO_2, 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 possibile 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^{o} 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 ameniable 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 forsee 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 qualty 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 as 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.

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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 Associaion 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.

PROFESSIONAL GEOLOGIST
JOHN H. PERRY
ALBERTA

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^{o}/35^{o}NE
1.00	Shale: - dark grey, carbonaceous. Silicified. Shattered due to cleavage.
0.65	Shale (with coal): - Sample #1, dark grey, highly carbonaceous with much coal powder from thin coal bands.
0.80	Shale (with coal): - Sample #2, 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^{O}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°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: - Sample #8, 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): - Sample #9, 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: - Sample #10, 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^{O}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	AIR DRY	5.58	59.05	14.75	20.62	0.15	3042
	1	DRY	-	62.54	15.62	21.84	0.15	3222
2	FISHER CREEK	AIR DRY	2.61	74.40	8.84	14.15	0.05	-
	2	DRY	-	76.39	9.08	14.53	0.06	-
3	FISHER CREEK	AIR DRY	2.98	66.99	9.76	20.27	0.15	-
	3	DRY	-	69.05	10.06	20.89	0.15	-
4	FISHER CREEK	AIR DRY	3.40	39.22	8.58	48.80	0.27	7570
	4	DRY	-	40.60	8.88	50.52	0.28	7836
5	FISHER CREEK	AIR DRY	1.70	58.77	10.23	29.30	0.16	3899
	5	DRY	-	59.79	10.41	29.80	0.17	3966
6	FISHER CREEK	AIR DRY	5.02	38.62	13.34	43.02	0.25	7099
	6	DRY	-	40.66	14.04	45.30	0.26	7474
7	COAL RIDGE	AIR DRY	4.36	62.30	14.59	18.75	0.40	3794
		DRY	-	65.14	15.25	19.61	0.41	3967
8	WEST HILL	AIR DRY	6.52	56.93	14.01	22.54	0.16	3825
	TRENCH A	DRY	-	60.91	14.99	24.10	0.17	4092
9	WEST HILL	AIR DRY	3.61	70.59	11.36	14.44	0.11	-
	TRENCH B	DRY	-	73.23	11.78	14.99	0.12	-
10	DOUBLE	AIR DRY	2.23	62.37	12.96	22.44	0.15	3811
	MOUNTAIN	DRY	-	63.79	13.26	22.95	0.15	3898

L.M. LAKOSIL - CHIEF CHEMIST, Coal div.
SIGNATURE AND TITLE

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 3H7

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_2	Calorific Value BTU/lb.
6	FISHER CREEK 6	0.05%	----
7	COAL RIDGE	-----	3794
10	DOUBLE MOUNTAIN	0.04%	----

LL:at

Bie Ong,

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 analyised 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 with out 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 representive samples to a commercial lab set up for coal preparation analysis.

Becouse 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

Your file Votre référence

Our file Notre référence

JAN 17 1983

Tourism and Economic Development

January 6, 1983

RPH. 83-01-18

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

A.R. Cameron

AC/db

Encl.

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

Institute of Sedimentary and Petroleum Geology
Geological Survey of Canada
3303-33rd St., N.W. Calgary, Alta.
T2L 2A7

Institut de géologie sédimentaire et petrolière
Commission géologique du Canada
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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.

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

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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

	FRACTIONAL(DRY BASIS)			CUMULATIVE (DRY BASIS)		
Sp. Gr.	Wt. %	Ash %	BTU/lb.	Wt. %	Ash %	BTU/lb.
- 1.5	-----	-----	------	-----	-----	------
1.5 - 1.6	0.73	34.24	9,505	0.73	34.24	9,505
1.6 - 1.7	0.74	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	73.30	69.41	3,813	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

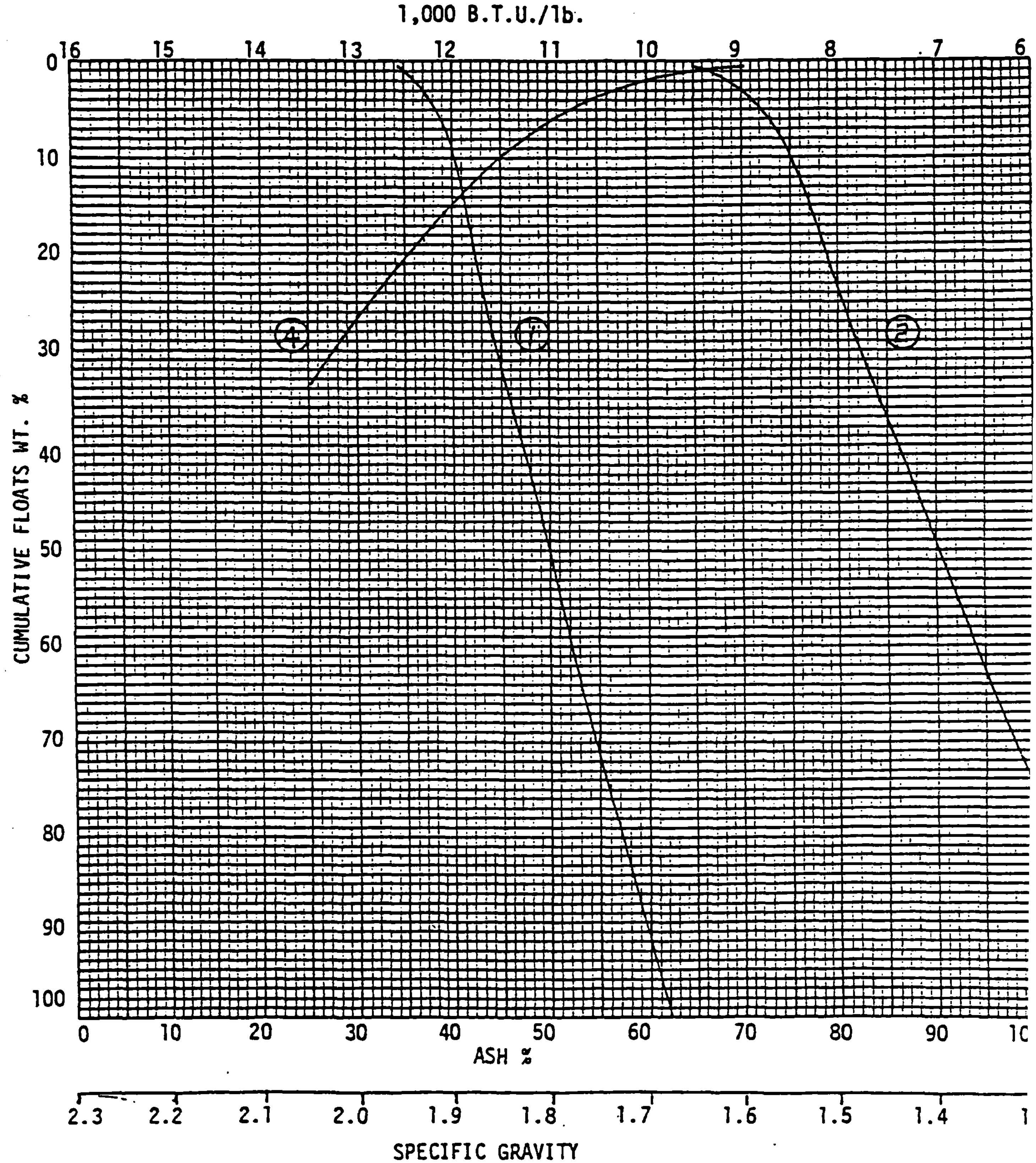
SAMPLE: #1 North Vein, West Hill

SIZE: ¼" 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

	FRACTIONAL (DRY BASIS)			CUMULATIVE (DRY BASIS)		
Sp. Gr.	Wt. %	Ash %	BTU/lb.	Wt. %	Ash %	BTU/lb.
- 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	69.65	71.12	3,541	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

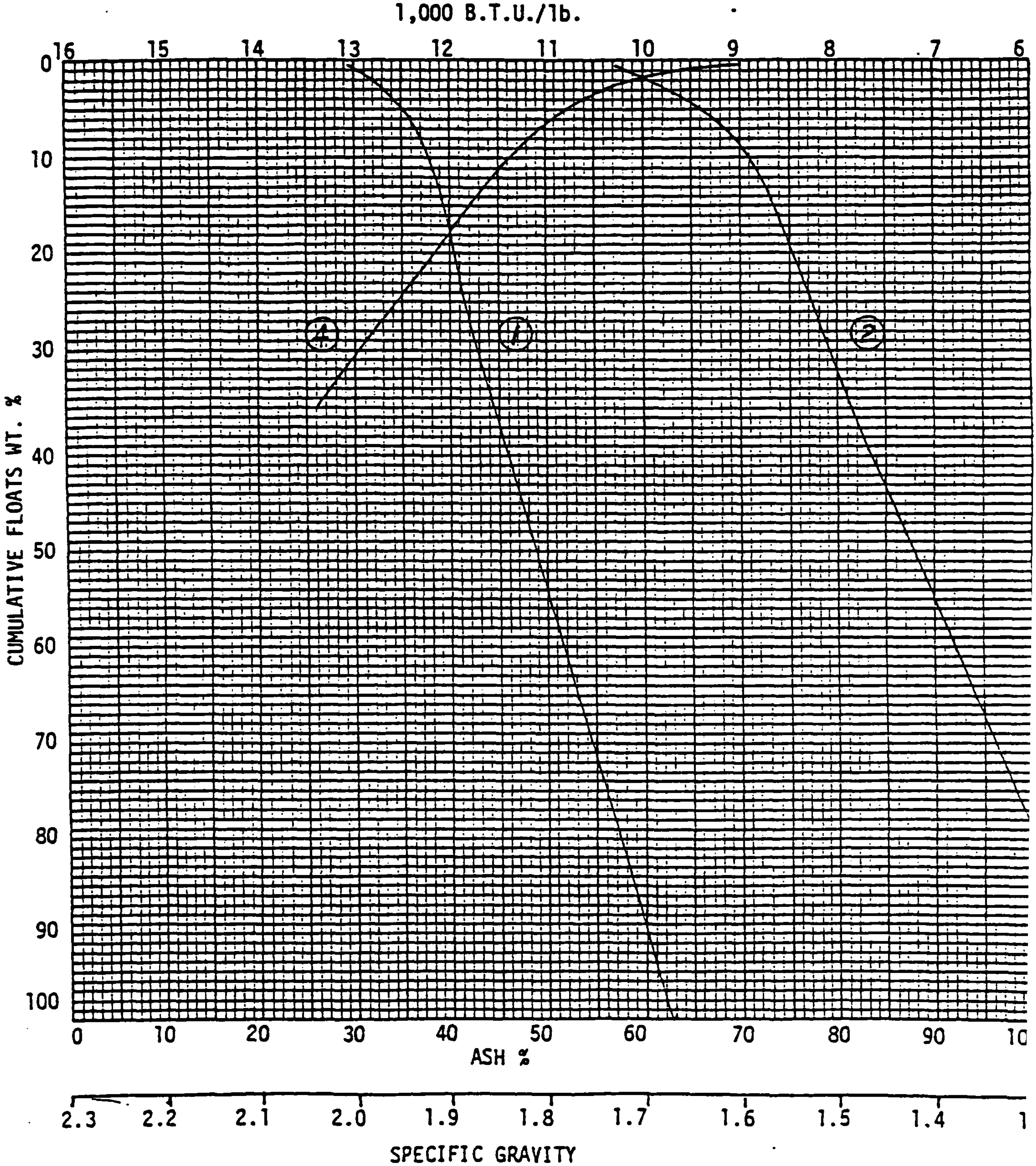
SAMPLE: #2, South Vein #2, West Hill

SIZE: ¼" 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

	As-Rec'd Basis	Air-Dry Basis	Dry Basis
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

