

PR-PEACERIVER CANYON 73C1JA

PRELIMINARY STUDY ON THE
PEACE RIVER CANYON COAL PROP.

HALFERDAHL ASSOC.

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INNABAR PEAK MINES LTD.

1973 PRELIMINARY FEASIBILITY STUDY AND DRILLING
ON
PEACE RIVER CANYON COAL PROPERTIES
NORTHEASTERN BRITISH COLUMBIA

Geographic Coordinates
(Centre of Properties)
55° 56' N
122° 8' W
NTS Sheet 93-O/16E

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January 21, 1974

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*Rec'd with
L.T. 1915 FEB. 12/74*

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REFER TO:

PR-PEACE RIVER CANYON
73(A)A

CONFIDENTIAL
ANALYSIS FILE

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SECTION 1.0

INTRODUCTION

Cinnabar Peak Mines Ltd. began investigation of its Peace River Coal Properties with a small drilling program in 1969 shortly after their acquisition. Work including the gathering of geological information, sampling coal seams, trenching, and drilling, continued in 1971 and 1972. Accounts of the 1969, 1971, and 1972 explorations including a compilation of all available pertinent geological and related information are given in the reports listed in Section 8.0 References. This information is not repeated herein. In 1973 the work included preparing access to additional sites and the drill sites themselves, drilling and logging three holes, searching for coal seams by bulldozer trenching, and obtaining engineering data on the feasibility of mining coal on the properties.

Field work commenced on July 2 and ended on October 9, 1973 with a crew of a geologist, G.A. Checklin, and assistant, supplemented from August 5 to 12 by a mining engineer, G.A. Haslett, and assistant. Accommodation was rented in Hudson Hope, and transportation was provided by a rented 4 x 4 pick-up truck. D6, D7 and D8 bulldozers were used as convenient and available. A Longyear drill rig capable of cutting NQ core was used for the drilling.

This report presents the geological and engineering data obtained during the 1973 exploration. Section 3.0 was prepared by G.A. Haslett; Sections 4.0 to 6.0 were prepared by G.A. Checklin and L.B. Halferdahl. In Fig. 1.3 holes drilled by the British Columbia Hydro and Power Authority are numbered 58-1 to 58-6; those drilled by Cinnabar Peak Mines Ltd. in 1969 are numbered 69-1 to 69-3; and those drilled by Cinnabar Peak Mines Ltd. in 1972 and 1973 are numbered 72-1 to 72-4 and 73-4A to 73-6. Elsewhere throughout this report the prefixes 72 and 73 have been omitted from the holes drilled in 1972 and 1973. Throughout this report unless otherwise stated the thicknesses of coal seams represent the total stratigraphic thicknesses including partings from the bottom of the lowest coal to the top of the highest coal; where appropriate the total stratigraphic thicknesses of coal omitting partings are also stated.

SECTION 2.0

SUMMARY AND RECOMMENDATIONS

2.1 Summary

The exposures of the Gething Formation in the Peace River Canyon: at the tail race of the Bennett Dam, at the Aylard Mine, at Contact Point, at Coal-bed Creek, and at Johnson Creek, indicate a regular sequential deposition of coal, shale, sandstone, and then seat earth to coal in upward succession with the absence of profound disturbances since the time of deposition. Sandstone appears from the examination of all available sections to be the predominant rock member of the Gething Formation. Glacial erosion at the top of the Gething Formation is visible in parts of Johnson Creek and had already been confirmed in 1972 by drilling and seismic studies. The main cleavage patterns in the exposed coals have azimuths from 349° to 354° and most frequently of 351° . A similar regularity of azimuth between 266° and 273° is apparent in the secondary cleavage. The coal seams examined, both at the top of the Gething Formation as at Contact Point, and nearer the bottom as at King Gething No. 3 and Aylard Mines, exhibit hardness and little oxidation even where they have been exposed to the atmosphere for a number of years. The seams examined in the trenches on the south slope of Mount Johnson indicate that a total thickness of approximately 41 feet of coal is present in a 400-foot vertical succession of strata, in the middle part of the Gething Formation.

Three drill holes totalling 1140 feet were drilled, partly cored, and logged. Three new trenches were excavated. The Superior Seam is now known to range from 16 to 37 feet below the Moosebar-Gething contact. The Trojan Seam ranges up to $10\frac{1}{2}$ feet thick with 10 feet of coal and appears to thicken and contain more coal towards the south where the dip apparently decreases. The Mogul Seam ranges up to $5\frac{3}{4}$ feet thick in one drill hole and has been correlated with seams in trenches excavated in 1971 on the south slope of Mount Johnson. A group of coal seams 65 to 70 feet above the Mogul Seam, an unnamed seam about 40 feet below the Mogul Seam, and the Castle Point Seam have been

similarly correlated.

Analyses indicate that coal from the Trojan Seam contains very low ash and low sulfur, has coking properties, and is likely to have a yield of 75 per cent. Washability curves flatten at specific gravities above 1.50, showing that the coal can be readily processed. Analyses indicate that the Mogul Seam and the seam about 40 feet below the Mogul Seam can be expected to contain excellent thermal coal. Coal from the Castle Point Seam appears to have coking properties, but to contain more than one per cent sulfur.

Mineable reserves in the Trojan Seam in a small part of the property to a depth of 1500 feet are estimated at 23.8 million long tons. Mineable reserves in the Mogul Seam and the seam about 40 feet below the Mogul Seam in the same part of the property to a depth of 1500 feet are estimated at 24.5 million long tons. Large additional reserves are mineable in these and other seams on the property, but information from drilling and about the economic depth of mining is not sufficient to permit reliable estimates of their size.

2.2 Recommendations

From the estimates of mineable reserves, the expectation of favorable mining conditions, and the high quality of the coal, the continuation of an exploration program is justified and recommended. This program will be directed to obtaining data for the establishment of an open-pit mine on and near the southern slopes of Mount Johnson and extending to the northwest. It will involve additional drilling and the driving of exploratory and sampling adits at suitable seam outcrops. A further drilling program is recommended to establish the continuity of the seams down slope southwest of Mount Johnson for a projected underground mine.

SECTION 3.0

PRELIMINARY FEASIBILITY STUDY

A field study was made of all available outcrops and exposures within the Peace River Canyon Properties of Cinnabar Peak Mines Ltd. and on some adjacent properties. A visit was also made to the Sukunka Mine of Brascan Resources Ltd. and associated companies, some 37 miles south of Chetwynd. The purpose of the study was

- i) To examine the structure of the deposits to acquire preliminary engineering data for feasibility studies for one or more mines within the property,
- ii) To advise on the spotting of drill holes to locate structures present for an open pit mine or mines, and structures present for an underground mine or mines.

Mines and sections are presented generally in the sequence from bottom to top of the Gething Formation. The seam sections and inclinations given are subject to correction. Those taken on the surface exposures could be affected by embankment slump and drift; underground sections could be affected by distortion through extrusion of the seam floor on the exposed flanks of the seam.

3.1 Aylard Mine

The mine consisted of four adits driven in a northerly direction along the strike of the seam. A section of the Grant Seam in which this mine was worked is shown in Fig. 3.1.1.

The adits were driven within 12° off parallel to the main cleavage pattern of the coal. The two westerly adits are blind. The two easterly adits are connected by a crosscut. An attempt appears to have been made to connect the crosscut back to the blind adits but this was abandoned. Evidence of large powder hole pockets was present in the westerly adit. This adit suggests that those who mined it had great difficulty in breaking the coal despite the small angle of the line of the adit to the main cleavage. The coal in this seam appears, therefore, to be of a hard nature. Pillars left for support would generate a fairly high

stress value to yield. There is a possibility that underground room-and-pillar mining could operate successfully in this seam down to 1500-foot depths of cover. Although 1000 feet is an arbitrary figure usually given as the limit of depth of cover for this type of underground mining, workings at greater depths of cover have in some places been successfully undertaken with room-and-pillar systems.

The coal seam varies in height from 5'3" to 5'7½". The seam is overlain by a roof of 11" of mudstone character and then by 5'1" of shales. Above this are sandstones to the visible height of the canyon walls. The total section represents a normal sequence of deposition for stable coal measures. The immediate roof appears to be of a weak nature but has nevertheless stood mostly unsupported for more than 40 years. A roof fall has occurred in the crosscut between the easterly adits. This fall is a probable result of oxidation in the shales due to prolonged atmospheric exposure and weathering rather than to any other factor. The roofs of the adits suggest that a narrow entry pattern, approximately 12 feet wide, would be desirable to maintain unbroken roofs in these entries if a working mine were to be re-opened.

The seam floor was hard and could not be broken up by pick to reveal its character. Tri-axial compressive tests would probably confirm that such a floor would accept the heaviest trackless underground mining machinery.

3.2 King Gething No. 3 Mine

The workings of this mine are in two seams which will be referred to as the upper and lower seams.

3.2.1 Upper Seam. Entry and exit to this mine were made via the lower jack-hole shown on the plan given in Fig. 6 of the report dated December 30, 1971. Of the two adits originally driven the lower one appears to have been closed as a result of strip mining operations. The upper or main adit has partly caved at its entrance, and entry at this point would have required taking unnecessary risk without a repair crew available. It was noted that the adits were again driven on

a bearing close to north and at only a small angle to the main cleavage, as were those at the Aylard Mine; this possibly confirms that the coal was of a hard nature.

In the main adit a wedge-shaped section of the floor was taken up and removed from the low side for an approximate width of 9 feet. The purpose of this was to form a level floor on which the rail track could be laid for running the tubs or hutches loaded with coal out of the mine. On the high side of the removed wedge of floor, some 16 inches of hard flinty material, possibly chert, were revealed, and below it more coal with a thickness that could not be measured. The rail tracks were laid on this coal.

This section of the seam in this mine as measured was 5'6" thick from the floor to the roof on the bench above the track wedge and was checked in the raise entries off the main adit. The structure of the coal and the immediate roof was not identifiable with that of the seam worked at the Aylard Mine. A section of the seam is shown in Fig. 3.2.1 together with a section of the main adit in this seam.

The coal and the floor are of hardness similar to those at the Aylard Mine. The roof immediately overlying the seam is, however, a brown sandstone and appears stronger than that above the seam at the Aylard Mine. The comment on seam characteristics for underground mining made for the seam at the Aylard Mine applies also to this seam, except possibly for a stronger roof which would allow wider entries. A reservation should be made that erosive channel action during deposition of extensive sandstones above a coal seam can produce "washouts" of the seam.

3.2.2 Lower Seam. Two other adits were driven at a lower level at the King Gething No. 3 Mine. It is possible that the seam into which they are driven was revealed during the strip operation, and a decision was then made to explore this seam. It appears that these adits were abandoned after only a limited drivage possibly of 90 to 100 feet. The section (Fig. 3.2.1) shows coal that probably contains a comparatively large amount of both iron sulphide and iron

carbonate. The entire section of 5'10½" is of hard coals. Some other sections appear hard and canneloid and with a high inherent ash content and, therefore, this seam is probably of dubious commercial value.

3.3 Trenches on the South Slope of Mount Johnson

The seams exposed by these trenches are unlike all other outcrops on the property: they show a high degree of oxidation, and have remained in contact with glacial drift since the post-glaciation period, and still illustrate the effects of severe erosion at that time. All the other outcrops of seams that were examined were either at creeks or rivers which transported away all glacial material and eroded parts of the coal seams and adjacent rocks so that they show the seams in the same condition in which they are likely to be encountered if mined. Because of the oxidation, correlation of seams could not be made from the comparison of coal types within each seam.

3.3.1 No. 2 Trench (Upper Trench). This trench (Fig. 3.3.1) shows variable gradients in the strata which suggest undulation. This feature is consistent with anticlinal structures where the deeper beds in the series show some distortion due to the lateral thrust that caused the uplift of the anticline. Also, the normal sequence of coal measure deposition is inverted at one point in the section exposed by the trench. The consistency of the remainder of the section shows, however, that this is not due to any overfolding of the structure. Seven larger coal seams are revealed by this trench.

3.3.2 No. 3 Trench (Lower Trench). A section of the rocks exposed along this trench is given in Fig. 3.3.2. The strata at the southwest end of the trench are the most steeply inclined at 51° with a progressive decline to 29° at the northeast end. This feature is fairly consistent with the behavior of strata on the limbs of either anticlinal or synclinal structures, as the more shallow beds are bent to lesser radii of curvature which cause them to emerge at steeper angles than deeper beds. Two major seams are revealed in this trench.

3.4 Trojan Seam in Coalbed Creek

The thickness of the Trojan Seam (Fig. 3.4.1) at Coalbed Creek ranges between 6'7½" and 6'10". This variation is ascribed to an irregular stone parting 5½" to 8" thick, 14 inches above the floor of the seam. The actual coal in the section appears to be 6'2" thick. The appearance of the coal suggests higher rank.

3.5 Seam at the Falls on Lower Moosecall Creek

The seam (Fig. 3.5.1) at the falls on Lower Moosecall Creek is overlain by 1'3½" of weak fissile shales that become stronger above. Above the stronger grey shales are sandstones. Below the weak fissile shales is 3'11" of bright coal which terminates in a distinct parting at a coal band 9½" thick through which a pronounced and repeated pattern of parallel "back up" slips or fractures runs at an angle of 46° to the bedding. Below this coal are two bands of grey clayey shale, one of 2" and the lower of 4½", which contain lenticular concretions with a high content of disseminated pyrite. Below this is a further 1'4" of coal.

3.6 Section near Contact Point in the Peace River Canyon

West from Contact Point, the transition from the Moosebar Formation to the Gething Formation was noted with the conglomerate at the contact quite apparent. Coal seams start near the top of the Gething Formation with two inaccessible seams approximately 16" thick, and three more seams, 2'6¾", 2'8½", and 3'4" thick respectively. The 3'4" seam is underlain by another 2'4½" of coal with 1'3" of sandstone parting. The section (Fig. 3.6.1) was difficult to measure with any accuracy because of the severe erosive action of the river. However, consistency of deposition at uniform gradient was apparent.

SECTION 4.0

CORRELATIONS OF COAL SEAMS

4.1 Methods of Correlation

4.1.1 Drilling. Three holes were drilled as part of the 1973 program. Several additional drill-sites were prepared, and access provided to them. This work included the installation of a 30-foot, 42-inch culvert on Coalbed Creek. The holes drilled are 4A, 5, and 6 with depths of 497 feet, 137 feet, and 506 feet, respectively, totalling 1140 feet.

Drill hole 4A was drilled near Hole 4 which was abandoned in 1972 because of difficulty with overburden. Drill hole 4A encountered 199 feet of the Moosebar Formation below 127 feet of overburden. This probably indicates that the Moosebar and Gething Formations have lower dips at drill hole 4A than previously predicted.

Drill hole 5 was drilled to further define the trace of the Trojan Seam and to help locate a suitable place for an adit.

Drill hole 6 was drilled to test seams below the Trojan and to confirm the previous correlations of the seams in Trenches No. 2 and 3 on the south slope of Mount Johnson. It penetrated nearly 300 feet of overburden before reaching bed-rock, and thus appears to have gone down into a deep stream channel, eroded before deposition of the present silt cover. Because of the drillers' difficulties, it eventually had to be abandoned at 506 feet, just a few feet above the expected level of the Milligan Seam.