Sp. Gr.	FRACTIONAL (DRY BASIS) Wt. %	Ash %	BTU/lb.	CUMULATIVE (DRY BASIS) Wt. %	Ash %	BTU/lb.
- 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	34.67	73.54	2,329	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

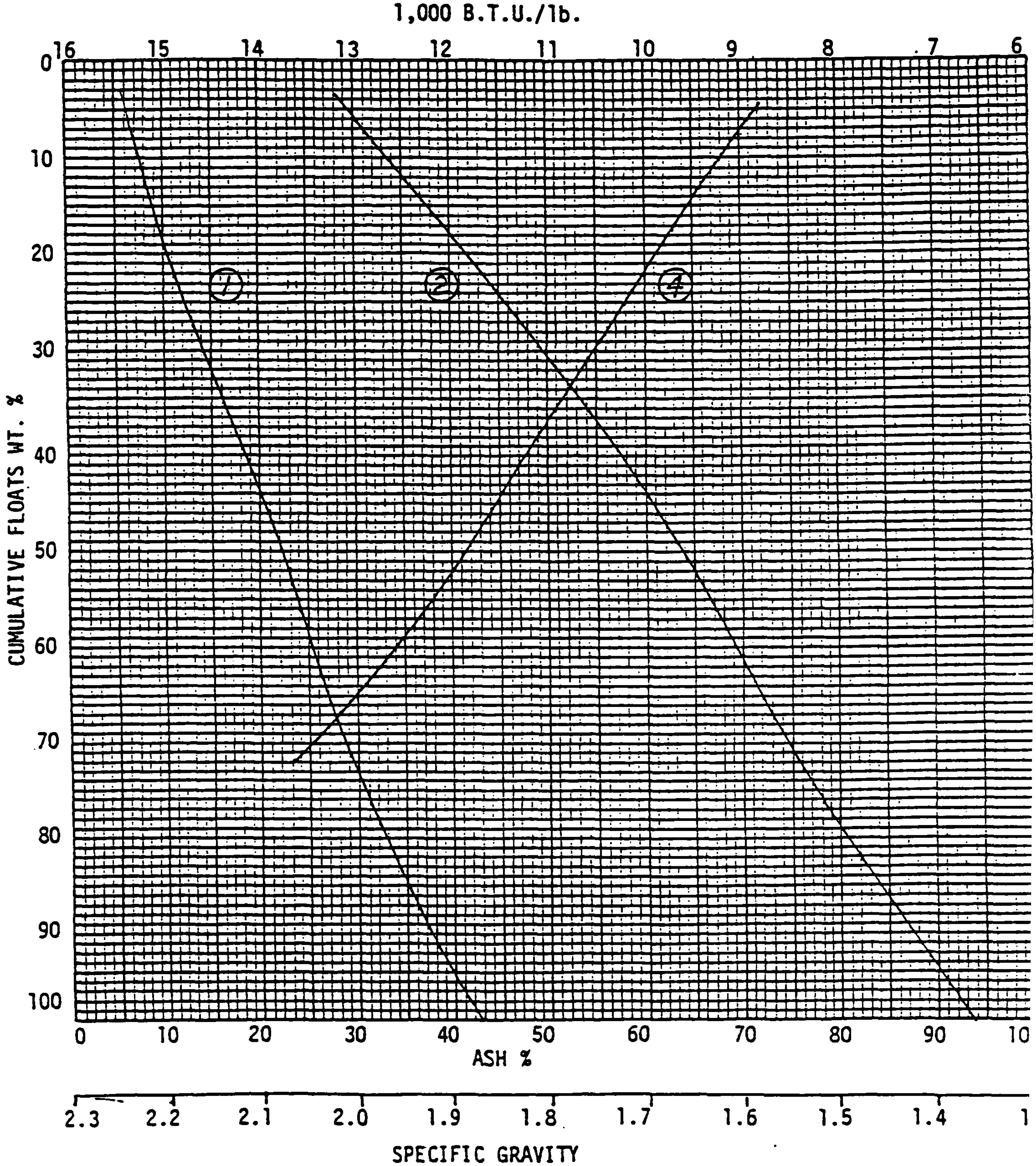
SAMPLE: #3, Hill Wash, South Vein, West Hill

SIZE: ¼" 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.

<u>Quality Data from Taylor (1969)</u>

(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 downslop 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).

JHP COAL-EX CONSULTING LTD.
Suite 806, 402 West Pender Street
Vancouver, British Columbia, V6B 1T6
Ph (604) 669-7033

WHITEHORSE COAL PROPERTY:

86-031

SUMMARY REPORT ON THE

1986 TEST PIT - BULK SAMPLING PROGRAM

PROGRAM DESIGNATION NO:
EIP 86-031

COAL MINING LEASES:
2989, 2990, 2991 and Coal Exploration License 30

CLAIM SHEET NO'S:
105 D/6 and 105 D/11

LATITUDE: 60° 29'N / LONGITUDE: 135° 16'W

WORK PERIOD:
September 9th, 1986 - March 28th, 1987

REPORT PREPARED FOR:
WHITEHORSE COAL CORP.

MINING SUPERVISED BY:
JHP COAL-EX CONSULTING LTD.

REPORT AUTHOR:
J.H. PERRY, P. GEOL. (COAL-EX)

DATE SUBMITTED:
March 31st, 1987

JHP
COAL-EX CONSULTING LTD.
Suite 806, 402 West Pender Street
Vancouver, British Columbia, V6B 1T6
Ph (604) 669-7033

March 31, 1987

Whitehorse Coal Corporation
P.O. Box 5478
Whitehorse, Yukon
Y1A 5H4

Attention: Mr. P. Poggenburg, President

Dear Sirs:

Re: Whitehorse Coal Property Report

We are pleased to submit herewith two copies of our report entitled "Whitehorse Coal Property: Summary Report on the 1986 Test Pit - Bulk Sampling Program."

The report discusses the activities undertaken during the 1986 work program and summarizes the results obtained from geological observations and coal testing and analysis.

We urge Whitehorse Coal Corporation to continue the work initiated on coal testing and analysis to further evaluate the practicalities of selective mining.

Should you have any questions concerning our report, we will be available to discuss them with you.

Yours sincerely,
JHP Coal-Ex Consulting Ltd.

John Perry

J.H. Perry
President

SUMMARY

Exploration on the Whitehorse Coal Property during 1986 consisted of test mining and bulk sampling. A test pit was located on coal mining lease 2989, in the northwest corner of the property. Prevous drilling (in 1985) defined coal reserves along the southwest flank of West Hill. The pit was located down-hill from these holes, between hole 85-3 and 86-6.

Stripping (Phase I) began on October 1st, 1986 and was completed by October 19th with the removal of 16,109 cubic metres of material. Subsequent to this, during the coal mining (Phase II) portion of the program, an additional 750 cubic metres of material was removed from atop the seam and along the front of the pit. In-situ coal reserves within the pit were estimated at 7,450 tonnes; 5,250 tonnes of potential product coal and 2,200 tonnes of oxidized coal mixed with soil. Coal mining began on October 20th at the western end of the pit. This area was quickly abandoned due to large amounts of residual rock above the seam and a second face was established in the east central portions of the pit, downhill from hole 85-4. Subsequent coal mining proceeded towards the west. Mineable coal was restricted to the back half of the pit due to the presence of a deep permafrost zone along the front. This created certain difficulties due to the size of the backhoe in relation to the mining area. These difficulties were also compounded by unexpected geological structures.

The seam stratigraphy in the pit correlates well with the drill holes. Most of the variations can be explained by the presence, or absence, of igneous intrusions (present as sills). It was these rock bands that the selective mining process concentrated on removing from the "product" coal. In the eastern parts of the mined area the geology is complicated by the presence of a sharp roll, or anticlinal fold, which results in a drastic steepening of the dip along the highwall. It was fortuitous that the sills present in this area were found at the top of the seam and were therefore, relatively easy to remove. Otherwise, the seam had to be bulk mined. In the central and western portions of the mined area the geologic structure was more uniform, with dips commonly 20° to 25° to the northwest. Throughout these areas the sills were found at the top, middle and in the lower

parts of the seam. Selective mining was employed in these situations. While success was achieved in the removal of the orange-coloured, altered igneous bands it was at the expense of coal loss. This mining was also time consuming. Where possible loose coal from atop the permafrost zone was also recovered.

Coal and mixtures of coal and rock were stockpiled adjacent to the pit. Approximately 3,290 tonnes are contained within five stockpiles; two of these (Stockpiles #1 and #2) contain an estimated 1,885 tonnes of "product" coal. The quality of this coal is, as yet, undetermined. It is anticipated that stockpile #1 (845 tonnes) may be higher in ash than stockpile #2 (1,040 tonnes) and so better suited for use in the planned fluidized bed combustor at the Yukon College than for more conventional industrial or domestic uses. In-situ reserves remaining within the pit are estimated at 2,150 tonnes potential "product" and 3,650 tonnes of coal within the permafrost zone.

Samples of the coal seam were taken from several locations within the mined area and from the stockpiles. A 14-tonne "bulk" sample was also taken and shipped to Calgary for testing. To date, only a few of the samples have been subjected to preliminary analysis. The "bulk" sample has undergone screening and washability testing in addition to other coal analyses. The "bulk" sample represents an entire seam composite and includes all rock bands. Preliminary results from this sample indicate that the raw coal is relatively high in ash (45.4%). It is unlikely that the ash content can be significantly reduced by crushing and screening. Washability results indicate that only very small recoveries of low-ash coal can be anticipated; at a 1.9 S.G. cut the yield is approximately 50% with 27% ash. The total seam raw ash in some parts of the area may be as low as 34%. More analyses are necessary before predictions can be made regarding the ash contents of selectively mined coal.

Recommendations for further work within and adjacent to the stripped area include: completion of the testing and analyses for all the samples, additional geological mapping and drilling and the evaluation of the thin coal "seam" which underlies the main seam. It is further recommended that detailed exploration be conducted throughout the areas held under coal mining lease.

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1.0 INTRODUCTION AND TERMS OF REFERENCE

In early September, 1986 Coal-Ex Consulting Ltd. was retained by Whitehorse Coal Corp. (W.C.C.) to supply geological and supervisory services for a test pit - bulk sample program on the Whitehorse Coal Property. Primary tasks to be handled by Coal-Ex included:

- pre-program data review
- selection of pit location
- pit design
- supervision of mining activities (both waste rock removal and coal mining)
- sampling and geological data gathering
- co-ordination of coal testing
- final report preparation

Coal-Ex was assisted in the pit design and in the supervision of some of the mining activities by Terra Scan Technical Consultants. Terra Scan were also responsible for topographic and in-pit surveying (see Section 4.3).

This report summarizes the activities undertaken during the mining of the bulk sample. Topics discussed include program logistics, monitoring and supervision as well as data collection. Reviews of the pit and coal seam geology are presented but no detailed data handling has been undertaken. Preliminary results from the testing and analysis of various coal samples are also reviewed.

2.0 EXPLORATION FRAMEWORK

The Whitehorse Coal Property is located in southwestern Yukon, approximately 30 kilometres southwest of Whitehorse. The property comprises three Coal Mining Leases and one Coal Exploration Licence for a total of 19,987 hectares. Apart from some volcanics and meta-volcanics of uncertain age, rocks contained within the property boundaries belong to the Mesozoic period. Coal is found within the Upper Jurassic - Lower Cretaceous Tantalus Formation.

Between 1981 and 1984 W.C.C. conducted several reconnaissance exploration programs comprising prospecting, trenching and road construction. This work identified two laterally continuous coal zones within the coal leases in the northwestern portions of the property. These coal occurrances were named Coal Zones A and B (see Perry, 1984). Exploration during 1985 incorporated cat-trenching, road construction and open-hole, rotary drilling. All the drill holes were positioned along the southern slopes of West Hill and targetted Coal Zone B. Of the six holes drilled, five intersected this coal zone. A report on the 1985 exploration program, which includes geological interpretations and reserve calculations, was prepared by L.W. Carlyle, P. Geol (1985). Based upon the results of this work, W.C.C. proceeded with plans for coal mining which culminated in the 1986 bulk sample program.

3.0 PROGRAM OBJECTIVES

The 1986 test pit - bulk sample program had four primary objectives. They were:

1) by the use of selective mining techniques, provide approximately 2,000 tons of run-of-mine coal for sample product distribution to potential customers;

2) provide sufficiently large and representative samples for comprehensive analysis on a variety of sized coals in both raw and cleaned states. Such coals would approximate potential products gained from selective mining and bulk mining techniques;

3) examine the suitability of selective mining for future bulk sample extraction or small-scale production scenarios; and,

4) obtain data on the mined coal seam with respect to seam thickness, rock band distribution, coal quality and geologic structure.

4.0 LOGISTICS

4.1 Introduction

The program consisted of two contiguous work phases; Phase I involved removal of the majority of overburden (waste rock) from the pit while Phase II incorporated the removal of the residual overburden and selective coal mining. The entire program, including pre-mobilization road maintenance, covered a period of approximately 8 weeks from September 9th to November 5th, 1986. Phase I began on September 30th and Phase II started on October 20th, 1986.

Access to the pit site was via the main exploration road that extends from the premises of Whitehorse Copper to the northern portion of the property. This road passes within a few metres of the pit. The larger pieces of mining equipment were mobilized by low-boy trailer to Whitehorse Copper from whence they made their way to the pit area under their own power. The D-8 Caterpillar operated by W.C.C. had to assist the scraper on some of the steeper slopes. A fuel wagon was hauled into the property by the mining contractor's bulldozer.

The majority of the mined coal was stockpiled on site in three main and two secondary piles. Approximately 300 tonnes were trucked to a stockpile located near the Whitehorse end of the property access road, for near-term distribution to potential customers. A 14-tonne "bulk" sample was trucked to Calgary for detailed coal testing.

Mining concluded on November 5th and the demobilization of all equipment was completed by November 6th, 1986.

4.2 Road Maintenance

Some early maintenance of the main access road was undertaken in August with the repair of a wash-out and associated culvert installation near kilometre six. This work was conducted using a bulldozer and loader contracted from Melberg Verrico Contracting Ltd.

The main phase of road maintenance began on September 9th, prior to the mobilization of mining equipment, and continued until the end of the bulk sampling program. Tasks undertaken during this period included:

- reduction of grades on the steeper slopes;
- elimination of one switchback;
- widening of corners; and,
- construction of passing zones.

This work was necessary for easier trucking of coal from the pit area to Whitehorse Copper. The road maintenance was carried out by W.C.C. using their own Wabco grader and a Caterpillar D-8 rented from Gunrunner Trucking Ltd. Other activities utilizing this equipment included snow removal and assistance with the mobilization and demobilization of the mining equipment.

4.3 Surveying

Surveying duties were contracted to Terra Scan Technical Consultants and were performed by Mr. D. Clark. The pit area was surveyed prior to stripping and a topographic map was produced at a scale of 1:500. Further surveys were carried out during the early stages of stripping to control the pit limits and slope of the highwall. A final survey of the pit floor was undertaken at the end of Phase I. Additional Terra Scan responsibilities included the final calculations of waste rock/overburden volumes removed during Phase I and the detailed reporting of all Phase I mining activities with associated pit maps and cross-sections. The reader is, therefore, referred to the report authored by Mr. Clark entitled "Construction Summary, Excavation for Exploration of Pit No. 1". Terra Scan also provided advice on the pit design and Mr. Clark assisted in the supervision of the overburden removal.

4.4 Mining

The contractor for the mining was Melberg Verrico Contracting Ltd. of Whitehorse, Yukon. Phase I, overburden/waste rock removal, was achieved using an International TD-25 bulldozer with ripper and a Caterpillar 631-B scraper. Phase II, overburden clean-up and coal mining, utilized a Caterpillar 235 backhoe with a 3/4 cubic yard toothed bucket and 2 cubic yard clean-up bucket and a gravel truck (trimed capacity, 8.9 cubic metres).

The activities relating to the waste rock stripping have been reported by Clark (1986). A description of the coal mining stage (Phase II) is presented below, in Section 5.0.

4.5 Trucking

The transfer of coal from the stockpiles at the pit to a smaller stockpile near Whitehorse Copper was carried out by two gravel trucks supplied by Carcross Indian Band Construction Ltd. Trucking began on November 1st and finished on November 5th. A total of 20.5 loads were hauled, totalling approximately 300 tonnes. The last load shipped from the pit area comprised a 14 - tonne "bulk" sample which was subsequently sent to Calgary for detailed testing.

4.6 Project Management and Primary Contractors

Geological services, pit planning and supervision of all pit activities were provided by Mr. J. Perry, P. Geol. (Coal-Ex Consulting Ltd.). Overall program control and supervision of road maintenance was conducted by P. Poggenburg (W.C.C.).

The personnel and primary contractors who contributed to the 1986 program are listed below:

Whitehorse Coal Corp.

P. Poggenburg	Project Manager

Consultant

J.H. Perry, P. Geol.	Coal-Ex Consulting Ltd. Suite 806 - 402 West Pender Street Vancouver, B.C. V6B 1T6

Contracting Companies

Terra Scan Technical Consultants 302 Jarvis, Whitehorse Yukon Y1A 1A3	Surveying, waste rock volumes, consultation on pit design, assistance with supervision of stripping, reporting of phase I activities.
Melberg Verrico Contracting Ltd. P.O. Box 4332 Whitehorse, Yukon	Mining contractor; minor road maintenance.
Gunrunner Trucking Ltd. Whitehorse, Yukon	Caterpillar D-8 for road maintenance. Operator provided by W.C.C.
Carcross Indian Band Construction Ltd. Carcross, Yukon	Hauling of coal from pit area to Whitehorse Copper and Calgary, Alberta.
Birtley Coal and Minerals Testing 505 - 50th Avenue, S.E. Calgary, Alberta	Coal testing: 14-tonne "bulk sample"
Chemex Labs Ltd. 212, Brooksbank Avenue North Vancouver, B.C. V7J 2C1	Coal testing: channel samples

5.0 MINING

5.1 Site Selection and Pit Design

The general site for the test pit was pre-determined by Whitehorse Coal Corp. prior to the 1985 drill program. This location was selected based upon results obtained from a large bulldozer cut on the eastern nose of West Hill which exposed a significant section of Coal Zone B. Other major factors which determined the general pit location were:

- access;
- ease of excavation; and,
- proximity to suitable areas for waste disposal.

The 1985 drill program was designed to provide a coal reserve for future mining by establishing geological control over the seam stratigraphy and by determining the coal quality from fresh coal samples.

Prior to the 1986 field program, the data provided by Carlyle (1985) was reviewed by Coal-Ex. In conversations with Mr. P. Poggenburg during the review period it was concluded that, subject to field confirmation, the primary location for the pit was between holes 85-3 and 85-6. Factors influencing this conclusion included:

i) the correlation of the seam stratigraphy between holes 85-3, 4, 5 and 6 and the lack of the main seam in hole 85-1;
ii) the steeper topographic slope east of hole 85-3;
iii) the presence of thicker conglomerate east of hole 85-3.

Field examination of the drilled area by J.H. Perry and P. Poggenburg confirmed the final pit location; namely, that the headwall be centered between holes 85-4 and 85-5 and the eastern and western wing walls extend towards holes 85-3 and 85-6, respectively.