4.1.2 Logging. Only a gamma ray neutron log was run in drill hole 4A because it was blocked at 446 feet; hence, no record of the Trojan Seam could be obtained. Both gamma ray neutron and sidewall density logs were successfully run in drill hole 5. In drill hole 6, a gamma ray neutron log was run from the bottom but a sidewall density log only from 435 feet, inside the string of drill rods left in the hole when it was abandoned at 506 feet. The density sonde would not enter the core barrel, some 12 feet above the drill bit as determined from the caliper log.

4.1.3. Trenching. Although additional trenching was not originally planned as part of the 1973 program, three trenches were excavated by a D6 bulldozer which

otherwise would have been on standby. Superior Trench 1 was excavated in an attempt to locate the Superior Seam, but failed when more than 10 feet of overburden encountered at its south end indicated that there the Superior Seam has probably been eroded. Trojan Trench 1 was excavated in an attempt to expose the Trojan Seam. However, it could not be completed because the thin dry silts in which it was started were saturated with water at depths of less than 10 feet about 200 feet northeast from where it was started. The Titan Trench was excavated in the southwest slope of Mount Johnson, where under 25 feet of overburden it encountered an erosional remnant of coal, which is probably part of the Titan Seam.

4.2. Superior Seam

The intersection of the Superior Seam in drill hole 4A at 16 feet below the Moosebar-Gething contact is the highest in the succession yet recorded near the Peace River Canyon. McLearn (1950) describes the seam as being 23 to 26 feet below this contact, and in drill hole 72-1 near Moosebar Creek it is 37 feet below this contact. If the depths below this contact for the Superior and Trojan Seams are consistent in drill holes 3, 4A, and 5, drill hole 5 missed the Superior Seam by about 20 feet stratigraphically and drill hole 3 by only a few feet stratigraphically.

4.3 Trojan Seam

In drill hole 4A, the Trojan Seam was intersected 130 feet below the Moosebar-Gething contact, where it is 126 inches thick and contains 120 inches of coal. This compares with a total thickness of 129½ inches including 107½ inches of coal in drill hole 3, a total thickness of 133 inches including 103 inches of coal in drill hole 5, and an exposed total thickness of 82 inches including 78 inches of coal in its outcrop on Coalbed Creek. In 1971, 6 feet of strata at the base of the Trojan Seam in Coalbed Creek were drilled without encountering coal. However, slumping above the exposed coal in Coalbed Creek may cover more coal there, and thus explain its reduced thickness. These data suggest that in this area, the Trojan Seam increases in thickness and contains more coal towards the south.

73-4A-10.5'
73-3-9'
73-5-8.5'
Coalbed 6.5'
cr.

4.4 Seams below the Trojan Seam

Although the weathered nature of the coal in Trenches No. 2 and 3 on the south slope of Mount Johnson makes correlations of the seams in them difficult, additional data were obtained which confirm the correlations made in 1971. The 1971 correlations were based mostly on the sequences and thicknesses of the seams, and the sequences and thicknesses of the intercalated strata in the two trenches. A stratigraphic section combining new measurements in these two trenches is given in Fig. 4.1.12. Comparison of this stratigraphic section with that obtained from drill hole 6 (Fig. 4.1.11) strengthens all these correlations.

4.4.1 Seam between the Trojan and Mogul Seams. Four coal seams, totalling $40\frac{1}{2}$ inches in a thickness of 78 inches, were intersected in drill hole 6 about 65 feet above the top of the Mogul Seam. The density log indicates that other seams may have been drilled but not cored above these seams. Five coal seams containing 50 inches of coal in a thickness of 77 inches, 72 feet above the Mogul Seam in Trench No. 2, appear to correspond to the four seams in drill hole 6.

Eighteen feet below this unnamed coaly interval is a $29\frac{1}{2}$ -inch coal seam in drill hole 6 and a 44-inch coal seam in Trench No. 2.

4.4.2 Little Mogul and Mogul Seams. Measured thicknesses of the Mogul Seam are 69 inches in drill hole 6, 66 inches in Trench No. 3, and 60 inches in Trench No. 2. The Mogul Seam is separated from the Little Mogul Seam by about 75 inches of mainly black shale in drill hole 6, $76\frac{1}{2}$ inches of mainly grey and black shales in Trench No. 3, and 117 inches of black and grey shales and sandstone in Trench No. 2. The Little Mogul Seam is $19\frac{1}{2}$ inches thick in drill hole 6, 26 inches thick in Trench No. 3, and 23 inches thick in Trench No. 2.

4.4.3 Seams below the Mogul Seam. As indicated partly by core and by the density log, drill hole 6 intersected a coal seam $44\frac{1}{2}$ inches thick, 42 feet below the bottom of the Mogul Seam. This appears to correspond to a coal seam 51 inches thick, 39 feet below the Mogul Seam in Trench No. 3. In 1971, this seam was correlated with the Castle Point Seam, but in drill hole 6 the Castle Point Seam was

intersected 105 feet below the Mogul Seam, almost exactly as described by McLearn (1950). A 16-inch seam noted in 1971 about 95 feet below the Mogul Seam in Trench No. 3 probably corresponds to the Castle Point Seam, and an 18-inch seam below it to the Milligan Seam.

SECTION 5.0 ANALYSES OF COAL

In general, samples of coal were collected and the raw coal analyzed from cored seams more than 10 inches thick in order to obtain preliminary information on the thicker seams, to help in correlating the thinner seams, and to learn variations in composition of the coal throughout the coal measures. The analytical reports on the raw coal samples in Appendix 2 show that most of the coals are medium volatile bituminous, and that some have F.S.I. values characteristic of coking coal.

Most of the samples from the cored seams that are thick enough to consider for mining either now or in the future were composited in composite samples 1, 2, 3, 4, 5, and 6, which were extensively tested and analysed as described in the following paragraphs. However, more than 2 feet of coal, as interpreted from the density log, are included in lost core from the seam about 40 feet below the Mogul Seam. Thus, the two samples, No. 604 and No. 606, from this seam total only 16½ inches of coal and were not composited. The analyses of the raw coal from this seam show that it is not coking coal but can be expected to be an excellent thermal coal.

Composite samples, 1, 2, and 3 represent all samples including partings from the Superior and Trojan Seams. Complete results are in Appendix 3, and are summarized in Table 1. They show very low ash and low sulfur, and that the Superior Seam has a higher F.S.I. than the Trojan Seam. Yields for the Trojan Seam vary inversely with the thickness and number of partings in the composite samples. Many more samples including bulk samples are required to predict the yield that could be obtained in a processing plant, but 70 to 75 per cent appears likely. The samples from the Trojan Seam adjusted to a moisture-free ash-free basis are remarkably consistent with 29½ to 32 per cent volatiles and 68 to 70½

per cent fixed carbon.

Composite samples 4, 5, and 6 represent all samples including partings from the seam 65 feet above the Mogul Seam, the Mogul Seam, and the Castle Point Seam, respectively. Complete results are in Appendix 4, and are summarized in Table 2. As these are the first analyses from drill cores of these seams from the Peace River Canyon Properties of Cinnabar Peak Mines Ltd., fewer sink-float tests were made on the + 100 mesh fractions than for composite samples 1, 2, and 3. The analyses in Table 2 show that the Mogul Seam may well contain excellent thermal coal, and that the Castle Point Seam has coking properties. The low yield for the Castle Point Seam is caused by a thick parting, and by lost core interpreted as coal from the density log and not included in the composite sample.

SECTION 6.0

RESERVES

In this section mineable reserves are based on outcrop and drill-hole data and projections generally less than $1\frac{1}{2}$ miles from them. They are practically available on the basis of current economic operation levels and with current technical knowledge. They are estimated only in the Trojan and Mogul Seams and the unnamed seam about 40 feet below the Mogul Seam, to depths of about 1500 feet. As sufficient data are not yet available to establish very precise estimates of reserves mineable by open-pit methods, the mineable reserves are estimated for each of the three seams, and then considerations of the reserves mineable by open-pit are presented.

The reserves in the Trojan Seam, based on an average thickness of 8 feet of coal, a specific gravity of 1.42, and underlying an area of 4.5 square miles in Lots 1048, 1055, 1056, 1057, 1058, 1059, 1060, 1065, and 1066, are estimated at 39.6 million long tons. In Fig. 1.3 these reserves lie between the surface trace of the Trojan Seam shown and the 1500-foot isobath whose surface projection lies approximately along the Moosebar-Gething contact. At a 60 per cent extraction rate, the mineable reserves in the Trojan Seam within the nine lots just listed are 23.8 million long tons.

For:

TABLE 1:

'Clean Coal Composite Data for Composite Samples 1, 2, & 3'

TABLE 2

'Summary of Analysis for composite Samples 4, 5, & 6'
(Specific Gravity 1.60)

The reserves in the Mogul Seam, based on an average thickness of $5\frac{1}{2}$ feet of coal, a specific gravity of 1.42, and underlying an area of 3.8 square miles in Lots 1048, 1050, 1055, 1056, 1057, 1059, 1060, and 1065 are 23.0 million long tons. Similar reserves in the unnamed seam are 17.8 million long tons for a total of 40.8 million long tons. At a 60 per cent extraction rate for underground mining, the mineable reserves in the Mogul Seam and the unnamed seam within the eight lots just listed are 24.5 million long tons.

Preliminary information suggests that an open-pit mine on the southern and southwestern slopes of Mount Johnson might have reserves of 1.7 million long tons per thousand feet of axis. Estimates based on combined total pit lengths ranging from 4000 to 12,000 feet indicate open-pit reserves ranging from 6.8 to 20.4 million long tons. Some of these reserves are in the Mogul Seam and the unnamed seam, and if data from additional work show that they are recoverable by open-pit methods, they would have to be subtracted from the underground reserves in these seams estimated in the previous paragraph.

Additional reserves are present in the Trojan Seam: at depths of less than 1500 feet in Lots 1064 and 1069 west of the major northerly trending fault, and in Lots 1045, 1046, 1044, and 1039 to the northwest; at depths greater than 1500 feet in Lots 1057, 1058, 1065, 1066, 1067, 1068, and 1069 with the actual depth limit being determined by mining experience; and in some of the coal licences east of the major northerly-trending fault. Other additional reserves exist in the Mogul and other seams near it stratigraphically, but data are insufficient to estimate those recoverable. Other additional possible recoverable reserves in the Grant-King and the Murray - "48" Seams are estimated at 50 million long tons.

SECTION 7.0

CONCLUSIONS

1. An open-pit mine with reserve estimates, based on only preliminary knowledge, ranging from 6.8 to 20.4 million long tons on Lots 1048, 1050, 1055, and 1056 may be available on the southern and southwestern slopes of Mount Johnson.

2. With the restrictions on an underground mining operation of 60 per cent extraction and a limiting depth of cover of 1500 feet, an underground mine with 45.5 million long tons of reserves is available within Lots 1048, 1050, 1055, 1056, 1057, 1058, 1059, 1060, 1065, and 1066.
3. The prospects of additional reserves, suitable for open-pit or underground mining or both, in Lots 1039 and 1041 east and west of Portage Mountain are real. Other additional reserves east of the major northerly-trending fault and in the northwestern part of the property are present, but data on them are insufficient to estimate recoverable tonnages.
4. The analyses and washability data indicate that medium volatile coals of very low ash content can be produced for metallurgical markets at acceptable yields from the Trojan Seam. They also indicate that fuels with low ash and high calorific value are available without any processing for thermal markets, from the Mogul Seam and an unnamed seam about 40 feet below the Mogul Seam.
5. The maintenance of the regularity of the cleavages indicates that effects of the orogenic forces of the mountain building that produced the Rocky Mountains and their Foothills are subdued within these deposits. The severe distortions and lateral interface shearing between planes in a seam or seam succession that characterize some other deposits in the Rocky Mountains and Foothills are absent here.
6. The predominance of sandstones in the Gething Formation could give conditions favorable to underground mining. Generally the maintenance of access roadways in underground mines that have massive sandstones in parts of the succession of strata is easier, because of the greater inherent strengths of sandstones.
7. The hardness of the coals in seams in the Gething Formation is capable of generating the necessary constraining pressures for pillars which are subjected

to stresses produced by depth loading, and thereby could maintain effective support for room-and-pillar mining. This hardness is not affected by prolonged exposure of these coals to oxidation by the atmosphere, and appears to be a function of their low ash content.

8. The predominance of sandstones in the Gething Formation suggests that the levels of methane emission will not be high: as sandstones are more permeable than shales, they have permitted migration of methane from the coal measures well in advance of mining.

Respectfully submitted,

G.A. Haslett

G.A. Haslett, B. Sc., C. Eng., P. Eng.

G.A. Checklin

G.A. Checklin, B. Sc., P. Eng.

L.B. HalferdaHL

L.B. HalferdaHL, Ph.D., P. Eng.



Expiry Date: August 5, 1974

Edmonton, Alberta
January 21, 1974

SECTION 8.0

REFERENCES

- Checklin, G.A. and Halferdahl, L.B. (1971) - 1971 geological exploration of Peace River Canyon coal properties northeastern British Columbia; L.B. Halferdahl & Associates Ltd., Edmonton; 37 pp., 9 appendices, 12 figures, 5 tables, unpublished.
- McLearn, F.H. and Kindle, E.D. (1950) - Geology of northeastern British Columbia; Geol. Surv. Can. Mem. 259.
- Van Dyck, G.A. (1972) - 1972 winter drilling project on Peace River Canyon coal properties northeastern British Columbia; L.B. Halferdahl & Associates Ltd., Edmonton; 16 pp., 3 appendices, 5 figures, 4 tables, unpublished.
- Van Dyck, G.A. and Ridell, K.P. (1972) - 1972 summer exploration of Peace River Canyon coal properties northeastern British Columbia; Halferdahl & Associates Ltd., Edmonton; 10 pp., 3 appendices, 6 figures, unpublished.

SECTION 9.0

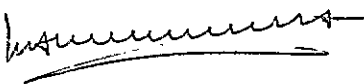
CERTIFICATES

9.1 G.A. Haslett

I, George A. Haslett with business and residence addresses in Edmonton, Alberta, do hereby certify that

1. I am a registered Professional Engineer in the Province of Alberta, and a Chartered Engineer of the United Kingdom, and a Member of the Institution of Mining Engineers, London, England.
2. I am a graduate of the University of Durham, England (B. Sc. in 1952 in Mining Engineering in the Faculty of Applied Science).
3. I am a holder of First Class Certificates of Competency granted by i) The Province of Alberta ii) the United Kingdom Ministry of Power to act as a manager of underground coal mines. I am also the holder of a Manager's Certificate for Strip Mines granted by the Province of Alberta.
4. I have held posts as mine superintendent, assistant manager, and project engineer in the mining industry with the United Kingdom National Coal Board, and in mine planning and mining engineering in western Canada.
5. I have worked as a consultant mining engineer to the coal industry.
6. I am at present engaged as a faculty member in the Earth Resources Section at the Northern Alberta Institute of Technology, Edmonton, and as a private consulting engineer.
7. The data in Section 3.0 of this report were obtained during my examination of the properties from August 5 to 12, 1973.