Prior to the field program, Whitehorse Coal Corp. outlined the broad scale and scope of the project. Prelimiary pit design was then undertaken by Coal-Ex using the data supplied by Carlyle (1985). Initial waste rock volumes were estimated at 14,250 cubic metres, based upon a 60° highwall slope. In-situ coal reserves were estimated at 7,600 tonnes using a coal seam thickness of 2.5 metres and a specific gravity of 1.8.

Additional design was carried out subsequent to the topographic survey of the pit area. Waste volumes and in-situ coal tonnages calculated at this stage were 13,650 cubic metres and 7,300 tonnes, respectively. Adjustments to this pit plan were necessary once the initial phase of highwall development had been carried out. A bench was added along the deepest section of the highwall to reduce the volume of waste rock and for safety considerations. Final estimates for ultimate waste rock and in-situ coal resources were calculated at 16,600 cubic metres and 7,450 tonnes respectively. The waste rock volumes were considered to be accurate to ± 20%, depending upon the dip of the coal seam. Coal reserves were based upon a 2.5 metre seam thickness and an estimated specific gravity of 1.8; 2,200 tonnes were estimated to be oxidized and/or mixed with soil leaving a potential 5,250 tonnes of "product" coal. No assumptions of coal quality were made.

5.2 Overburden/Waste Rock Removal (Phase I)

Stripping of the overburden/waste rock formed Phase I of the pit development. As this portion of the program has been described by Clark (op. cit.) it is not dealt with here. At the end of Phase I the amount of overburden removed was calculated by Terra Scan to be 16,109 cubic metres. Further discussion of residual overburden volumes removed subsequent to Phase I are presented in Section 5.3.

5.3 Coal Mining (Phase II)

Phase II consisted of three components:

i) exposure of the coal seam along the lip, or outer limit, of the pit;
ii) removal of residual overburden/waste rock; and,
iii) coal mining.

Prior to coal extraction some time was spent in completing the "facing up" of the coal seam along the front, or lip, of the pit. An approximate length of 65 metres had been excavated at the western end of the pit during the final stages of Phase I. Intermittent work by the backhoe over a period of several days completed this work for all but the easternmost 20 metres of the pit front. Initially, all the loose waste material piled over the coal subcrop by the Phase I stripping was removed. This was followed by the removal of the original soil and till horizons which overlay the coal. Most of this material was sidecast away from the pit, although some was hauled away by dump truck. Approximately 400 cubic metres of overburden were removed during this operation.

The removal of residual overburden/waste rock was carried out in conjunction with the coal mining. The original plans called for mining to begin at the west end of the pit and then proceed towards the east. The floor of the resulting excavation would have sloped towards the highwall and also towards the western end, providing natural drainage for surface run-off and snow melt. Work in this area was quickly abandoned, however, primarily due to the relatively large amount of waste rock which remained above the main seam. The Phase I stripping was planned to stop at or just above the first showing of coal once a certain depth had been reached. At the west end of the pit, this point was subsequently found to represent a thin coal and coaly shale zone which lay approximately one to 1.5 metres above the main seam. Other geological factors, such as the presence of many intrusive bodies and possible structural complexities, combined with time constraints to precipitate a change in the mining plans. The work at the western end of the pit resulted in the removal of some 150 cubic metres of material;

approximately 50 cubic metres of this represented the coal and coaly shale band. This material was kept to provide a base for the product coal stockpiles.

Prior to the excavation of a new coal face, the backhoe removed some 60 cubic metres of rock from the back of the western half of the pit. This rock "wedge" abutted against the highwall making it impossible for the scrapper to mine.

The new production face was excavated downhill from drill hole 85-4. A cut was established across the width of the pit and subsequent mining proceeded by face retreat towards the west. This was to have been achieved by having the bucket of the backhoe work in an up-dip and/or down-dip direction. Such a method would have provided an optimum combination of control and productivity, resulting in a minimum of coal loss and rock contamination. Two factors prevented this approach, however, and the hoe was obliged to dig along the general strike of the coal seam. These factors were:

- the presence of a 5 metre wide permafrost zone along the front of the pit; and,
- the presence of a sharp "roll" or fold within the coal seam near the back of the pit. The trend of this structure was sub-parallel to the highwall and as a result the roll stayed within the pit for some distance.

As the permafrost zone significantly reduced the recoverable coal within this part of the pit, it was necessary to mine right back to the highwall. This entailed mining the area affected by the structural roll; a situation that would have otherwise been avoided during this program. The mining proceeded with great care to avoid rock contamination particularly by orange-coloured rock bands encountered at the top and, later, near the bottom of the coal seam. However, mining in this fashion was time consuming.

Throughout most of the mining the backhoe sat above the working face and loaded into the dump truck which was either positioned in the pit bottom or behind the hoe, on top of the coal seam. The sequence of mining involved the following steps:

a) removal of residual overburden and waste rock with little or no intermixed coal to the dump;

b) removal of intermixed coal and waste rock to stockpile #3 for base material and/or for later beneficiation;

c) coal and orange coloured rock bands stockpiled for later coal beneficiation (stockpile #4);

d) loose coal obtained from atop the permafrost zone, coal obtained from the initial cut area, downhill from hole 85-4, and any coal with relatively large amounts of intermixed carbonaceous claystone to stockpile #1 as "high-ash product";

e) the main portion of the coal seam to stockpile #2 as product;

f) large lumps of permafrost material to stockpile #5. This was mainly intermixed coal and carbonaceous shale, saved for later addition to stockpile #1.

The mining of coal from the second face began on October 25th and concluded November 4th; a period of 11 days. A total of 239 truck loads were hauled to the various stockpiles; loads of waste rock taken to the dump were not tallied. The daily range in stockpiled loads was quite variable (from 12 to 27) due, primarily, to the amount of residual waste material removed and to equipment problems. An estimate of the various tonnages present in each stockpile is presented in Table 5.1. Approximately 3,290 tonnes were stockpiled; some 1,885 tonnes comprise "product" coals contained within stockpiles 1 and 2. Stockpile #1 is anticipated to have a higher ash content than stockpile #2 and, consequently, may be better suited for use within the fluidized bed combustor planned for the Yukon College than for other, more conventional, industrial or domestic uses.

TABLE 5.1

Estimates of Stockpiled Tonnages

Stockpile No.	Loads	Est. Volume (cu. m.)	Estimated Tonnage
1. (product)	66	470	845*
2. (product)	81	577	1,040*
3.	12	85	185**
4.	77	548	1,180**
5.	3	21	40*

Note: i) all volume estimates are based upon a full load, trimmed to the top of the gravel box (8.9 cu. m), factored by 0.8.

ii) * estimated specific gravity = 1.8

iii) ** estimated specific gravity = 2.15

The volume of waste rock removed from above the coal over the mined area was approximately 140 cubic metres. Therefore, the total overburden/waste rock removed from the pit during phase II was 750 cubic metres.

6.0 GEOLOGY

6.1 Introduction

Prior to the 1986 field program, data on the coal seam stratigraphy of the West Hill area came from six rotary drill holes and several cat-trenches. No detailed seam descriptions were available and, as no cores had been taken, the most reliable information was provided by the down-hole geophysical logs.

The seam targetted for the trial mining was fully defined in four of the drill holes (85-3 to 85-6); it was not present in hole 85-1 and hole 85-2 was collared at or near the seam floor. Seam thicknesses in holes 85-3 to 85-6 varied from 3.35 metres (hole 85-5) to 4.27 metres (hole 85-3). These are apparent thicknesses; Carlyle (1985) assigned dips of 30° and 32° to the seam, across the proposed pit area. True thicknesses were, therefore, projected to range between 2.90 and 3.62 metres. Variations in the character of the coal seam, as portrayed by the "density" geophysical logs, were due to differences in the number and thicknesses of in-seam rock bands. These bands were estimated to range in true thickness from a few centimetres to 0.80 metres.

No data was available on the geologic structure of the area except for occasional beddings obtained from outcrops over the southwestern flanks of West Hill.

6.2 General Pit Geology

Before stripping commenced outcrops and road cuts in and around the pit area were examined. The surface distributions and thicknesses of the major lithologies were found to be in broad agreement with those projected from the geophysical logs. No folds or faults were noted. Bedding orientations were, however, quite variable with dips ranging from 10° to 48° to the west, northwest, north and northeast. Some of this variability was due to the presence of cross-bedding within the conglomerates, sandstones and siltstones. In addition, irregular bedding surfaces were common within the finer grained (siltstone and shale) lithologies. These strata exhibited a high degree of jointing and fracturing; some of the latter was undoubtedly cleavage. The siltstones and shales also showed a marked tendency for concentric weathering. All of these factors made structural observations difficult. Several patches of orange-coloured rocks were noted. These represented weathered, highly-altered igneous intrusions. The relationships of these bodies to the bedding was not always visible; in two cases they appeared to be dykes.

Coal is exposed in the side and floor of a large excavation east of the pit area at the location of drill hole 85-2. Detailed examination of this coal-bearing sequence was prevented by a heavy snowfall. Preliminary observations indicated that the sequence had been subjected to strong deformation as evidenced by large amounts of shearing, small-scale disharmonic folding and the presence of a strong, penetrative cleavage. Interestingly, not all of the strata were affected by the small-scale folds. Some layers of hard coal and several orange-coloured rock bands appeared relatively planar, exhibiting only minor warps.

Geological observations were made during Phase I, as time permitted. No detailed mapping of the pit was undertaken, however. The stratigraphic sequence exposed in the highwall above Coal Zone B was composed of lenticular siltstones and arkosic sandstones with thin interbeds of shale, carbonaceous shale and coaly shale. These were overlain by a thick channel conglomerate which formed the highest rock unit exposed within the pit. The orange-weathering igneous rocks originally exposed in road cuts across the hillside, were found to represent thin (0.25 to 2.0 metre) dykes. Other thin, discontinuous sill-like bodies were occasionally located along the bottom half of the highwall. Sills were commonly found immediately above, within and below the main coal seam (see Section 6.3). Some of these may have been fed by shallow dipping dykes similar to those exposed in the permafrost zone along the front of the pit, approximately 30 metres from the pit's western end. Alternatively, these shallow dipping intrusions may represent discordant "steps" which take the sills from one stratigraphic horizon to another.