Edmonton, Alberta
January 21, 1974


G.A. Haslett, B.Sc., C. Eng., P. Eng.

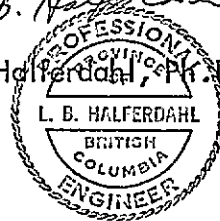
9.2 L.B. Halferdahl

I, Laurence B. Halferdahl, with business and residence addresses in Edmonton, Alberta, do hereby certify that

1. I am a registered Professional Geologist and Professional Engineer in the Province of Alberta and a licensed Professional Engineer in the Province of British Columbia.
2. I am a graduate of Queen's University, Kingston, Ontario (B.Sc. in 1952 and M.Sc. in 1954 in Geological Sciences in the Faculty of Applied Science) and of The John Hopkins University, Baltimore, Maryland (Ph.D. in 1959 in the Department of Geology).
3. From 1957 to 1969 I was on the staff of the Research Council of Alberta as a mineralogist and geologist where I was in charge of the mineralogy laboratory and conducted various field and laboratory investigations.
4. Since 1969 I have been a consulting geological engineer conducting and directing property examinations and evaluations, and exploration programs for metallic minerals, industrial minerals, oil sands, and coal.
5. The data in Sections 4.0. to 6.0 of this report were obtained from work carried out on the properties directed by G.A. Checklin from July 2 to October 9, 1973 and under my general supervision.

Edmonton, Alberta
January 21, 1974

L.B. Halferdahl
L.B. Halferdahl, Ph.D., P. Eng.



Expiry Date: August 5, 1974

for:

APPENDIX 2 : ANALYTICAL REPORTS ON RAW COAL SAMPLES

(from cored seams >10 inches thick)

REFER TO: PR- PEACE RIVER CANYON 73(A)A
CONFIDENTIAL ANALYSIS FILE

For:

APPENDIX 3 : ANALYTICAL REPORTS ON COMPOSITE SAMPLES

Composite #1	Superior Seam in D.H. 4A
Composite #2	Trojan Seam in D.H. 4A
Composite #3	Trojan Seam in D.H. 5
Composite #4	Unnamed Seam about 65 feet above Moqui Seam in D.H. 6
Composite #5	Moqui Seam in D.H. 6
Composite #6	CASTLE Point Seam in D.H. 6

Refer to: PR - PEACE RIVER CANYON 73(A)A
CONFIDENTIAL ANALYSIS FILE

APPENDIX 4: FIELD PERSONNEL

Name	Position	Time on Property 1973	
G. Checklin	Geologist	July 2	- October 10
L. Halferdahl	Geologist	July 14	- July 15
		August 11	- August 12
		October 9	- October 10
G. Haslett	Engineer	August 5	- August 12
B. Lipsett	Assistant	August 5	- August 12
M. Lipsett	Assistant	July 2	- August 31
M. Tremblay	Assistant	October 6	- October 7

For:

- 5.1.1. WASHABILITY CURVES FOR COMPOSITE SAMPLE #1
SUPERIOR SEAM IN DRILL HOLE 4A
- 5.1.2. WASHABILITY CURVES FOR COMPOSITE SAMPLE #2
TROJAN SEAM IN DRILL HOLE 4A
- 5.1.3. WASHABILITY CURVES FOR COMPOSITE SAMPLE #3
TROJAN SEAM IN DRILL HOLE 5
- 5.1.4. WASHABILITY CURVES FOR COMPOSITE SAMPLE #4
UNNAMED SEAM ABOUT 65' ABOVE MONGOL SEAM
IN DRILL HOLE 6
- 5.1.5. WASHABILITY CURVES FOR COMPOSITE SAMPLE #5
MONGOL SEAM IN DRILL HOLE 6
- 5.1.6. WASHABILITY CURVES FOR COMPOSITE SAMPLE #6
CASTLE POINT SEAM IN DRILL HOLE 6

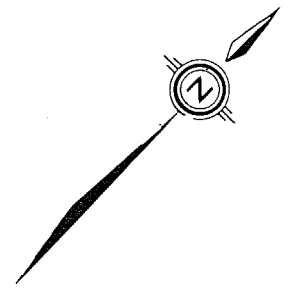
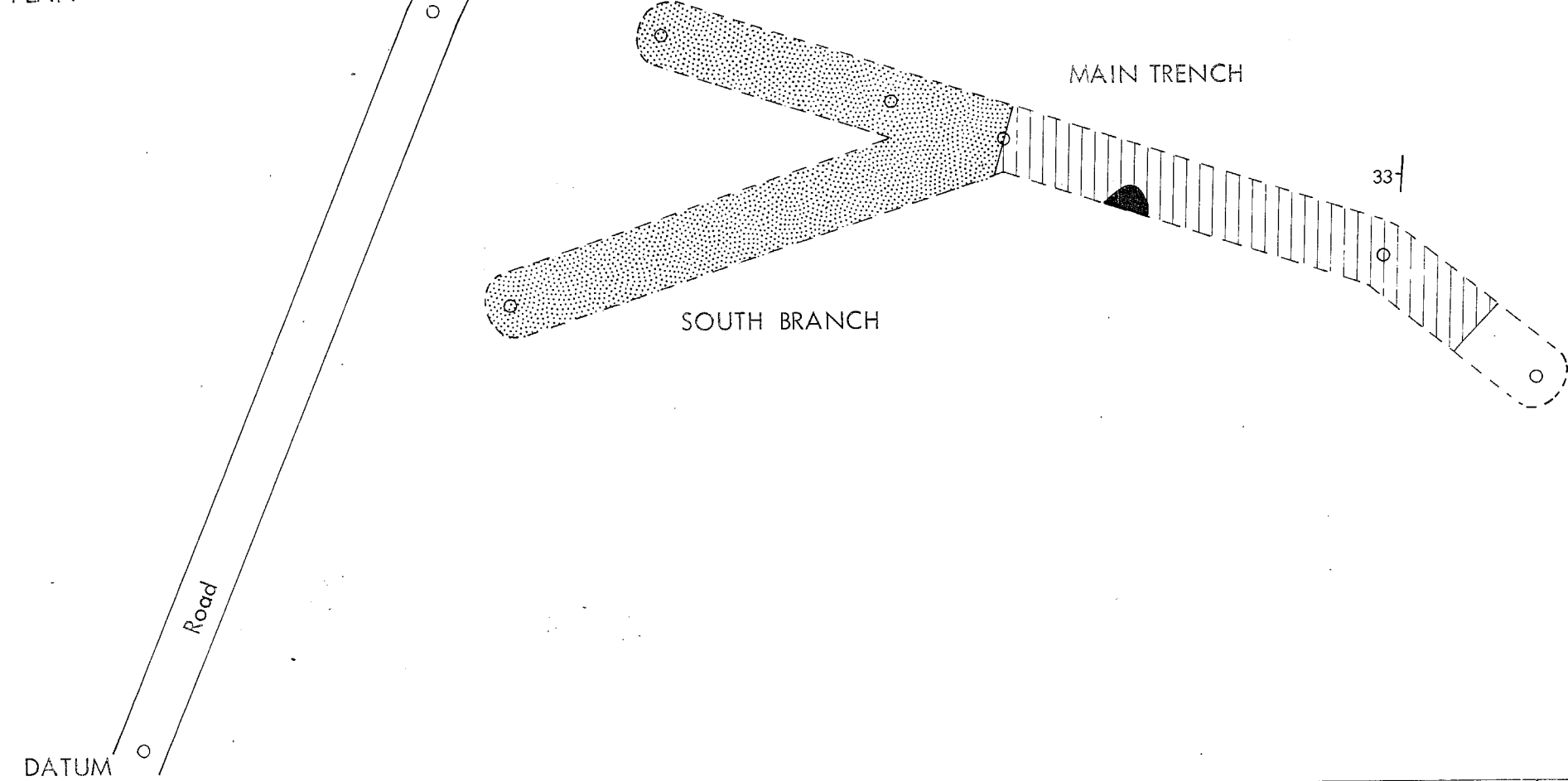
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PR - PEACE RIVER CANYON 73(4)A
CONFIDENTIAL ANALYSIS FILE

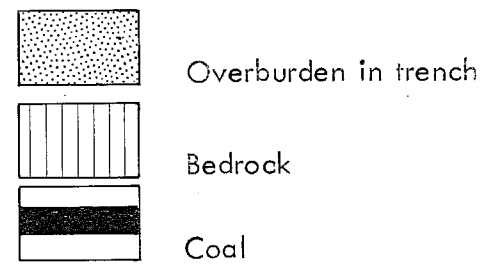
PR - PEACE RIVER CANYON 73(2)A
CINNABAR PEAK MINES LTD.

00 17

PLAN

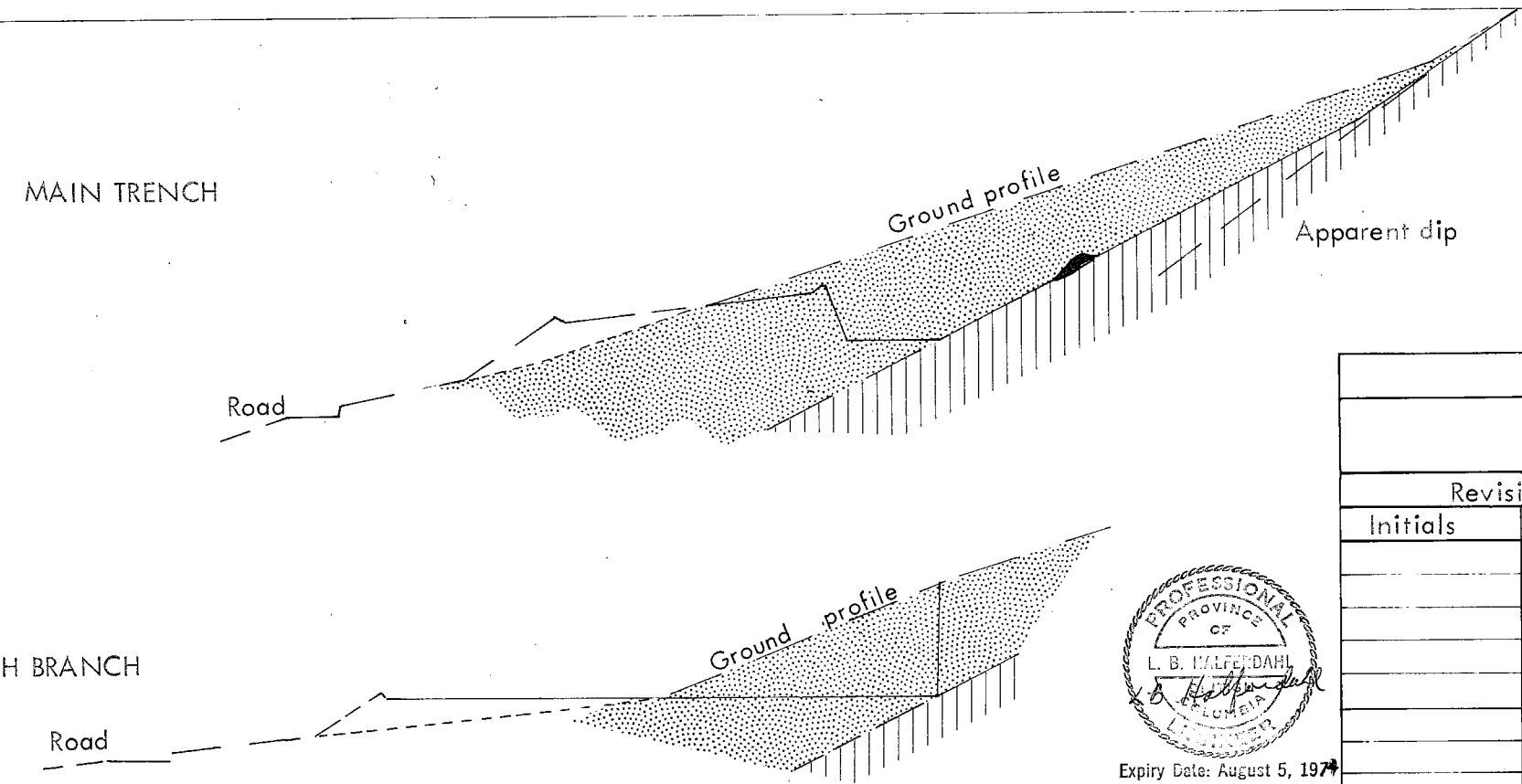


SYMBOLS



Strike and dip of bedding 33'
 Survey point O

SECTION



Information from the plan has been projected onto the cross section with azimuth of 46°

572

PR-PRC 73(2)A

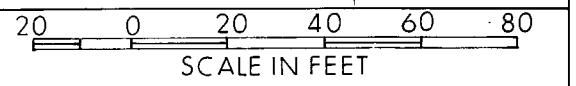
CINNABAR PEAK MINES LTD.

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 EDMONTON, ALBERTA

Revisions	
Initials	Date

Fig. 4.1.14 Plan and Cross Section of Titan Trench 1, Lot 1055

PEACE RIVER CANYON PROPERTIES



GAC November, 1973

Drawing No. CP-73-24



Expiry Date: August 5, 1974

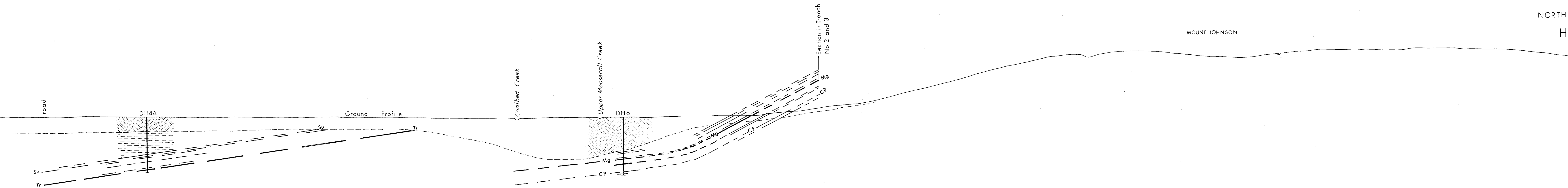
SOUTH

NORTH



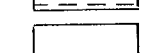
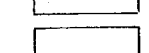
H

H'

MOUNT JOHNSON



SYMBOLS

-  Overburden
-  Moosebar Formation
-  Gething Formation
-  Coal Seam

- Su Superior
- Tr Trojan
- Ti Titan
- F Falls
- Ge Gething
- Mg Mogul
- CP Castle Point
- MI Milligan

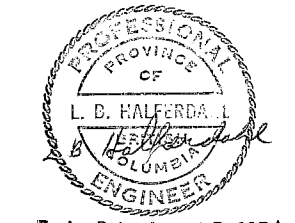
Notes

Only information from drill holes and surface trenches and from interpolations between them is shown.

Seams in surface trenches on Mount Johnson have been projected 217 feet east to the line of section with azimuth of 30°, and are therefore shown extending above the ground profile.

Horizontal and vertical distances are to scale, but thicknesses of coal seams are schematic and not to scale.

Reserves estimated are only in the Trojan and Mogul Seams, and the unnamed seam about 40 feet below the Mogul Seam.



Expiry Date: August 5, 1974

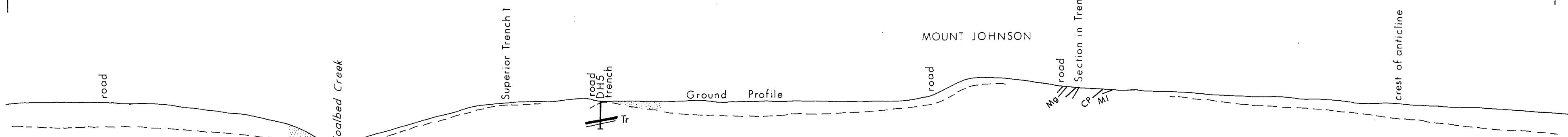
572
 PR-PRC 73(2)A

CINNABAR PEAK MINES LTD.		Fig. 4.1.15 Section H - H' from Fig. 1.3
HALFERDAHL & ASSOCIATES LTD. EDMONTON, ALBERTA		
Revisions		PEACE RIVER CANYON PROPERTIES
Initials	Date	
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		GAC November, 1973
		Drawing No. CP-73-25


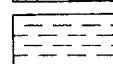

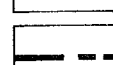
*No. of figures 1.3
 on this page 1.1*

SOUTHWEST

NORTHEAST



SYMBOLS

-  Overburden
-  Moosebar Formation
-  Gething Formation
-  Coal Seam

- Su Superior
- Tr Trojan
- Ti Titan
- F Falls
- Ge Gething
- Mg Mogul
- CP Castle Point
- MI Milligan

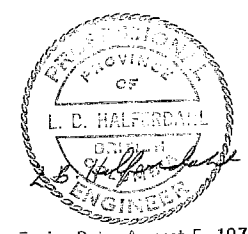
Notes

Only information from drill holes and surface trenches and from interpolations between them is shown.

Information from Trenches No. 2 and No. 3 has been projected onto the line of section with azimuth of 60°.

Horizontal and vertical distances are drawn to scale, but thicknesses of coal seams are schematic and not to scale.

Reserves estimated are only in the Trojan and Mogul Seams, and the unnamed seam about 40 feet below the Mogul Seam.



Expiry Date: August 5, 1974

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PR-PRC 73(2)A

CINNABAR PEAK MINES LTD.		Fig. 4.1.16 Section I - I' from Fig. 1.3																								
HALFERDAHL & ASSOCIATES LTD. EDMONTON, ALBERTA																										
PEACE RIVER CANYON PROPERTIES																										
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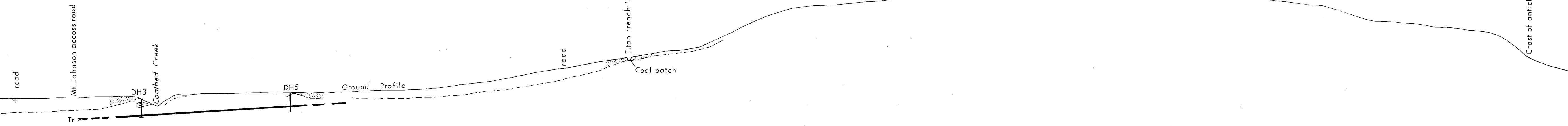
SOUTH

J


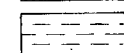

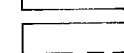
NORTH

J'

MOUNT JOHNSON



SYMBOLS

-  Overburden
-  Moosebar Formation
-  Gething Formation
-  Coal Seam

- Su Superior
- Tr Trojan
- Ti Titan
- F Falls
- Ge Gething
- Mg Mogul
- CP Castle Point
- MI Milligan

Notes

Only information from drill holes and surface trenches and from interpolations between them is shown.

Azimuth of section south of drill hole 5 is 354°; azimuth of section north of drill hole 5 is 8°.

Horizontal and vertical distances are drawn to scale, but thicknesses of coal seams are schematic and not to scale.

Reserves estimated are only in the Trojan and Mogul Seams, and the unnamed seam about 40 feet below the Mogul Seam.

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EDMONTON, ALBERTA

Revisions	
Initials	Date

Fig. 4.1.17 Section J - J'
from Fig. 1.3

PEACE RIVER CANYON PROPERTIES

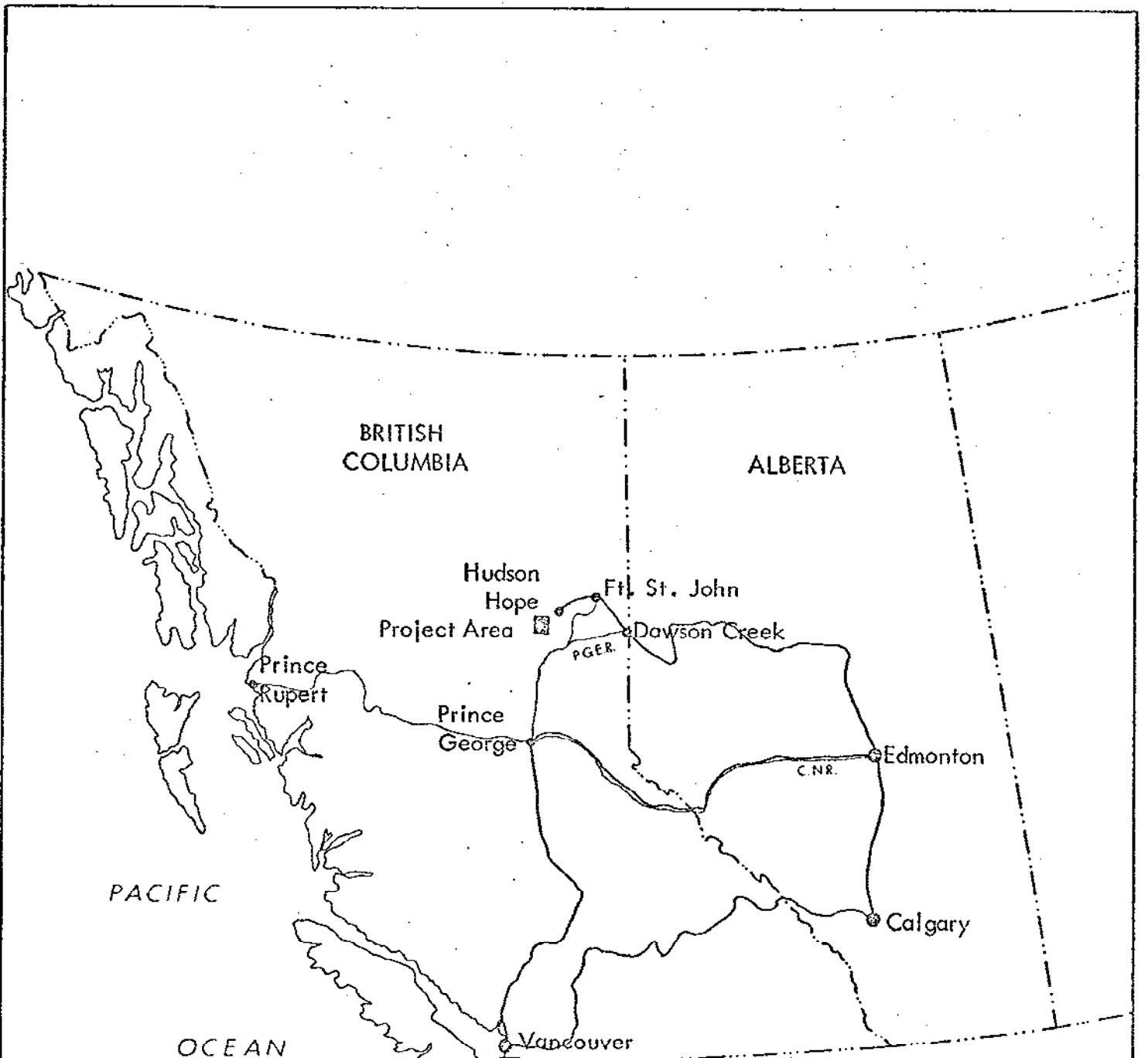
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SCALE IN FEET

GAC November, 1973

Drawing No. CP-73-27



Expiry Date: August 5, 1974



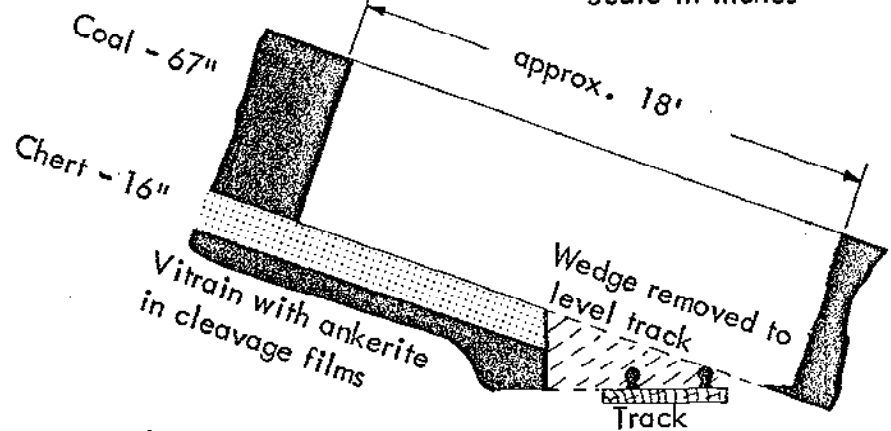
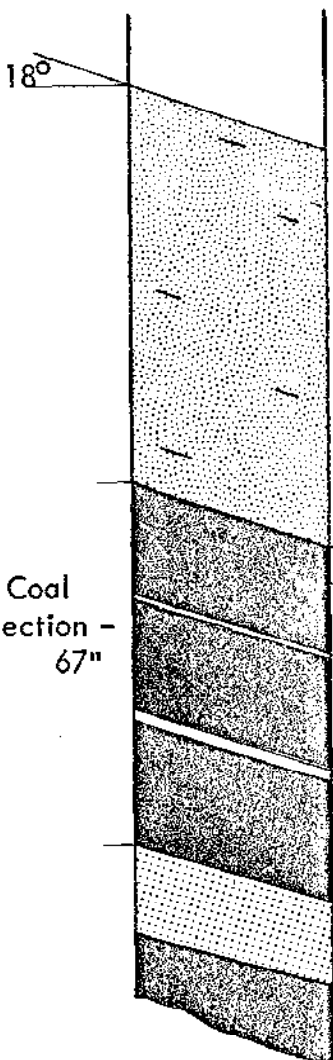
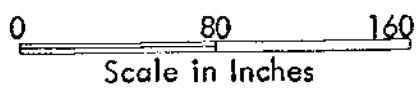
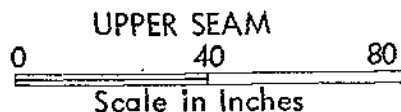
U.S.A. 572

PR-PRC 73(2)A



Expiry Date: August 5, 1974

CINNABAR PEAK MINES LTD.	
HALFERDAHL & ASSOCIATES LTD. EDMONTON, ALBERTA	
Fig. 1.1 Location Map	
PEACE RIVER CANYON PROPERTIES	
Drawn: LBH	December, 1973



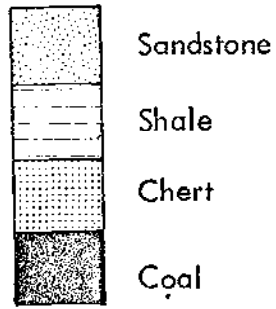
MAIN ADIT IN UPPER SEAM

Sandstone, soft, brown, locally nodular with abundant irregular coal lenses - 80"

Coal Section - 67"

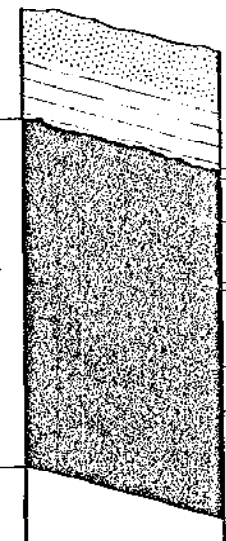
- Fusain - 1/2"
- Clarain, fusain, banded - 5"
- Clarain, splinty - 13"
- Clay parting, iron-stained - 1/2"
- Clarain, hard - 23"
- Clay with ankerite - 1"-2 1/2"
- Clarain, splinty - 9"
- Vitrain and clarain - 14"
- Chert, hard - 16"

SYMBOLS

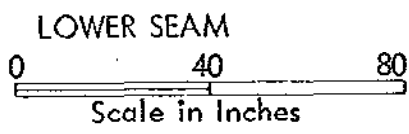


Vitrain with ankerite in cleavage films, base not exposed

Coal Section - 68"



- Sandstone
- Shale, laminated
- Coal, intergrown - 3"
- Vitrain - 10"
- Cannel coal with back-up slips - 11"
- Vitrain - 1 1/2"
- Coal, hard, bright with pyrite - 15"
- Coal, hard, bright - 8"
- Coal, banded, hard with heavy iron stain in cleavage - 21"



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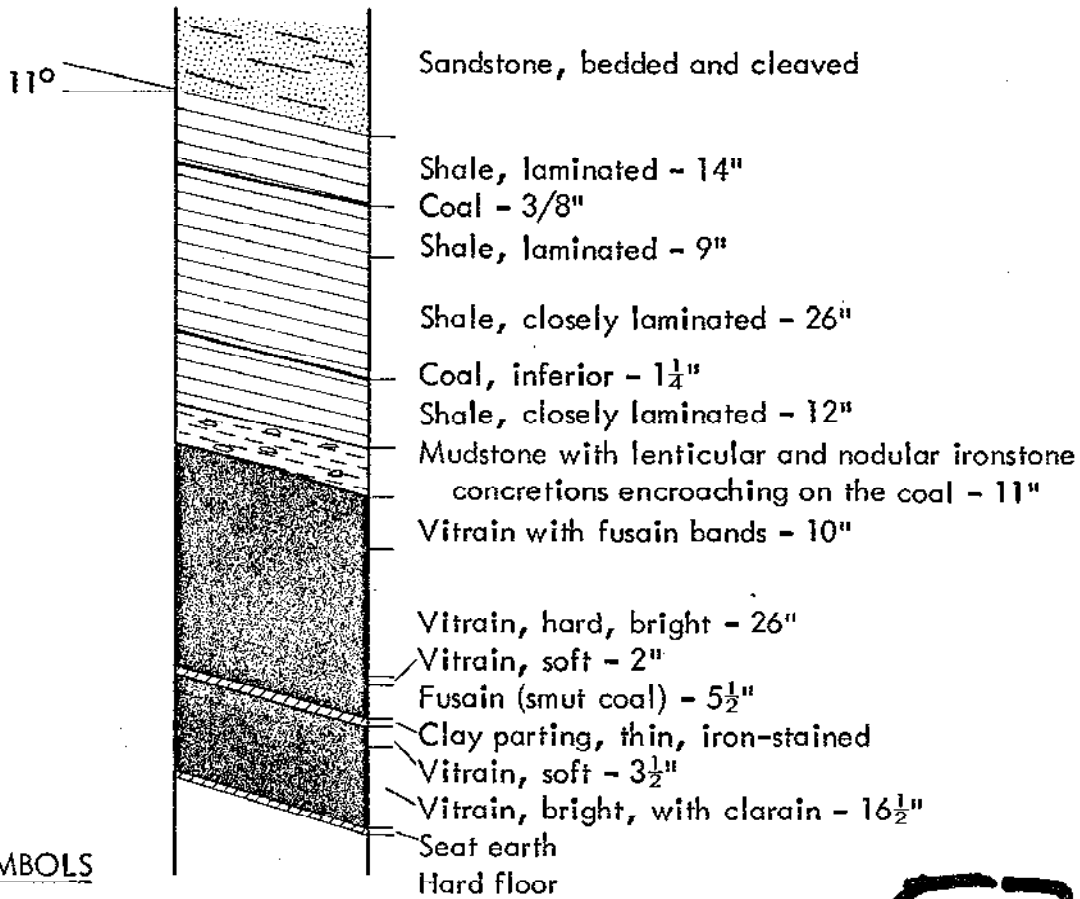
CINNABAR PEAK MINES LTD.	
HALFERDAHL & ASSOCIATES LTD. EDMONTON, ALBERTA	
Fig. 3.2.1 Sections of Upper and Lower Seams and Main Adit in Upper Seam at King Gething No. 3	
PEACE RIVER CANYON PROPERTIES	
GAH	September, 1973
Drawing No. CP-73-5	

PR-PRC 73(2)A

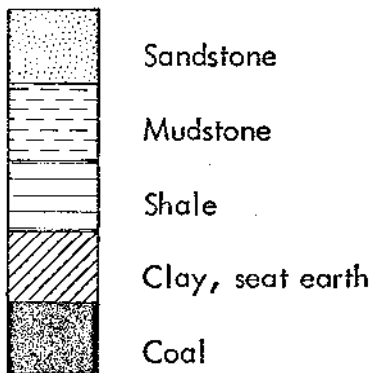
Coal section varies from $63\frac{1}{2}$ " to 67" thick.