Bedding measurements on strata exposed within the highwall were variable, similar to those already described. They were generally shallow (10^{o} to 30^{o}) and many dipped towards the northwest. Cross-bedding and/or poorly developed bedding again presented difficulties in obtaining many reliable readings. A zone of highly disturbed and fractured rock is found within the pit. This zone extends across the western pit floor and intersects the highwall near the centre of the pit, rising across the highwall to the east. Preliminary examination of this zone suggests that it probably represents a fault or sharp structural roll which dips into the highwall at 50° to 65°. The disturbed zone is approximately 5.5 metres wide; the central 1.5 metres are highly tectonized with much soft, white, "chalky" secondary mineralization (calcite?) or the fracture surfaces. This zone of deformation and the general variability in bedding undoubtedly reflect structures similar to, or the same as, those later exposed within the coal seam (see Section 6.3.3).

6.3 Coal Seam Geology

This section briefly summarizes some of the more important aspects of the coal seam geology as observed within the test pit.

6.3.1 Seam Stratigraphy

The opening of the coal face below hole 85-4 presented the first opportunity to examine the full coal section in any detail. Observations within the "coal-mining" area (that portion of the pit from which coal was mined) and from atop the main seam at the pit's western end, indicate that the character of the coal seam closely reflects the patterns presented by the drill holes. In other words, while there is considerable seam variation in an east-west direction there is little variation in a north-south direction. Seam sections in the pit correspond relatively well to those presented by the geophysical logs of holes 85-4 and 85-5. A measured section located 17 metres west of the east wall of the "coal-mining" area was 3.24 metres thick compared to 3.81 metres for the seam in 85-4. Most of the difference in thickness is probably due to two factors: i) the top of the measured section may correspond to a rock band located within the uppermost parts of the coal seam in 85-4 (possibly at a depth of 97 feet), and is not, therefore, the seam roof sensu-stricto, and ii) the measured section recorded true thickness while the drilled section most probably represents apparent thickness. A seam section located 36 metres from the east wall, southeast of hole 85-5, was slightly thicker than the drilled section (3.81 metres compared to 3.35 metres). In this portion of the pit the seam characteristics are transitional between those exhibited by hole 85-4 and those of hole 85-5. Precise correlation of the seam roof between measured sections and the drill holes is difficult. It should be noted that correlations of the coal seam are hindered by the lack of detailed-scale (1:40) geophysical logs; only general-scale (1:100) logs were run in 1985. At the westernmost limit of the "coal-mining" area rock band distribution within the seam is similar to that exhibited by hole 85-5; no measured section was obtained from this point due to the rapid termination of activities. At the western end of the pit, the characteristics of the seam roof correspond closely to those portrayed by the "density" log of drill hole 85-6. It is to be supposed that the full coal seam would also show characteristics similar to those presented by this geophysical log.

Coal within the main seam ranges from being very hard, forming large lumps or slabs, to extremely friable and highly sheared, forming small pieces and powder. These physical characteristics exist at various horizons within the seam and are mirrored by some of the rock bands. The coal varies in appearance between dull-grey, shiny steel-grey and black. It generally increases in "blackness" with depth of cover; where the seam lay closest to the original topography most of the coal was grey. At the western end of the "mining" area, however, a thin coal split below the main seam possessed a steel-grey tone while most of the overlying coal was black. In most high rank coal seams, a very hard, grey coal typifies boney (high-ash) coal. While this type of coal is present within the main seam, unsheared slabs and lumps of ordinary coal also exhibit these features. The hardness is typical of anthracite and the grey-colour may be due to oxidation and/or the effects of permafrost. From the measured sections, boney, stoney and baked coals make up about 18% of the seam, lower ash coal comprises 55% to 62% and rock bands form 20% to 27% (see Appendix I).

Rock bands contained within the main seam are composed of a variety of shaley claystones and altered igneous instrusives (as sills). The claystones are commonly carbonaceous but sometimes contain little or no carbonaceous material; they may also be silty. Thicknesses range from less than one centimeter to 0.22 metres. The intrusive igneous bodies are sills; they are conformable to bedding and have baked the coal and/or claystone adjacent to both their upper and lower surfaces. These sills range in thickness from several centimetres to 0.40 metres; they are relatively continuous and terminate abruptly. As a result of post-emplacement tectonics, they may form en-echelon strips and exhibit boudinage. They are typically orange to buff coloured along their upper and lower surfaces (or throughout, where very thin) and along major joint surfaces. On freshly broken surfaces, particularly within the thicker bands, they are whitish to light grey. The sills within the main seam were all altered to fine clays and quartz with occasional rusty, weathered pyrite. At the western end of the pit in a thick sill immediately above the main seam, large round boulders of light coloured, fine-grained igneous rock (possibly rhyolitic) are contained within an altered clay-rich matrix similar to that found in the thinner sills.

It is important to understand the distribution and lateral extent of the sills as they probably account for most of the variation exhibited by the main seam (as portrayed on the geophysical logs). In the "coal-mining" area below 85-4 a sill is located at or near the top of the main seam. Precise correlation is difficult but it probably represents the rock band present at 97.5 feet on the log of 85-4. A few metres to the west another sill is present above the first; this may be equivalent to the rock band at 96.5 feet in 85-4. Towards the west the lower of these two sills disappears after approximately 7 metres. The upper sill continues across most of the coal mining area and effectively forms the roof of the seam, although a thin coaly band usually overlies it. This sill is probably equivalent to the rock band at 117 feet within 85-5; the rock band at 121.5 feet in 85-5 also includes a sill. Within the mined area this latter sill first appeared approximately 43.5 metres west of the initial cut. At that point it lay approximately 0.3 metres below the upper sill; this widened to 0.75 metres at the western limit of the mined area. A lower sill, equivalent to part of the rock band between 124.5 and 127 feet in hole 85-5, was first encountered some 18 metres west of the initial cut. This sill persisted at this horizon the remaining length of the "coal-mining" area. It should be noted that the sills often lie in contact with or in close proximity to claystone and boney/stoney coal bands. Consequently, the rock bands indicated on the geophysical log of hole 85-5 are not solely composed of altered igneous rock. The lithologies in contact with the sills have been baked along both the upper and lower contacts. These baked zones are commonly 0.05 to 0.12 metres thick but the thermal effects may extend to slightly greater thicknesses. This alteration results in ubiquitous columnar jointing and leaves the various lithologies somewhat brittle. While baked claystones can be differentiated from coal, the thermal alteration masks the true character of the coal which makes it difficult to distinguish one coal type from another. The sills within the uppermost portions of the main seam can be seen at the site of hole 85-2 approximately 120 metres east of the "coal mining" area. They are somewhat thinner at this location. Throughout the "coal-mining" area the floor of the main seam consists of a shaley claystone. Below this are other thin sills and claystones with interbeds of coal.

6.3.2 Structure

From south to north across the "coal mining" area the main structural features are:

i) along the front of the pit the beds exhibit a shallow dip (less than 10°) towards the south;

ii) they are gently folded to dip between 12° and 18° to the northwest. The fold axis plunges approximately 10° to N.075;

iii) dips steepen, ranging from 20° to 25° with localized warps of 40° to 46°; the direction of dip varies from west-northwest to north-northwest;

iv) the beds are sharply folded about an axis which plunges at approximately 10° to N.255° to 265°. Beds north of this axis dip steeply (65-72°) to the northeast. This fold trends into the headwall and its effects are not evident in the western two-thirds of the "coal-mining" area.

The shallow southerly dips and most of the shallow northwesterly dips lie within the permafrost zone. Most of the pit covers the moderately (20°-25°) northwest dipping portions of the seam. The steep northeastern dipping section of the coal seam is mainly restricted to the eastern third of the mined area; the axial trend of this anticlinal fold intersects the highwall approximately 18 metres from the start of mining. As a result, the zone of steeper dip disappears into the highwall.

Other structures contained within the coal seam included: zones of heavy shearing and disharmonic folding, low-amplitude short-wavelength warps, several joint sets, cleavage and boudinage of the sills. No detailed study of these structures was undertaken.

6.4 Remaining Coal Reserves - Pit Area

No detailed calculations have been made to determine the coal reserves that remain within the pit. A quick approximation based upon the same assumptions that were made in Section 5.1 suggests that a potential 2,150 tonnes of "product" (selectively mined raw coal) may be available. The original estimate of 2,200 tonnes for oxidized coal and coal mixed with soil has been increased to 3,650 tonnes to take the permafrost zone into account. These figures have been adjusted for the area already mined. No comparison between theoretical tonnage estimates and recovered tonnages has been carried out.

7.0 SAMPLING AND TESTING

A number of samples were taken during the program. The different sample types are discussed in Section 7.1 while the results of the testing are discussed in Section 7.2.

7.1 Samples

The test mining - bulk sample program produced approximately 1,885 tonnes of "product" coal. While this coal can be considered a bulk sample for supply to potential customers a number of other samples (including a smaller "bulk" sample) were taken for geological and control purposes. These samples were obtained as channel and grab samples from within the pit and as random samples from the main stockpiles. They are described in Appendix I.

The main objectives in sampling the coal seam within the "coal-mining" area were:

a) to provide independent "check" samples of the coal going to the product stockpiles (that is, stockpile #1 and #2);

b) to provide independent check samples of the coal going to form the 14-tonne "bulk" sample; and,

c) to determine the variability of coal quality within the seam, both laterally and vertically, and to ascertain the character of the seam as a whole.

Objective a) was not successful for stockpile #1 due to the erratic thicknesses and poor definition of the material which overlay the permafrost zone. Some of this material went to stockpile #1 while some went to stockpiles 3, 4 and 5. Sample 13 may have to suffice for stockpile #1 although samples 1 and 2 characterize a lot of the coal sent to this stockpile during the early stages of coal mining. Most of the material sent to stockpile #2 is characterized by samples 5 to

12 (one-third) and samples 16 and 16A (two-thirds) (item b), as well as by the stockpile sample (14).

At the end of the program a "bulk" sample of approximately 14 tonnes was obtained from coal set-aside for this purpose. This sample was intended to undergo detailed analysis and pilot-plant washing. As a result, the sample was required to reflect the run-of-mine coal that would be obtained from taking the whole seam (inclusive of rock bands) as opposed to coal obtained from selective mining. The resulting sample was collected from two sets of material, namely:

i) the coal taken from the section described by samples 5 to 12;

ii) coal taken from the section described by samples 16, 17 and 18.

The former material (i) was stored at one corner of stockpile #2 while the latter material (ii) was stored alongside stockpile #1. To reflect the general distribution of tonnage within the mined area the "bulk" sample was composed of one-third (i) and two-thirds (ii).