Thicknesses of units given in inches are stratigraphic; they may be distorted in this figure by the dip.

Dip of strata is shown by inclination of symbols.



SYMBOLS



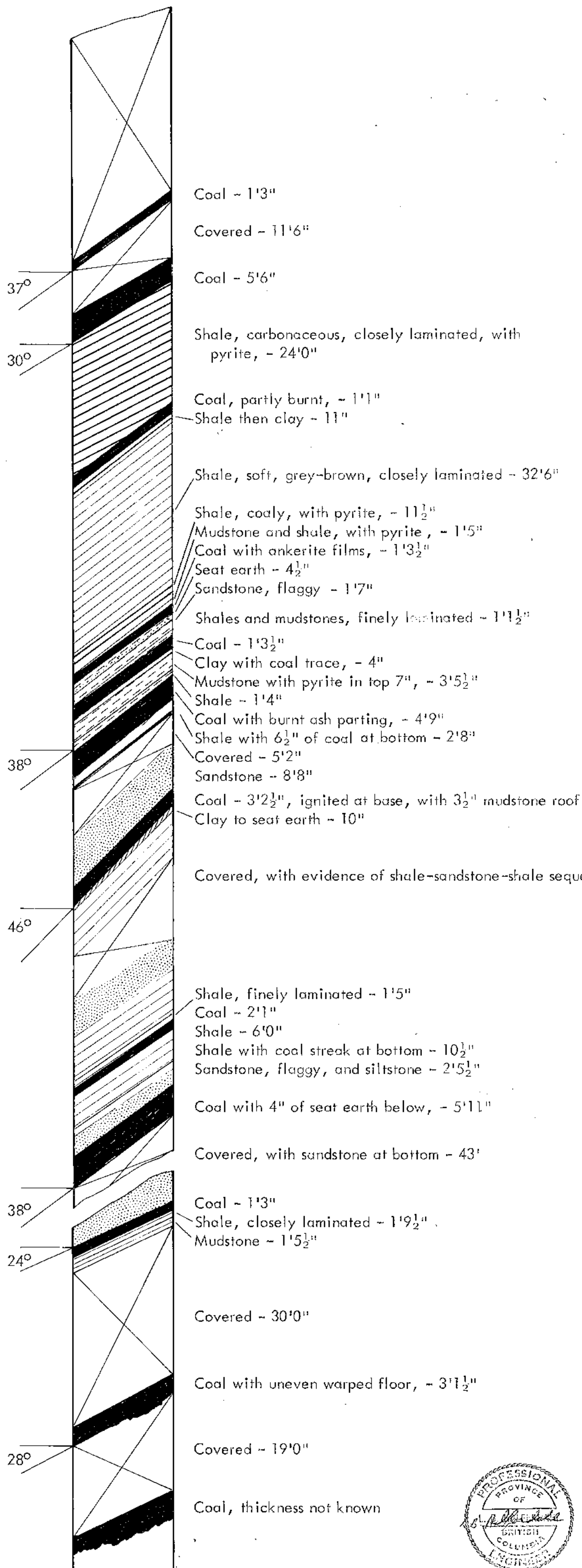
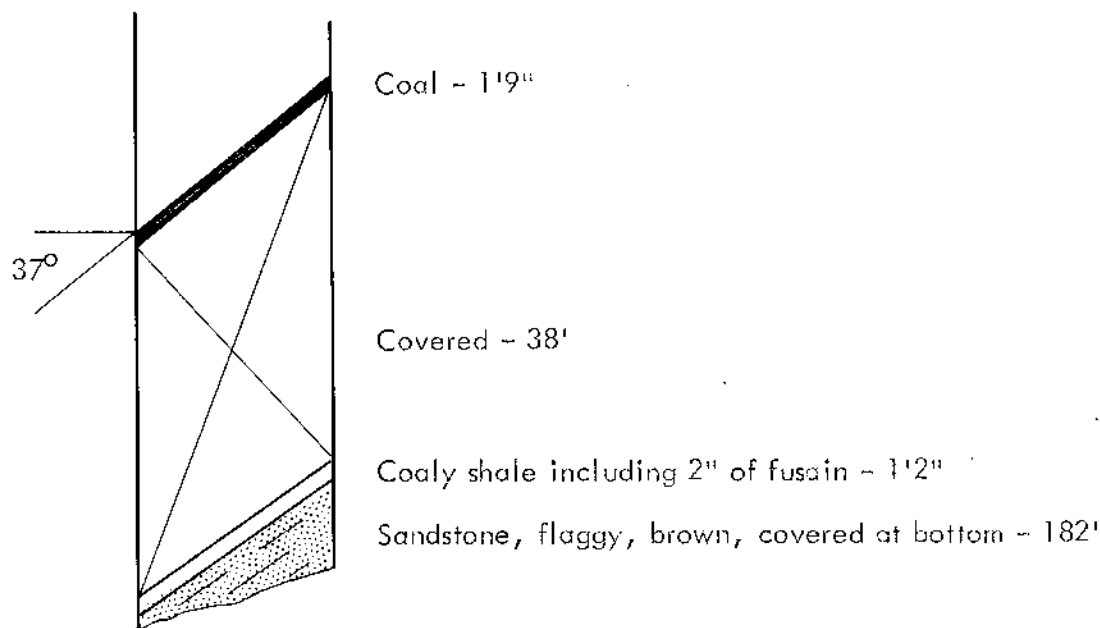
572

CINNABAR PEAK MINES LTD.	
HALFERDAHL & ASSOCIATES LTD. EDMONTON, ALBERTA	
Fig. 3.1.1 Section of Grant Seam and Overlying Strata at Aylard Mine	
PEACE RIVER CANYON PROPERTIES	
0 40 80 SCALE IN INCHES	
GAH	September, 1973
Drawing No. CP-73-4	

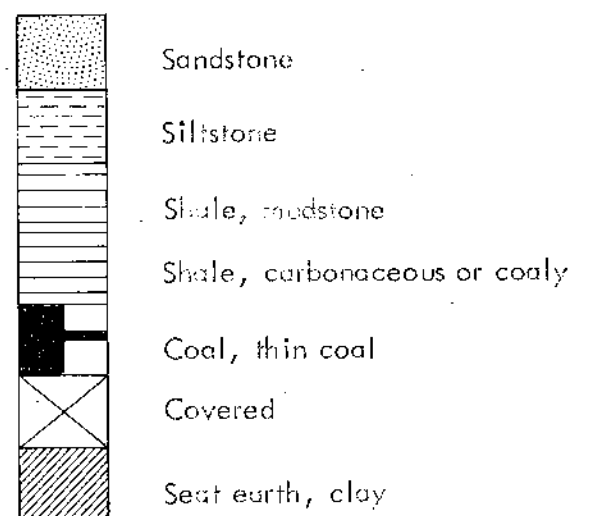


Expiry Date: August 5, 1974

PR-PRC 73(2)A



S' MBOLS



Possible inverted sequence of deposition

Inverted sequence of deposition

Thicknesses of units are vertical; they have not been corrected for dip.

Dips of strata are shown in degrees.

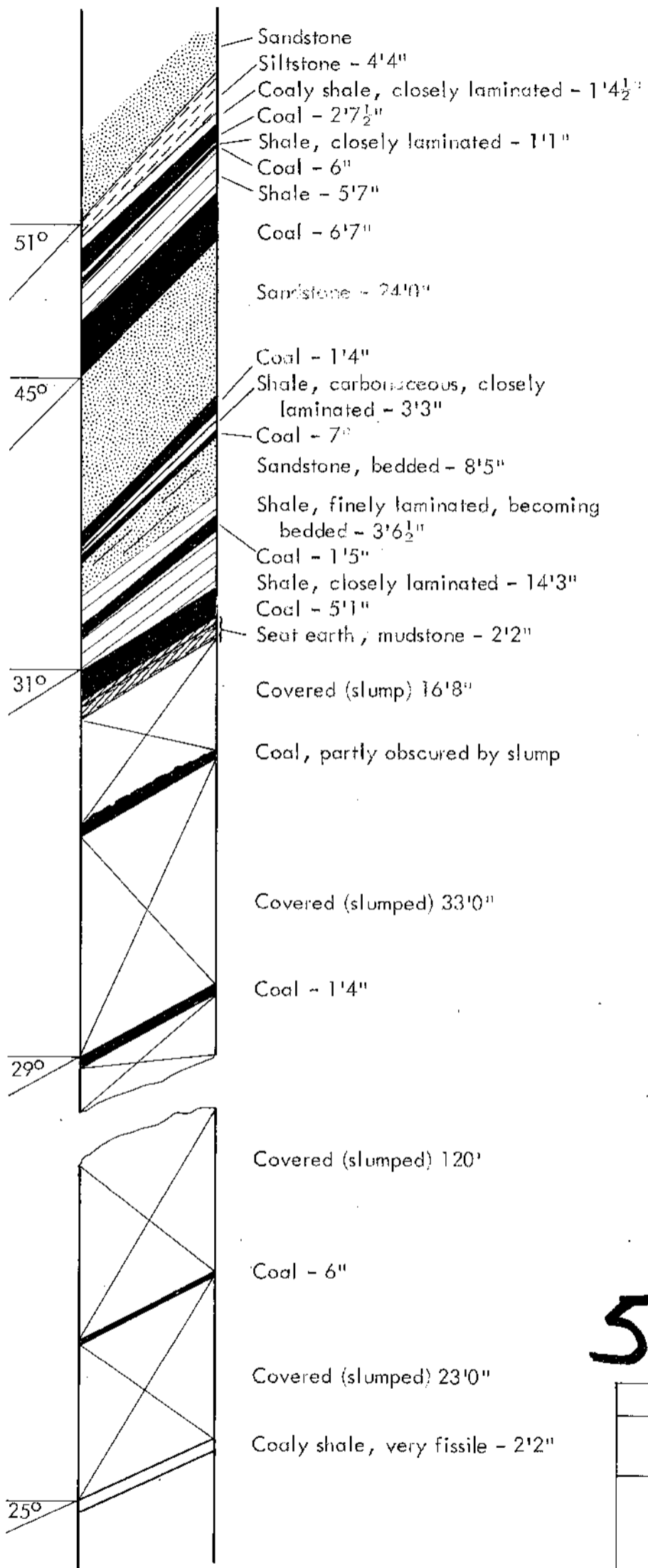
572

CINNABAR PEAK MINES LTD.	
HALFERDAHL & ASSOCIATES LTD. EDMONTON, ALBERTA	
Fig. 3.3.1 Section in Trench No. 2 (Upper) on South Slope of Mount Johnson	
PEACE RIVER CANYON PROPERTIES	
0 20 40 SCALE IN FEET	
GAH	September, 1973
Drawing No. CP-73-6	

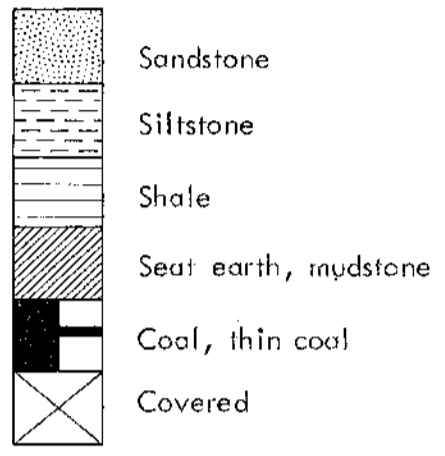


Expiry Date: August 5, 1974

PR-PRC 73(2)A



SYMBOLS



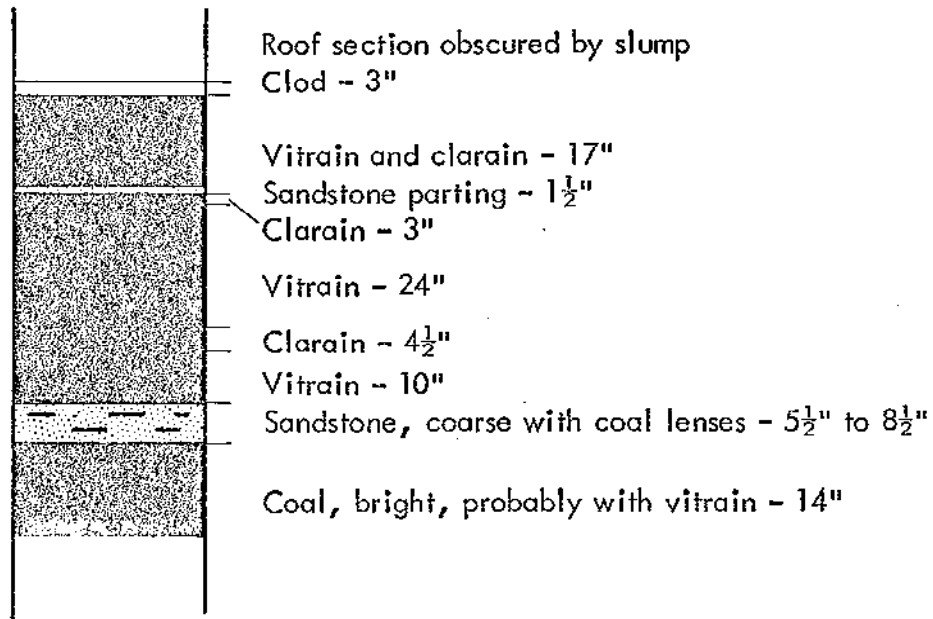
Thicknesses of units are vertical; they have not been corrected for dip.
 Dip of strata are shown in degrees.

572

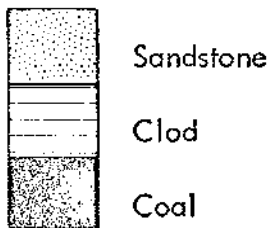


CINNABAR PEAK MINES LTD.
HALFERDAHL & ASSOCIATES LTD. EDMONTON, ALBERTA
Fig. 3.3.2 Section in Trench No. 3 (Lower) on South Slope of Mount Johnson
PEACE RIVER CANYON PROPERTIES
0 20 40 SCALE IN FEET
GAH September, 1973
Drawing No. CP-73-7

PR-PRC 73(2)A



SYMBOLS



Thicknesses of units are stratigraphic.

572

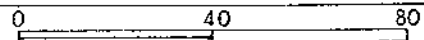
PR-PRC 73(2)A

CINNABAR PEAK MINES LTD.

HALFERDAHL & ASSOCIATES LTD.
EDMONTON, ALBERTA

Fig. 3.4.1 Section of Trojan Seam
at Coalbed Creek

PEACE RIVER CANYON PROPERTIES



SCALE IN INCHES

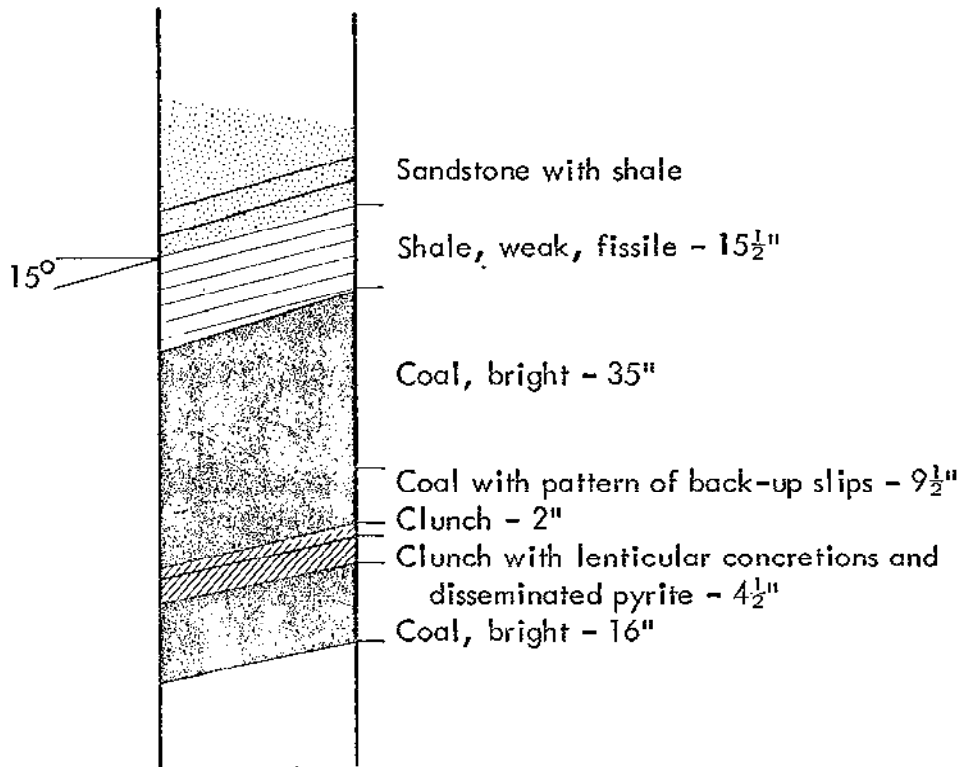
GAH

September, 1973

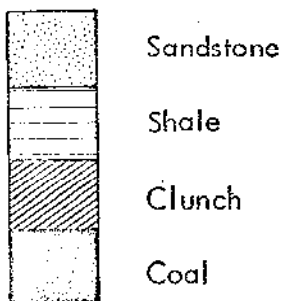
Drawing No. CP-73-8



Expiry Date: August 5, 1974



SYMBOLS



Thicknesses of units given in inches are stratigraphic; they may be distorted in this figure by the dip.

Dip of strata is shown by inclination of symbols.



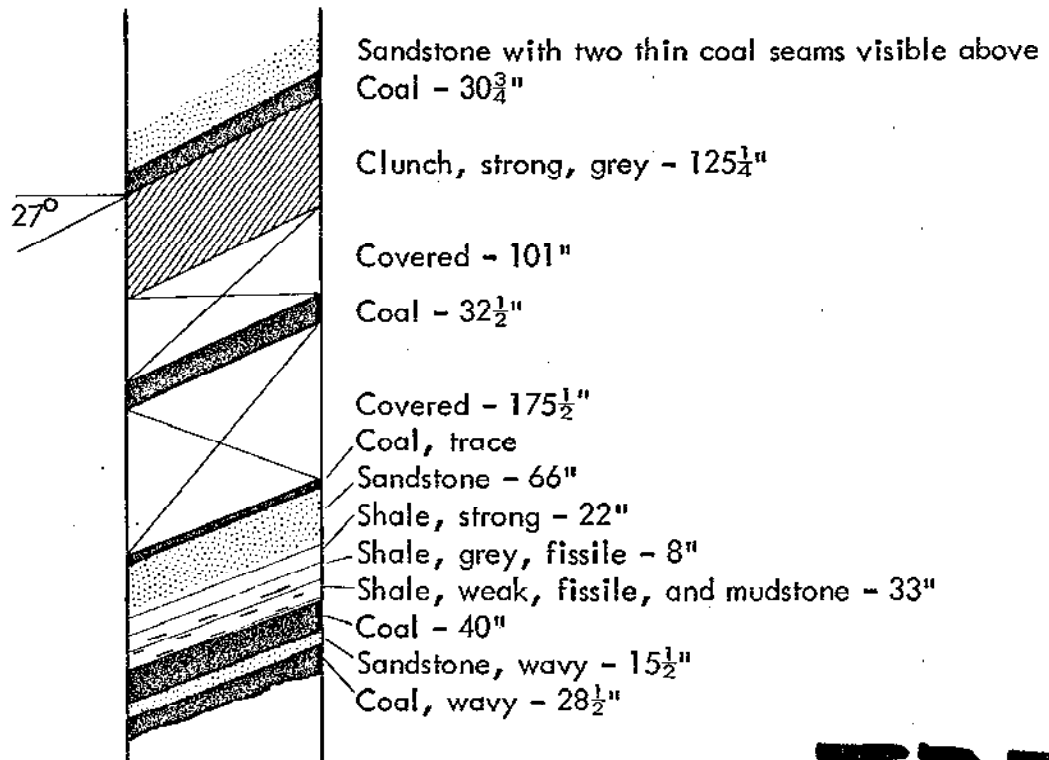
572

CINNABAR PEAK MINES LTD.	
HALFERDAHL & ASSOCIATES LTD. EDMONTON, ALBERTA	
Fig. 3.5.1 Section of Seam at Falls on Lower Moosecall Creek	
PEACE RIVER CANYON PROPERTIES	
0 40 80 SCALE IN INCHES	
GAH	September, 1973
Drawing No. CP-73-9	

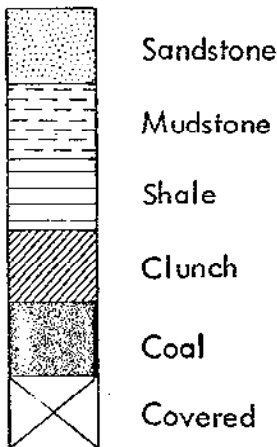
PR-PRC 73(2)A

Thicknesses of units given in inches are stratigraphic; they are distorted in this figure by the dip.

Dip of strata is shown by inclinations of symbols.



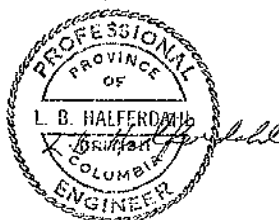
SYMBOLS



572

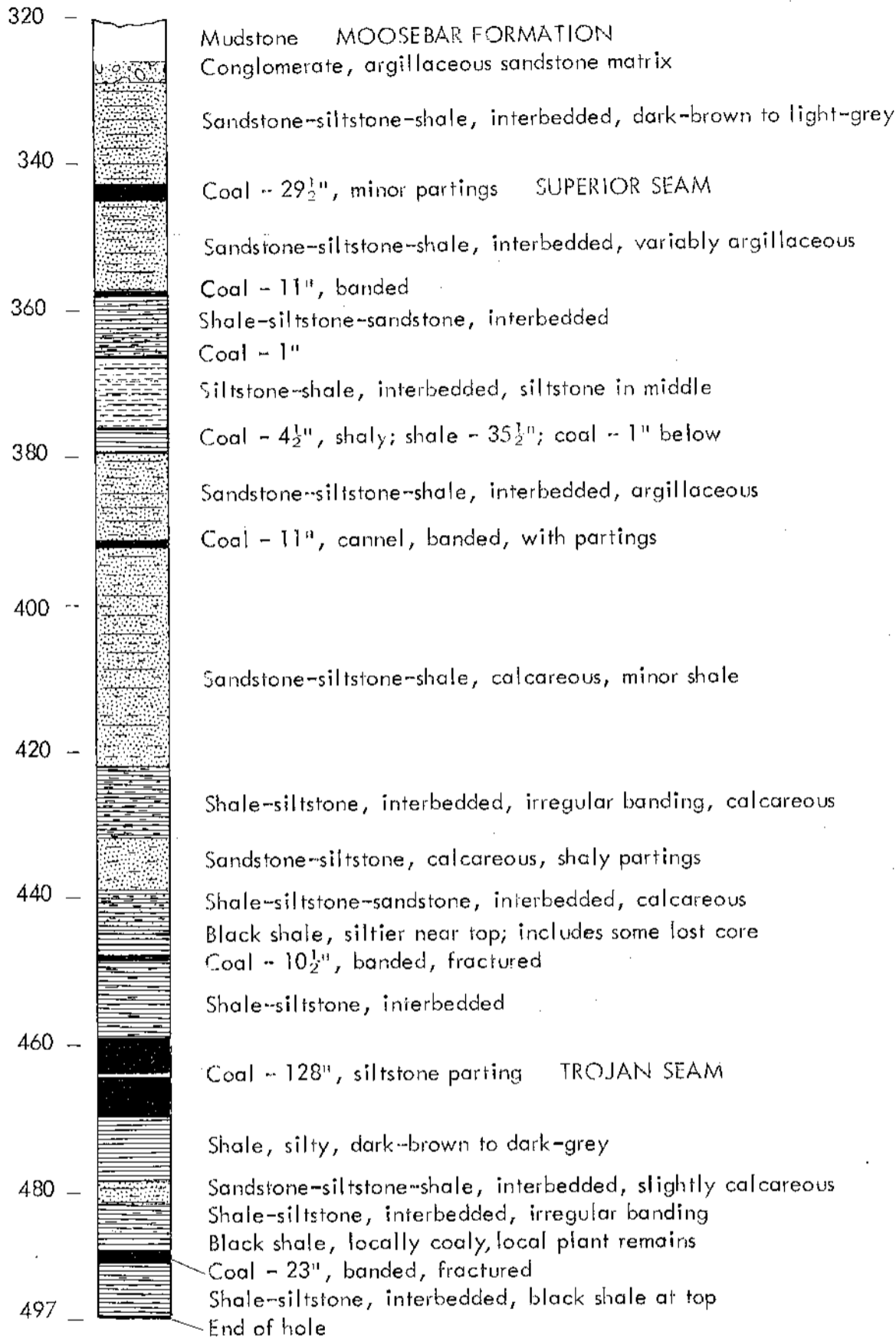
PR - PRC 73(2) A

CINNABAR PEAK MINES LTD.
HALFERDAHL & ASSOCIATES LTD. EDMONTON, ALBERTA
Fig. 3.6.1 Section near Contact Point
PEACE RIVER CANYON PROPERTIES
0 20 40 SCALE IN FEET
GAH September, 1973
Drawing No. CP-73-10

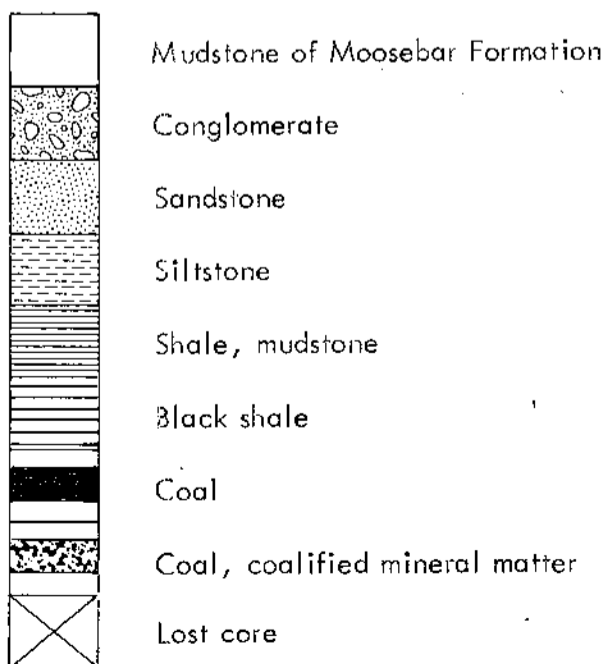


Expiry Date: August 5, 1974

Depth
in feet



SYMBOLS



Depths are measured from the collar of the hole. Thicknesses of units are vertical; they have not been corrected for dip.

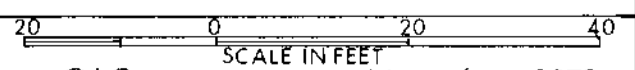
PR-PRC 73(2)A

CINNABAR PEAK MINES LTD.