The samples, 1 to 4 and 19, were taken for geological purposes (item c) while sample 15 represents stockpile #4. Four additional samples (A to D) were taken from some of the sills and baked margins of the host coal and/or claystone. These samples were obtained to test for anomalous elements such as precious metals.

7.2 Results of Coal Testing

Prior to the end of mining, it was intendend that most of the samples would undergo comprehensive testing and analysis. However, budget constraints shortened this part of the program. Consequently, only a few of the samples were examined; the scope of the laboratory work was also reduced. The results of the testing are discussed below; certificates of analysis are presented in Appendix II.

Samples 1 to 12 were sent to Chemex Laboratories Ltd., Vancouver for preliminary analysis whilst coal mining continued. Samples 1 to 4 were intended to provide quick data on ash, moisture and heat contents. The higher moisture levels observed in sample 1 (total moisture = 19.1%, residual moisture = 8.01% a.d.b.) probably reflect incipient permafrost in the top portions of the seam at this location. The ash contents of samples 2 and 3 are incongruous; sample 3 should contain less ash than sample 2 as the latter included a thick claystone band which was omitted in the former. Sample 4 was taken from part of the coal seam which contained several claystone and boney coal bands. It is possible that the results from samples 3 and 4 were interchanged; Chemex believes this to be unlikely.

Slightly more detailed analyses were undertaken on samples 5 to 12. These represent incremental (or ply) samples taken across the entire seam. They were submitted for preliminary proximate analysis, sulphur and heat content determinations. Residual moisture contents range from 2.12% to 4.56% (a.d.b.); it is interesting to note that moisture contents show a marked decrease from the seam top to floor. Ash contents range widely, from 20.35% to 61.51%, (a.d.b.), and correspond to the predominant material (coal or rock) which make up the ply samples. Volatile contents are consistent with coal of anthracite rank although samples 5 and 6 are slightly high. Sulphur content is very low, varying between 0.31% and 0.54% (a.d.b.). Heat contents are reasonably high considering the ash contents and reach 14,000 Btu/lb. on a moist, mineral matter-free basis (sample 8). Not all the samples burned to completion during the heat content determinations. Samples 5 and 7 were re-run using benzoic acid to aid the combustion process. This resulted in an increase in Btu's for each sample; sample 5 increased from 10,116 to 10,297 Btu/lb. and sample 7 from 7,525 to 8,017 Btu/lb. (a.d.b.). If the air-dried heat content of sample 8 is increased by approximately 180 But's/lb., similar to sample 5, then the moist, mineral-matter free Btu's increase to 14,250 per lb.

The determination of specific gravities for samples 5 to 12 would allow weighted averages to be made for each of the various analyses thus providing data for the seam as a whole at this particular sample location. An estimated composite of samples 5 to 12 indicates that the full seam section could have a raw ash content of approximately 34% (a.d.b.). No further analyses have been carried out on these samples, however, and samples 13 to 19 and A to D have not yet been tested.

The "bulk" sample sent to Calgary went to Birtley Coal and Minerals Testing. The sample was homogenized and large lumps were broken by hand to 8 inches. Representative sub-samples were taken for raw head analysis and screening. The raw head sub-sample was crushed to 3/4" and analyzed for proximate, sulphur and heat content. The results indicate that this raw, run-of-mine coal has a residual moisture of 1.9% and 45.4% ash, 8.4% volatiles, 44.3% fixed carbon and 0.36% sulphur (a.d.b.). The heat content is reported at 5,735 Btu/lb. (3,186 cal/gm) or, with benzoic acid, 6,904 Btu/lb. (3,836 cal/gm) on an air dried basis.

The sub-sample for screening filled six 45-gallon barrels. This material was crushed to pass 4" and then screened into nine fractions between 4" x 0. The results are fairly uniform throughout the various size fractions. Recoveries (by weight) varied from 6.2% (4" x 2") to 19.7% (1/2" x 1/4") although five of the size fractions ranged between 10.4% and 12.9%. Only 7.8% of the material passed 28 mesh while 17.3% fell between 4" x 1".

Residual moistures are all less than 1.8% except for the 1/16" x 28 mesh and 28 mesh x 0 with 11.5% and 13.2% (a.d.b.), respectively. These high values are probably due to either incomplete drying or the presence of clays that retain water molecules within their lattice structure. The ash contents of the various size fractions vary only slightly, from 42.5% (4" x 2") to 47.3% (2" x 1"). There are no trends towards lower ash contents in either the coarser or finer sizes. There are only small ranges in sulphur and heat contents.

Upon review of the screening data three composites were formed and readied for further testing. Three composites were made from the 4" x 28 mesh fractions these were; 4" x 1" (17.3% by weight), 1" x 1/4" (39.6%) and 1/4" x 28 mesh (35.3%). These composites were subjected to float: sink testing at specific gravity cut points of 1.50, 1.60, 1.70, 1.80 and 1.90. The 28 mesh x 0 fraction underwent froth flotation testing. The detailed results of this work are presented in Appendix II. These results indicate that the "bulk" sample provides very little coal of less than 20% ash. Theoretical values of ash and yield at a 1.8 S.G. cut are 22% and 33.6%, respectively. At a 1.9 S.G. cut, the values are ash = 27.08%, yield

= 49.6%. The results of the froth flotation indicate there is very little recoverable coal within the 28 mesh x 0 fraction.

Two samples were composited from the floats of the preceeding tests; one sample was from coal that reported to the floats at 1.8 S.G. and the other from coal floating at a 1.9 S.G. cut. These samples underwent proximate analysis, and sulphur and heat content determinations. On an air-dried basis the results from the 1.8 S.G. composite were: residual moisture = 1.9%, ash = 22.7%, heat content = 10,590 Btu/lb. (5,882 cal/gm). The 1.9 S.G. composite results were: residual moisture = 2.0%, ash = 27.0%, heat content = 9,810 Btu/lb. (5,448 cal/gm). The heat contents were determined using benzoic acid as an aid to combustion. As a prelude to more detailed analyses these two samples were tested for their ash fusion temperatures. The purpose of this was to see if there were potential slagging problems associated with the higher ash sample. Both samples show high initial deformation temperatures under reducing conditions (1.8 S.G. composite = 1349°C; 1.9 S.G. composite = 1393°C); the 1.9 composite always exhibits the higher temperatures. No further testing has been performed on the "bulk" sample.

It should be remembered that these tests were performed upon a sample that included all in-seam rock bands. Similar tests on selectively mined coal or blends of selectively mined and bulk mined coal may product significantly better washability results.

8.0 SELECTIVE MINING - DISCUSSION

One of the primary objectives of the test mining program was to provide a sample coal product to potential customers. As no coal washing plant was available, it was decided to utilize selective mining for "in-pit" cleaning. It was hoped that the removal of some of the thicker rock bands from the coal seam would lower the ash content significantly. Until the appropriate analyses have been performed it will not be possible to precisely determine how successful the mining was in this goal.

Some of the main factors that affected the efficiency of the selective mining during the 1986 program were:

(a) the presence of deep permafrost along the front of the pit;

(b) structural complexities within the coal seam;

(c) rock band recognition by the hoe operator;

(d) rock band hardness and the presence of permafrost bands within the seam; and,

(e) equipment suitability.

Some of the difficulties associated with items a) and b) have been discussed in Section 5.3. One additional point is that while the pit floor over the first 18 metres of coal mining was relatively flat once mining advanced beyond that, to the western flank of the anticlinal fold, the roof and floor of the seam pitched to the northwest. Consequently, the hoe had to shift its position constantly to obtain a relatively level surface from which to mine. Quite often the backhoe had to build its own operating pad.

Rock band recognition by the hoe operator (item c) was relatively straightforward for the orange-coloured sill rock. Without the aid of the geologist in the pit, however, it would have been impossible for the operator to have distinguished grey coal from grey claystone or black coal from dark grey to black claystone. The hardness of the rock bands and two permafrost bands within the coal seam (item d) provided more difficulties for the backhoe. Almost all of the coal mining was done using the 2 cubic yard clean-up bucket. Usually, it took several attempts to break the rock bands away from the coal face. Once the rock band broke the residual pull on the bucket often resulted in several cubic decimetres of good coal being taken with the rock (which is why this material as sent to stockpile #4). This was also the case for a permafrost band present within the top layer of coal, immediately below the seam roof. Also, it was never possible to selectively mine the lowermost coal band (below the lower sill), equivalent to sample 18. This was due to three reasons: i) permafrost in the coal, ii) lack of room, and iii) the difficulty in removing the lower sill (which often resulted in taking most of the lower coal band with it).

With regard to item e), it is unlikely that any one piece of equipment would be entirely suitable for mining under the conditions experienced within the test pit. However, if only one piece can be had, the Catepillar 235 backhoe is probably the best suited for operations of similar scale and scope in areas of similar geological complexity to that of the 1986 test pit. The use of the straight-edged clean-up bucket for selective mining is preferred over the toothed bucket if control over rock contamination is paramount. However, the clean-up bucket was slow in removing the main rock bands. If larger areas of just rock or coal were to be mined then bucket changes could be utilized; these take time by hand, and are not easy. To increase speed, teeth could be added to both sides of the clean-up bucket. The 3/4 cu. yd. toothed bucket can be used when coal loss and/or rock contamination are within acceptable limits, or are not of primary importance. The use of this bucket would result in higher face productivity.

9.0 CONCLUSIONS

From the preceeding sections of this report, the following conclusions are drawn:

- The main coal seam present within Coal Zone B in the West Hill area is laterally continuous over several hundred metres.

- The seam stratigraphy within the test pit correlates with the drill holes.

- Most of the in-seam variations shown on the geophysical logs of the 1985 drill holes are due to igenous intrusions (as sills).

- Further mining within the stripped area will probably be restricted to the back half of the pit because of a permafrost zone along the front.

- Selective mining in the central portions of the pit, downhill from hole 85-5, will be difficult due to the thinner coal splits.

- Conditions for selective mining should improve towards the western end of the pit, but more rock will have to be removed to expose the main seam.

- Selective mining can be employed east of presently mined area. Permafrost may prevent mining in the far eastern corner of the pit.

- Additional reserves are available between the highwall and the drill holes. Further work will be necessary to evaluate the feasibility of their recovery.

Conclusions drawn from the preliminary coal analyses should be treated with caution due to the limited data available. The few analyses performed to date indicate that:

- Coal that has not been selectively mined but which includes all the rock bands, is relatively high in raw ash (45.4%). The raw ash in any one part of the mined area may be as low as 34%.

- It is unlikely that crushing and screening of such raw coal would significantly reduce the ash content.