HALFERDAHL & ASSOCIATES LTD.
EDMONTON, ALBERTA

Fig. 4.1.1 Vertical Section of
Gething Formation in Drill Hole 4A

PEACE RIVER CANYON PROPERTIES



GAC November, 1973

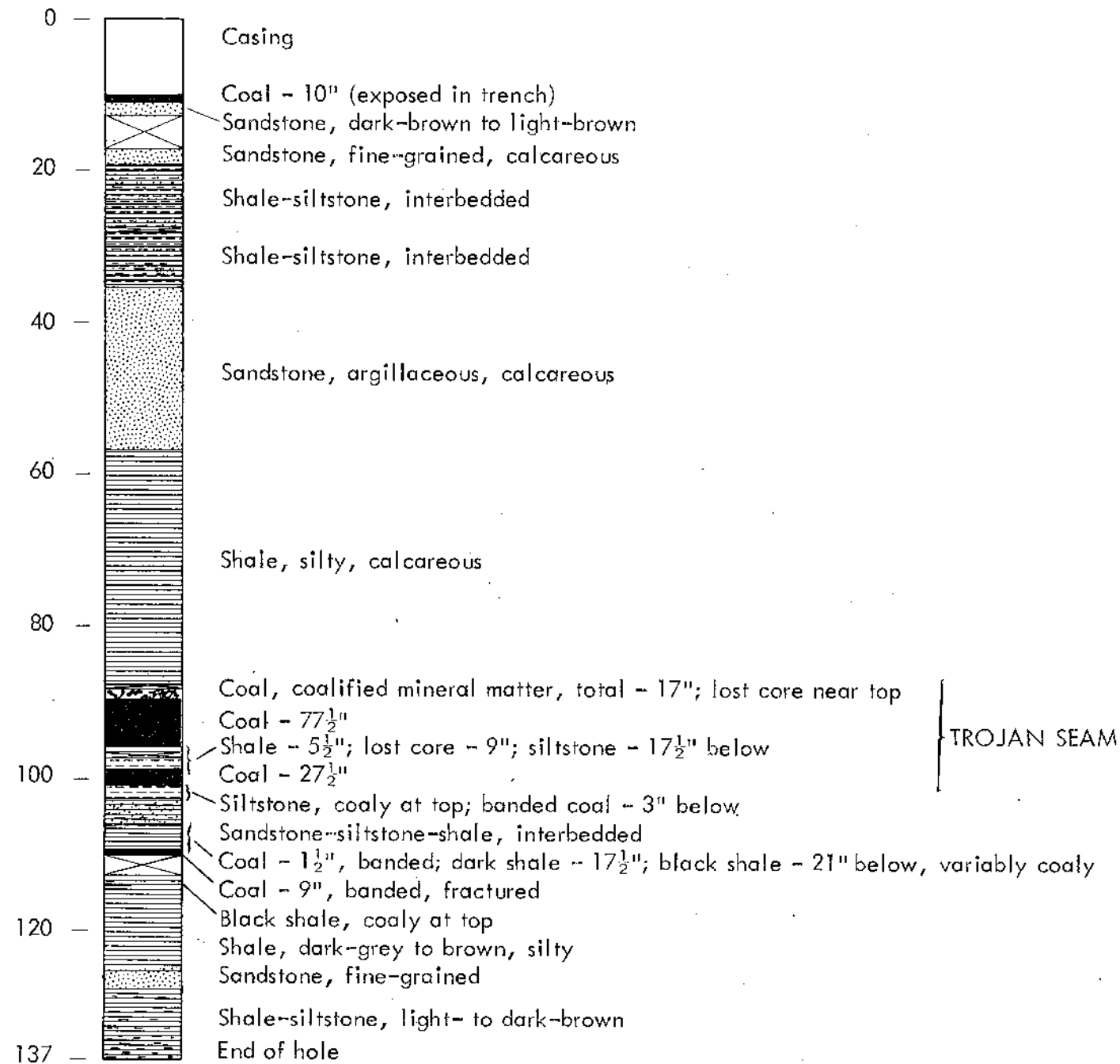
Drawing No. CP-73-11

572

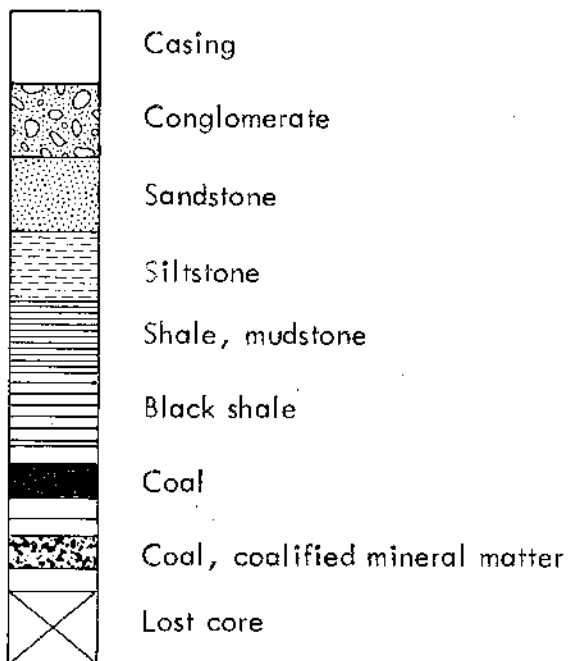


Expiry Date: August 5, 1974

Depth
in feet



SYMBOLS



Depths are measured from the collar of the hole. Thicknesses of units are vertical; they have not been corrected for dip.

572



PR-PRC 73(2) A

CINNABAR PEAK MINES LTD.

HALFERDAHL & ASSOCIATES LTD.
EDMONTON, ALBERTA

Fig. 4.1.2 Vertical Section of
Drill Hole 5

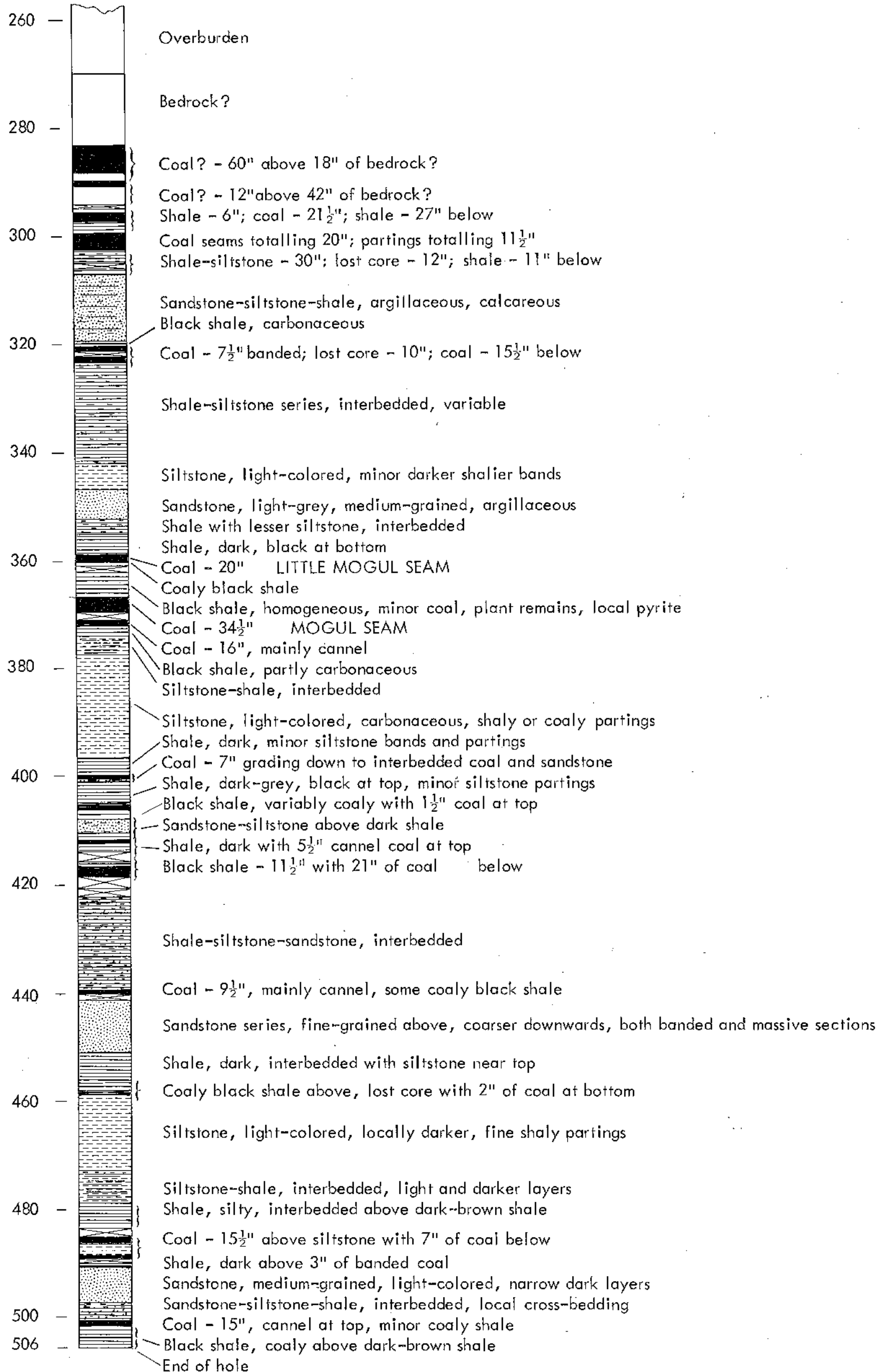
PEACE RIVER CANYON PROPERTIES

20 0 20 40
SCALE IN FEET

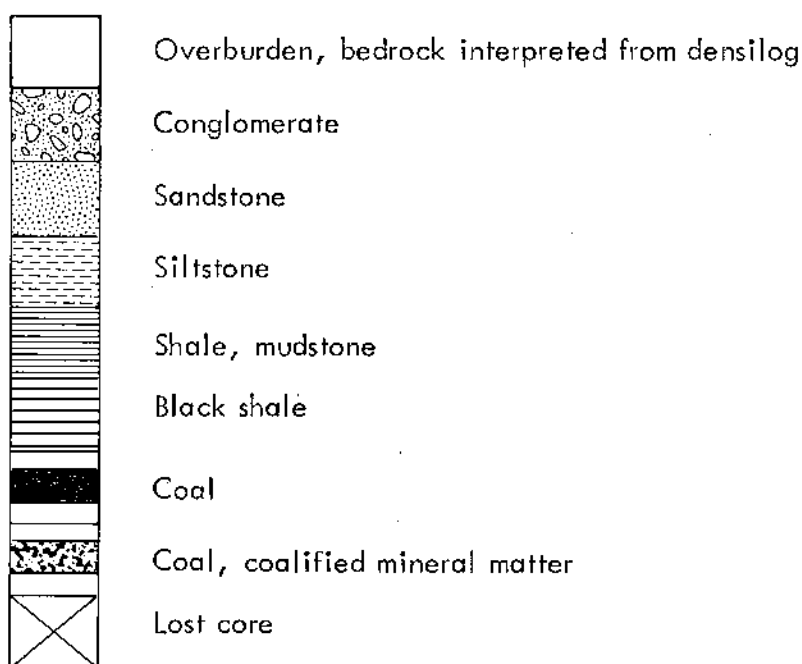
GAC November, 1973

Drawing No. CP-73-12

Depth
in feet



SYMBOLS



Depths are measured from the collar of the hole. Thicknesses of units are vertical; they have not been corrected for dip.

PR-PRC 73(2)A

CINNABAR PEAK MINES LTD.
HALFERDAHL & ASSOCIATES LTD.
EDMONTON, ALBERTA

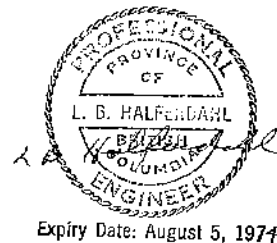
Fig. 4.1.3 Vertical Section of
Gething Formation in Drill Hole 6

PEACE RIVER CANYON PROPERTIES

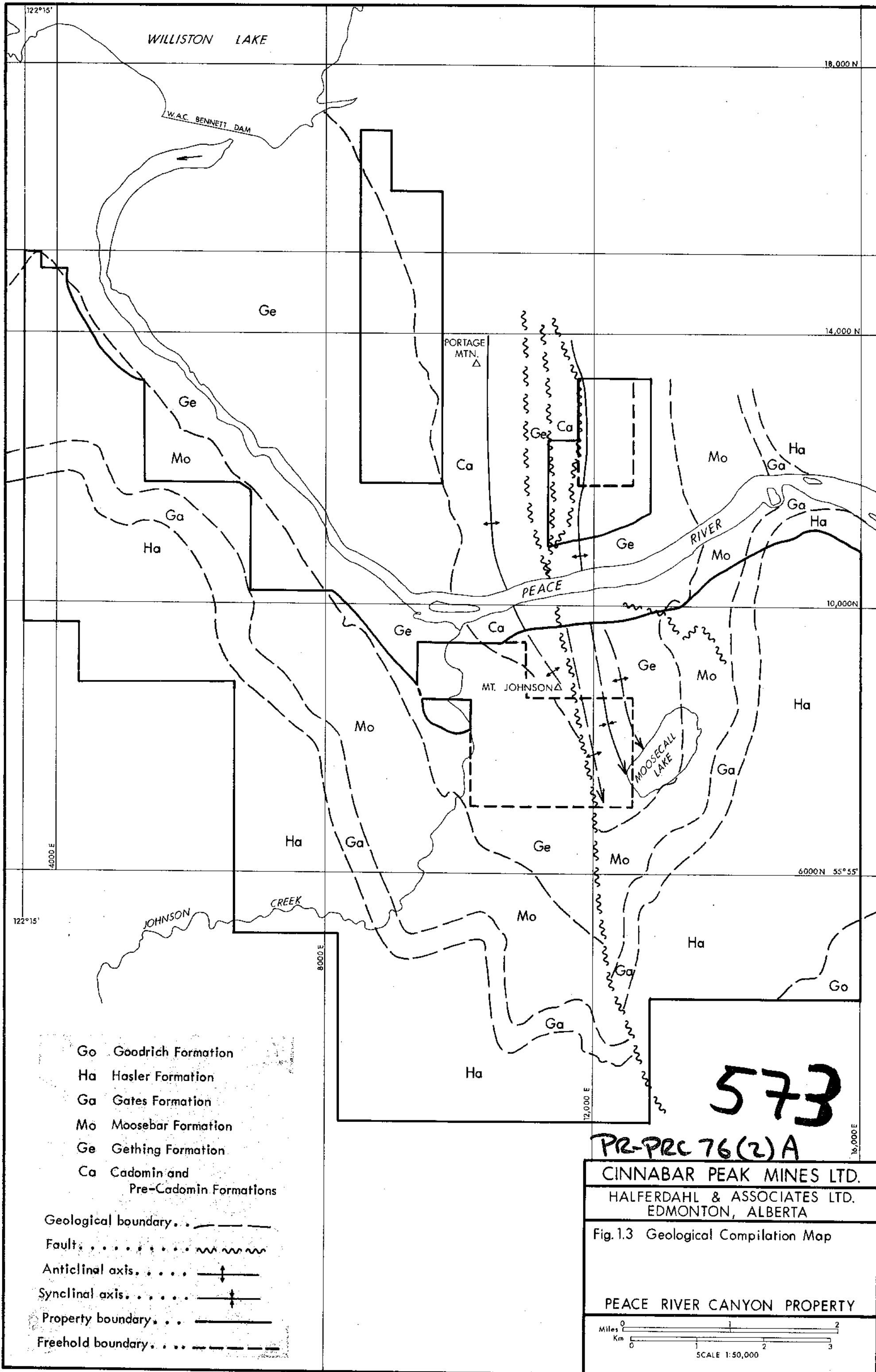
20 0 20 40
SCALE IN FEET

GAC November, 1973

Drawing No. CP-73-13



Expiry Date: August 5, 1974



FR-PEACE RIVER CANYON T(3)A
CINNABAR PEAK MINES WTD.
(Book B-2)