- Float-sink analyses on this sample yield very low recoveries of coal with less than 20% ash; at 27% ash theoretical recoveries are approximately 50%.

- In order to obtain a lower ash product and higher wash plant recoveries it may be necessary for operations in the West Hill area to wash selectively mined coal only or to blend bulk mined and selectively mined coals.

- Predictions of possible ash contents for product coal(s) obtained solely by selective mining must await additional coal testing and analysis.

10.0 RECOMMENDATIONS

If W.C.C. intends to continue mining along the West Hill area, we recommend that:

- All samples that have not yet been examined should undergo preliminary testing.

- Based upon the preliminary test results additional, comprehensive analyses should be undertaken. These analyses should determine the coal and ash characteristics for washed, screened and raw coal at various size fractions. Such data will enable decisions to be made regarding selective and/or bulk mining, crushing and screening or washing to produce a saleable product.

- The testing of the 14-tonne bulk sample should continue. Pilot plant coal washing should await the results of the preliminary analyses.

- Geological mapping be carried out within and adjacent to the pit, with particular emphasis on structural geology.

- Further drilling should be conducted both within the existing stripped area and to the west, north and east to confirm the amounts of additional reserves and to provide data which will aid the mining plan. Such a drilling program should be capable of providing cored holes; all holes should be geophysically logged.

- The coal "seam" immediately below the main seam should be evaluated with respect to its reserve potential and coal quality. This should form part of an overall search for nearby low-ash coal for possible blending purposes with the product coal from the existing pit.

It is further recommended that:

- Detailed surface geological mapping be undertaken across all of the northern coal mining leases.

- This mapping should be followed up by trenching and drilling.

Submitted by: **JHP COAL-EX CONSULTING LTD.**

J.H. Perrry, P. Geol, F.G.A.C., F.G.S.

11.0 REFERENCES

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1985: Report on the 1985 Drill Program, Whitehorse Coal Property; for Whitehorse Coal Corp., Unpublished.

Clark, D.

1986: Construction Summary, Excavation for Exploration of Pit No. 1; for Whitehorse Coal Corporation, Unpublished.

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APPENDICES

APPENDIX I

SAMPLE DESCRIPTIONS

SAMPLES 1 TO 3

Most of this coal section is composed of rubbly coal and claystone and powdered coal. Slabs and lumps representing more coherent strata are present near the base of the section.

Sample No.	True Thickness (m)	Description
		Top of section lies several centimetres below projected base of upper sill.
#1 (1.99m)	0.23	Coal - powdered.
	0.08	Coaly Claystone and Coal - mixed pieces and powder.
	0.54	Coal - pieces and powder; some carbonaceous claystone pieces.
	0.20	Coal - powder.
	0.10	Coal - pieces, with some stoney coal pieces.
	0.27	Coal - powder and pieces.
	0.09	Coal - heavily sheared, listric surfaces.
	0.09	Coal - powder.
	0.10	Claystone - light-bluish grey, broken.
	0.10	Coal - sheared, powdered.
	0.09	Carbonaceous Claystone - brown weathering, dark grey when fresh.
	0.10	Coal - powdered.
#2 (1.66m); #3 (1.07m)	0.16	Stoney Coal - fissile, highly sheared pieces.
	0.15	Carbonaceous Claystone - pieces, sheared.
	0.15	Coal - pieces, sheared.
	0.13	Coal - lumps.
	0.05	Coal - powdered.
	0.10	Claystone - bluish-grey
	0.02	Coal - powdered.

Samples 1 to 3 Continued

Sample No.	True Thickness (m)	Description
#3 (1.07m)	0.07	Claystone - bluish-grey.
	0.11	Coal - powdered.
	0.13	Coal - lump.
		----- Floor or main seam -----
#2 (1.66m)	0.10	Claystone - bluish-grey
	0.05	Coal.
	0.09	Claystone - bluish-grey
	0.06	Coal.
	0.22	Claystone - bluish-grey.
	0.07	Coal - lump.

Samples #1, #2 and #3 are channel samples across the seam. Sample #2 extends into the floor of the main seam. The seam floor (base of Sample #3) is believed to correlate with the depth of 107.5 ft. on the densilog of hole 85-4. These samples were taken from the centre of the excavation approximately 3 metres west of the east face of the "coal-mining" area.

SAMPLE #4

This is a grab sample taken horizontally across a 2.4 metre section of disharmonically folded coal seam. This sample was taken to determine the gross coal quality of a section of blocky and slab-forming coal and claystone. The location of this sample is approximately 10 metres west of the east face of the "coal-mining" area.

SAMPLES 5 TO 12

Sample No.	True Thickness (m)	Description
		Roof: Sill - altered igneous rocks.
	0.10	Baked Coal - shows columnar jointing.
#5 (0.27m)	0.04	Stoney Coal.
	0.08	Boney Coal.
	0.05	Stoney Coal.
	0.31	Coal - hard.
#6 (0.56m)	0.04	Stoney Coal.
	0.21	Coal - lump.
	0.09	Carbonaceous Claystone - some stoney coal.
	0.05	Stoney Coal.
#7 (0.49m)	0.22	Claystone - blocky, some carbonaceous and coaly bands.
	0.05	Coal - hard.
	0.08	Stoney Coal - large lumps.
#8 (0.24m)	0.24	Coal - with several thin claystone laminae near top.
	0.04	Claystone.
	0.04	Sheared Claystone - with coal laminae.
#9 (0.26m)	0.07	Coal.
	0.07	Claystone.
	0.04	Stoney Coal.
	0.17	Coal - lump.
#10 (0.41m)	0.05	Coal - thin claystone band near base and several claystone laminae throughout.
	0.19	Coal - many listric surfaces.

Samples 5 TO 12 Continued

Sample No.	True Thickness (m)	Description
#11 (0.19m)	0.03	Stoney Coal.
	0.05	Coal.
	0.11	Silty Claystone - sheared in bottom 0.03 m.
#12 (0.82m)	0.09	Coal - lump
	0.16	Coal - heavily sheared
	0.07	Stoney Coal.
	0.13	Coal.
	0.09	Claystone - dark grey.
	0.28	Coal - hard, occasional claystone and boney laminations.
		-- Floor of seam --
		Claystone - same as base of Sample #3

These samples represent channel samples taken across the full thickness of the main coal seam. This section was located in the centre of the excavated area approximately 17 metres west of the east wall.

SAMPLES 13 TO 15

These samples were taken from the main stockpiles. Each sample comprises several large bags which were taken at various intervals during the mining period.

Sample 13	(4 bags)	-	Stockpile #1
Sample 14	(6 bags)	-	Stockpile #2
Sample 15	(5 bags)	-	Stockpile #4

SAMPLES 16 TO 18

Sample No.	True Thickness (m)	Description
		Roof - altered igneous sill.
	0.12	Baked Coal - indeterminate types; hard, columnar jointing.
	0.10	Boney Coal - grey, very hard. Could be lower ash coal baked by intrusion.
	0.06	Coal - grey, hard.
	0.12	Boney Coal - grey, very hard.
	0.21	Coal - black and grey, mixed with rusty coloured, weathered surfaces.
#16 (2.20m)	0.02	Claystone.
	0.06	Coal - as above.
	0.02	Claystone.
	0.25	Coal - black, friable, sheared.
	0.52	Coal - black, very heavily sheared, listric surfaces. Could have interlayered carbonaceous claystone laminae in top third.
	0.05	Carbonaceous Claystone - soft, highly sheared.
	0.19	Coal - black, friable, sheared.
	0.03	Carbonaceous Claystone - as above.
	0.29	Coal - hard, friable.
	0.16	Coal - very hard; could be boney.
#16A (0.28m)	0.05	Coaly Claystone - dark grey
	0.11	Carbonaceous Claystone.
	0.08	Coal - grey, hard, could be boney.
#17 (1.21m)	0.04	Baked Coal.
	0.17	Altered igneous rock (Sill).
	0.11	Baked Contact - indeterminate, probably carbonaceous claystone.

Samples 16 TO 18 Continued

Sample No.	True Thickness (m)	Description
	0.15	Carbonaceous Claystone.
	0.19	Stoney Coal - grey, very hard
#17 (1.21m)	0.08	Carbonaceous Claystone.
	0.10	Coaly Claystone - grey.
	0.13	Carbonaceous Claystone.
	0.06	Boney Coal.
	0.05	Coal.
#18 (0.40m)	0.05	Boney Coal.
	0.24	Coal.
		--- Floor of Seam ---
		Carbonaceous Claystone.

These samples represent channel samples taken across the full thickness of the main coal seam. This section was located in the centre of the excavated area approximately 36 metres west of the east wall.

SAMPLE 19

Sample No.	True Thickness (m)	Description
		Roof - altered igneous rock (Sill).
#19 (0.75m)	0.09	Baked Claystone.
	0.08	Carbonaceous Claystone.
	0.03	Boney Coal.
	0.03	Coal - hard.
	0.13	Coaly Claystone.
	0.34	Coal.
	0.05	Boney Coal.
		Altered igneous rock (Sill).

This sample is a channel sample taken across the coal and claystone band that lies between the middle sill and the sill that forms the roof of the seam. The coal in this section is equivalent to the peak on the densilog of hole 85-5 centred about the 120 ft. depth. This sample was obtained from the centre of the excavated area approximately 47.5 metres west of the east wall.

14-TONNE "BULK" SAMPLE

Formed by coal characterized by samples 5 to 12 (one-third) and coal characterized by samples 16, 17 and 18 (two-thirds).

SAMPLES A, B, C AND D

These samples were obtained for ICP analysis and fire assay purposes primarily to test their metals content.

Sample A : Channel sample across the first sill above the seam floor approximately 36 metres west of the east wall.

Sample B : Channel sample across the uppermost sill (seam roof) taken from the highwall approximately 15 metres west of the east wall.

Sample C : Sample of the baked rock/coal below the sill (B, above).

Sample D : Channel sample across a zone containing two sills projected to lie below the main coal seam. Taken from a trench excavated along the front of the pit approximately 20 metres from the western end of the pit.

Sample No.	True Thickness (m)	Description
#D (1.48m)	0.06	Baked carbonaceous claystone.
	0.55	Altered igneous rock (Sill).
	0.62	Baked carbonaceous claystone, coal and unbaked carb. claystone and coal.
	0.25	Altered igneous rock (Sill).

APPENDIX II

RESULTS OF COAL TESTING
AND COAL QUALITY ANALYSES

Chemex Labs Ltd.

Analytical Chemists • Geochemists • Registered Assayers

212 Brooksbank Ave.
North Vancouver, B.C.
Canada V7J 2C1
Phone: (604) 984-0221
Telex: 043-52597

CERTIFICATE OF ASSAY

TO : WHITEHORSE COAL CORPORATION ** CERT. # : A8620334-001-A
INVOICE # : I8620334
BOX 5478 DATE : 1-DEC-86
WHITEHORSE, YUKON P.O. # : NONE
Y1A 5H4 WHITEHORSE

Sample description	BASIS	T.M. %	R.M. %	ASH %	V.M. %	F.C. %	SULFUR %	C.V. BTU/LB
SAMPLE #1	AR	19.1	--	--	--	--	--	--
	A.D.	--	8.01	50.15	--	--	--	3851
	DRY	--	--	54.51	--	--	--	4186
SAMPLE #2	AR	12.8	--	--	--	--	--	--
	A.D.	--	4.47	50.76	--	--	--	4823
	DRY	--	--	53.14	--	--	--	5048
SAMPLE #3	A.D.	--	4.74	51.91	--	--	--	--
	DRY	--	--	54.50	--	--	--	--
SAMPLE #4	A.D.	--	4.38	39.63	--	--	--	6830
	DRY	--	--	41.44	--	--	--	7143
SAMPLE #5	A.D.	--	4.56	20.35	10.48	64.61	0.42	10297
	DRY	--	--	21.32	10.98	67.70	0.44	10789
SAMPLE #6	A.D.	--	4.16	24.64	10.29	60.91	0.53	9341
	DRY	--	--	25.71	10.74	63.55	0.56	9746
SAMPLE #7	A.D.	--	3.12	37.83	7.18	51.87	0.44	8017
	DRY	--	--	39.05	7.41	53.54	0.45	8275
SAMPLE #8	A.D.	--	3.00	23.77	5.89	67.34	0.54	10397
	DRY	--	--	24.51	6.08	69.41	0.56	10719
SAMPLE #9	A.D.	--	3.01	48.52	7.66	40.81	0.36	6207
	DRY	--	--	50.02	7.89	42.09	0.37	6399
SAMPLE #10	A.D.	--	2.88	31.17	5.82	60.13	0.48	9325
	DRY	--	--	32.09	5.99	61.92	0.49	9602
SAMPLE #11	A.D.	--	2.12	61.51	5.50	30.87	0.31	4409
	DRY	--	--	62.84	5.62	31.54	0.32	4504
SAMPLE #12	A.D.	--	2.73	34.71	6.56	56.00	0.45	8544
	DRY	--	--	35.69	6.75	57.56	0.46	8784

NOTE: Calorific values on samples 5, 7, 9, and 11 were done with benzoic acid as requested.

VOI rev. 4/8

....
Registered Assayer, Province of British Columbia

CLIENT: WHITEHORSE COAL CORPORATION
PROJECT: BULK SAMPLE RECEIVED NOV. 20, 1986
LAB NO: 2694
DATE: DECEMBER 1, 1986

HEAD RAW ANALYSIS, air dried basis

ADM%	MOIST%	ASH%	VOL%	F.C.%	S%	CV CAL/GM	BASIS
11.80	1.90	45.40	8.40	44.30	0.36	3186	adb
	13.48	40.04	7.41	39.07	0.32	2810	arb
		46.28	8.56	45.16	0.37	3248	db

SIZE AND RAW ANALYSIS, air dried basis

SIZE FRACTION	WT%	RM%	ASH%	VOL%	FC%	S%	CV CAL/GM	CUMULATIVE WT%	CUMULATIVE ASH%
4" X 2"	6.20	1.10	42.50	6.40	50.00	0.38	3820	6.20	42.50
2" X 1"	11.10	1.60	47.30	7.10	44.00	0.34	3088	17.30	45.58
1" X 3/4"	7.30	1.80	45.70	7.10	45.40	0.33	3396	24.60	45.62
3/4" X 1/2"	12.60	1.30	46.70	7.80	44.20	0.34	2936	37.20	45.98
1/2" X 1/4"	19.70	1.80	45.80	7.80	44.60	0.33	3256	56.90	45.92
1/4" X 1/8"	12.90	1.70	46.80	8.30	43.20	0.34	2933	69.80	46.08
1/8" X 1/16	12.00	1.80	45.40	8.60	44.20	0.35	3064	81.80	45.98
1/16"X 28M	10.40	11.50	44.70	9.50	34.30	0.35	3369	92.20	45.84
28M X 0	7.80	13.20	45.10	10.80	30.90	0.35	3353	100.00	45.78

CLIENT: WHITEHORSE COAL CORPORATION
PROJECT: BULK SAMPLE RECEIVED NOV. 20, 1986
HEAD RAW - SIZE & RAW ANALYSIS
LAB NO: 2694
DATE: DECEMBER 4, 1986

HEAD RAW ANALYSIS, air dried basis

ADM%	MOIST%	ASH%	VOL%	F.C.%	S%	CV CAL/GM (USUAL)	CV CAL/GM (BENZOIC)	BASIS
11.80	1.90	45.40	8.40	44.30	0.36	3186	3836	adb
	13.48	40.04	7.41	39.07	0.32	2810	3383	arb
		46.28	8.56	45.16	0.37	3248	3910	db

SIZE AND RAW ANALYSIS

SIZE FRACTION	AIR DRIED BASIS		DRY BASIS	
	CV CAL/GM (USUAL) RUN #1	CV CAL/GM (BENZOIC) RUN #2	CV CAL/GM (USUAL) RUN #1	CV CAL/GM (BENZOIC) RUN #2
4" X 2"	3820	4339	3862	4387
2" X 1"	3088	3798	3138	3860
1" X 3/4"	3396	3934	3458	4006
3/4" X 1/2"	2936	3791	2975	3841
1/2" X 1/4"	3256	3736	3316	3804
1/4" X 1/8"	2933	3736	2984	3801
1/8" X 1/16	3064	3709	3121	3777
1/16 X 28M	3369	3813	3807	4314
28M X 0	3353	3735	3863	4303

NOTE: RUN #1 - USUAL METHOD
RUN #2 - BENZOIC ACID ADDITIVE METHOD

Birtley Coal
& Minerals Testing

CLIENT: WHITEHORSE COAL CORPORATION
PROJECT: BULK SAMPLE RECEIVED NOVEMBER 20, 1986
LAB NO: 2694
DATE: DECEMBER 10, 1986

FLOAT-SINK ANALYSIS, air dried basis: 4" X 1" (WT% = 17.3)

S.G. FRACTION	WT%	RM%	ASH%	CUMULATIVE WT%	CUMULATIVE ASH%
FLOAT - 1.50	0.10	0.90	5.40	0.10	5.40
1.50 - 1.60	6.40	1.70	13.00	6.50	12.88
1.60 - 1.70	20.60	2.10	22.70	27.10	20.35
1.70 - 1.80	16.00	2.30	32.30	43.10	24.78
1.80 - 1.90	16.10	2.00	41.30	59.20	29.28
1.90 - SINK	40.80	1.60	69.60	100.00	45.73

FLOAT-SINK ANALYSIS, air dried basis: 1" X 1/4" (WT% = 39.6)

S.G. FRACTION	WT%	RM%	ASH%	CUMULATIVE WT%	CUMULATIVE ASH%
FLOAT - 1.50	0.50	0.50	7.90	0.50	7.90
1.50 - 1.60	7.60	0.90	12.70	8.10	12.40
1.60 - 1.70	16.50	1.40	21.40	24.60	18.44
1.70 - 1.80	14.90	1.60	31.00	39.50	23.18
1.80 - 1.90	12.30	1.70	39.00	51.80	26.93
1.90 - SINK	48.20	1.10	68.70	100.00	47.07

FLOAT-SINK ANALYSIS, air dried basis: 1/4" X 28 MESH (WT% = 35.3)

S.G. FRACTION	WT%	RM%	ASH%	CUMULATIVE WT%	CUMULATIVE ASH%
FLOAT - 1.50	0.70	0.80	5.50	0.70	5.50
1.50 - 1.60	7.50	0.80	10.80	8.20	10.35
1.60 - 1.70	14.00	1.50	19.50	22.20	16.12
1.70 - 1.80	15.40	2.20	28.30	37.60	21.11
1.80 - 1.90	15.70	2.10	37.90	53.30	26.05
1.90 - SINK	46.70	1.40	68.70	100.00	45.97

Birtley Coal
& Minerals Testing

CLIENT: WHITEHORSE COAL CORPORATION
PROJECT: BULK SAMPLE RECEIVED NOVEMBER 20, 1986
LAB NO: 2694
DATE: DECEMBER 10, 1986

FROTH FLOTATION TEST, air dried basis: 28 MESH X 0 (WT% = 7.8)

PRODUCT	WT%	RM%	ASH%	CUMULATIVE WT%	CUMULATIVE ASH%
STAGE I	7.80	2.30	34.30	7.80	34.30
STAGE II	8.40	2.60	41.80	16.20	38.19
TAILINGS	83.80	2.00	46.50	100.00	45.15

PULP DENSITY = 10%
REAGENT = 4:1 = KEROSENE:MIBC
DOSAGE = 0.5 LBS/TONNE
CONDITIONING = 60 SECONDS
STAGE I = FIRST MINUTE FROTH
STAGE II = SECOND MINUTE FROTH

CLIENT: WHITEHORSE COAL LIMITED
PROJECT: BULK SAMPLE RECEIVED NOV. 20, 1986
LAB NO: 2694
DATE: JANUARY 8, 1986

ANALYSIS OF COAL

LAB NO:	SAMPLE ID:	MOIST%	ASH%	VOL%	F.C.%	S%	CV CAL/GM	BASIS	CV* Cal/Gm
2694	1.80 COMP.	1.90	22.70	8.30	67.10	0.54	5522	adb	5882
	CC #1		23.14	8.46	68.40	0.55	5629	db	5996
2694	1.90 COMP.	2.00	27.00	8.30	62.70	0.47	5172	adb	5448
	CC #2		27.55	8.47	63.98	0.48	5278	db	5559

ASH FUSION TEMPERATURES (DEG. F)

		REDUCING			
LAB NO.	SAMPLE ID:	IDT	ST	HT	FT
2694	CC #1	2460	2710	2800	2800+
2694	CC #2	2540	2790	2800+	—

* (with Benzoic Acid)

Birtley Coal
& Minerals Testing