ROKE

SIDEWALL DENSILOG

OIL ENTERPRISES LTD. CALGARY, ALBERTA

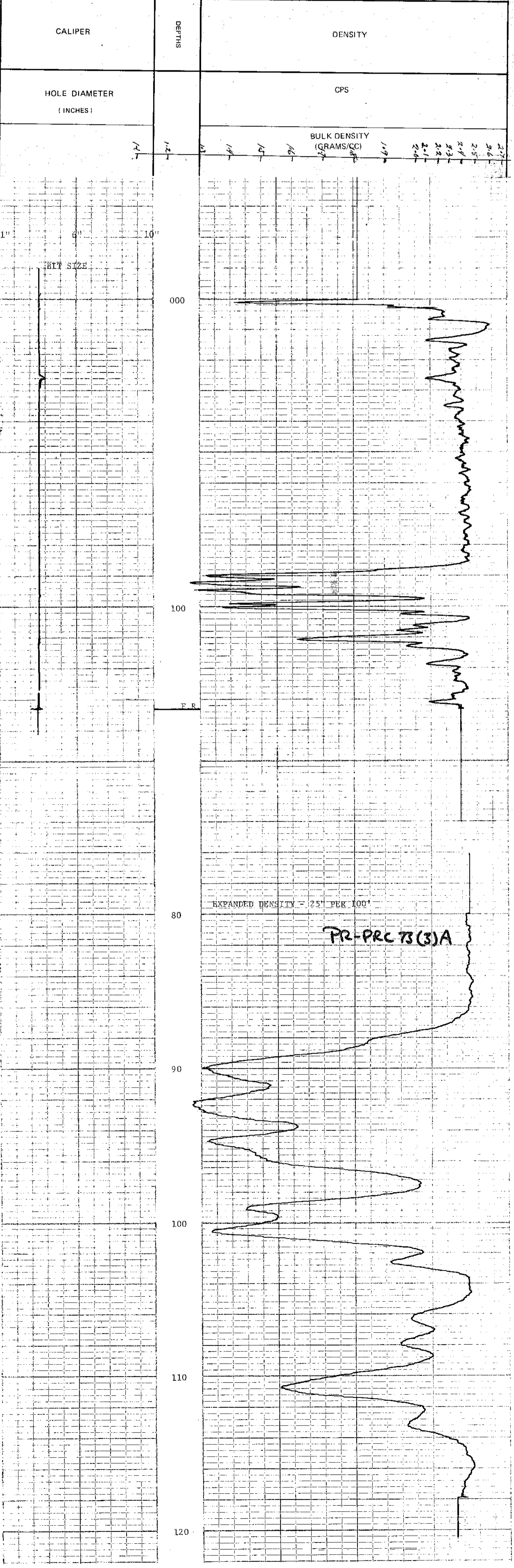
572

FILE NO.	COMPANY	WELL #	LOCATION	FIELD	PROVINCE
LSD	I. B. HALPERDAHT & ASSOCIATES LTD.	5		HUDSON HOPE	BRITISH COLUMBIA
SEC					
TWP					
RGE					
W					
Permanent Datum GROUND LEVEL Elev. _____					
Log Measured from CASING _____ 1. Ft. Above Perm. Datum					
Well Depths Measured from CASING _____					
Run No.	ONE	Other Services: GRN			
Date	30 SEPT 73	K.B. _____			
First Reading	133	CSG _____			
Last Reading	0	G.L. _____			
Footage Logged	133				
Depth Reached	136				
Depth Driller	136				
Casing Roke					
Casing Driller					
Fluid Type	WATER				
Liquid Level					
Min. Diam.	3.5 INCH				
Rm @ 9F		CINNABAR PEAK MINES LTD.			
Operating Time	2 HOURS	Fig. 4.1.6 Sidewall Densilog and Caliper of Drill Hole 5			
Tuck No.	33	PEACE RIVER CANYON PROPERTIES			
Recorded By	PETERSON	Drawing No. CP-73-16			
Witnessed By	CHICKLIN				

LOGGING DATA

RUN NO.	DEPTHS		SPEED FT/MIN	T.C. SEC	SENS SETTINGS	ZERO DIV. L OR R	CPS/DIV.
	FROM	TO					
1	0	133	9	5	1000	.7R	
EXPANDED SCALE							
	80	110	9	5	1000	.7R	

REMARKS



ROKE

SIDEWALL DENSITY LOG

OIL ENTERPRISES LTD. CALGARY, ALBERTA

FILE NO. _____
 COMPANY I. B. HALPERN & ASSOCIATES LTD.
 WELL # 6
 LOCATION _____
 RANGE _____
 FIELD HUDSON HOPE

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PROVINCE BRITISH COLUMBIA
 PERMIT No. _____
 GROUND LEVEL _____
 Log Measured from _____
 Well Depth Measured from _____

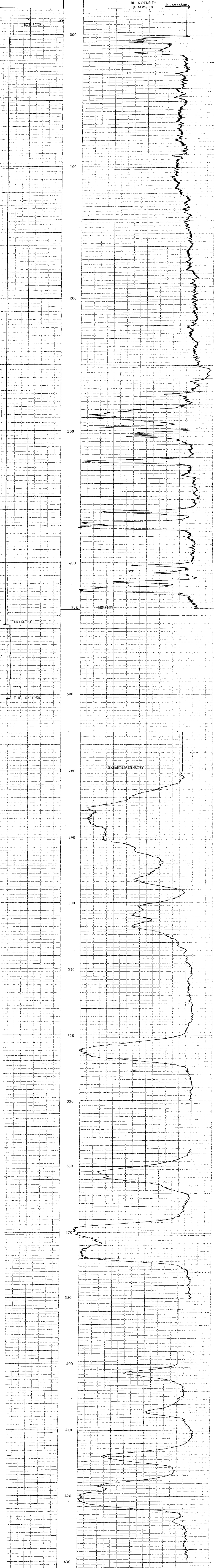
Run No. ONE
 Date 30 SEPT 73
 First Reading 435
 Last Reading 0
 Footage Logged 435
 Depth Reached 438
 Depth Driller 505
 Casing Bore _____
 Casing Driller _____

Fluid Type WATER
 Liquid Level _____
 Min. Depth 2.75 INCH
 Rim @ 9'
 Operating Time 3 HOURS
 Trace No. 33
 Drawing No. CP-73-18
 Recorded By PETERSON
 Witnessed By GIBSON

LOGGING DATA

RUN NO.	DEPTHS		SPEED FT/MIN	T.C. SEC	SENS SETTINGS	ZERO DIV. L OR R	CPS/DIV.
	FROM	TO					
1	0	435	9	3	1000	.7R	
	280	330	EXPANDED		SCALE 25" PER 100'		
	360	380					
	400	430	9	3	1000	.7R	

REMARKS LOGGED THROUGH DRILL ROD. NOTE - NO DENSITY SCALE. DENSITY TOOL BRIDGED IN CORE BARREL. DRILL BIT LOCATED AT 447 FEET AS SHOWN ON CALIPER LOG.



PR-FRC 73(3)A

ROKE

GAMMA RAY NEUTRON LOG

OIL ENTERPRISES LTD. CALGARY, ALBERTA

FILE NO. COMPANY L. B. HALFERDAHL & ASSOCIATES LTD.

WELL # 6

LOCATION

FIELD HUDSON HOPE

PROVINCE BRITISH COLUMBIA

GROUND LEVEL

PERMANENT DATUM

LOG MEASURED FROM CASING

WELL DEPTHS MEASURED FROM CASING

DATE 30 SEPT 73

RUN NO. ONE

LAST READING 0

FAULTS LOGGED

DEPTH REACHED 505

DEPTH DRILLER 505

CASING ROPE

FLUID TYPE AIR/WATER

LIQUID LEVEL 12 FEET

MIN. DIAM. 3.5 INCH

PEACE RIVER CANYON PROPERTIES

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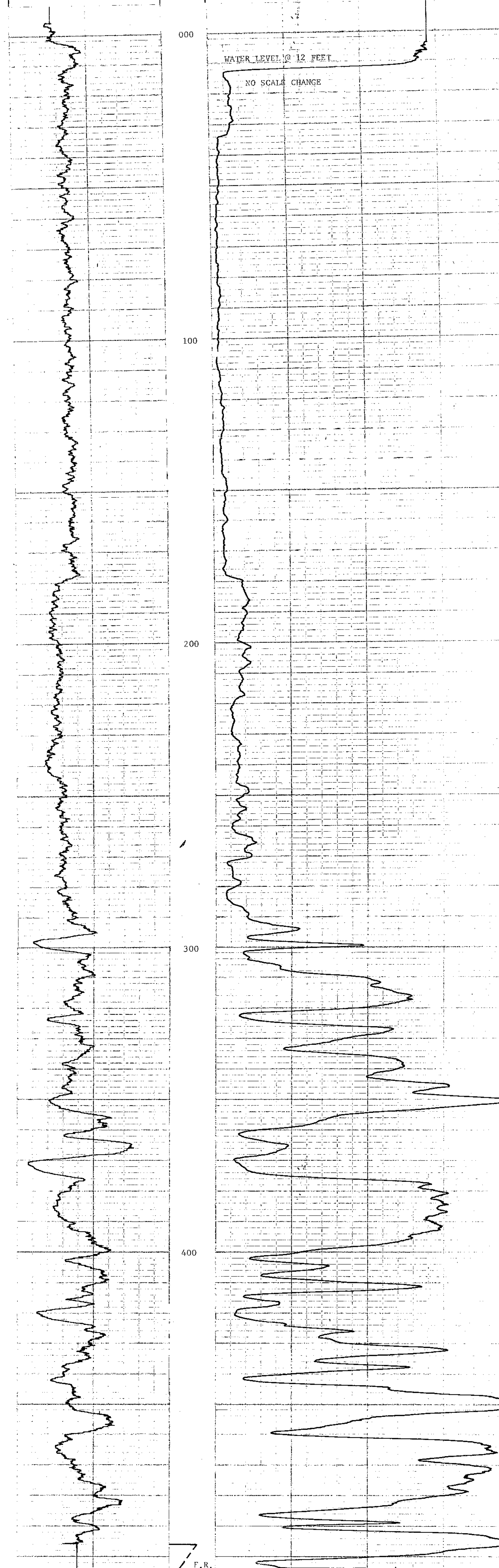
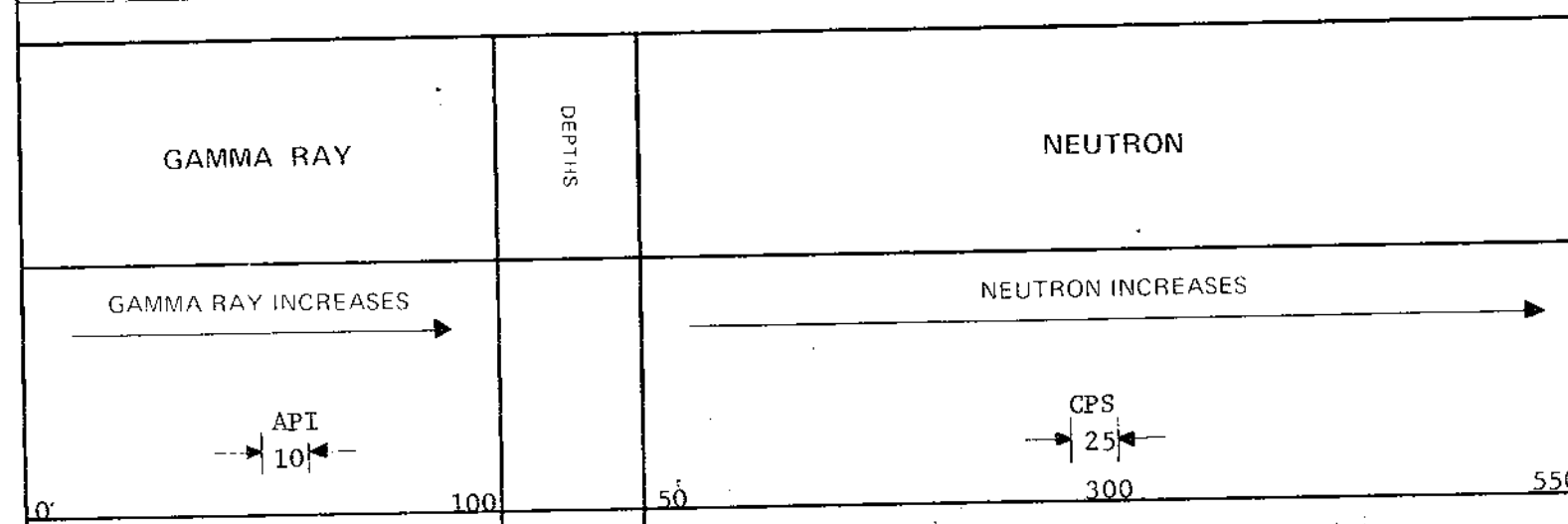
EQUIPMENT DATA

GAMMA RAY				NEUTRON			
RUN NO.	ONE			RUN NO.	ONE		
TOOL MODEL NO.				LOG TYPE	NEUTRON/NEUTRON		
DIAMETER	1 11/16			TOOL MODEL NO.	1 11/16		
DETECTOR MODEL NO.				DIAMETER	1 11/16		
TYPE	GEIGER			DETECTOR MODEL NO.	PROPORTIONAL		
LENGTH	18 INCH			TYPE	6 INCH		
DISTANCE TO N SOURCE	8.55 FT.			LENGTH	MRC-N-SS-W		
GENERAL				SOURCE MODEL NO.	598		
HOIST TRUCK NO.				SERIAL NO.	19 INCH		
INSTRUMENT TRUCK NO.	33			SPACING	AmBe		
TOOL SERIAL NO.	CGN27 177			TYPE	6.94x10 ⁶ N/S		
				STRENGTH			

LOGGING DATA

GENERAL				GAMMA RAY				NEUTRON			
RLN NO	DEPTHS FROM	SPEED TO	T.C. FT MIN	SENS SETTINGS	ZERO DIV L OR R	API G. R. UNITS PER LOG DIV	T. C. SEC.	SENS SETTINGS	ZERO DIV L OR R	API N. UNITS PER LOG DIV	
1	0	505	12	3	100	0.1	10	5	500	2 L	25 CPS

REMARKS LOGGED THROUGH DRILL ROD



PR-PRC 73(3)A

Recorded By: PETERSON Witnessed By: CHICKLIN

Fig. 4.1.7 Gamma Ray Neutron Log of Drill Hole 6

CINNABAR PEAK MINES LTD.

ROKE

GAMMA RAY NEUTRON LOG

OIL ENTERPRISES LTD. CALGARY, ALBERTA

COMPANY L. B. HALPERDAHL & ASSOCIATES LTD.

WELL # 4A

LOCATION 7304 A

FIELD Peace River Canyon (73)

PROVINCE BRITISH COLUMBIA

Permanent Datum GROUND LEVEL

Log Measured from CASING

Well Depth Measured from CASING

Run No. ONE

Date 30 SEPT 73

First Reading 445

Last Reading 0

Footage Logged 445

Depth Reached 446

Depth Driller 505

Casing Roke

Casing Driller

Liquid Level

Min. Diam. 3.5 INCH

Rm. @ of

Operating Time 2 HOURS

Truck No. 33

Recorded By PETERSON

Witnessed By CHICKLIN

Other Services:

K. B. _____

CSS _____

G.L. _____

Fig. 4.1.4 Gamma Ray Neutron Log of Drill Hole 4A

PEACE RIVER CANYON PROPERTIES

Drawing No. CP-73-14

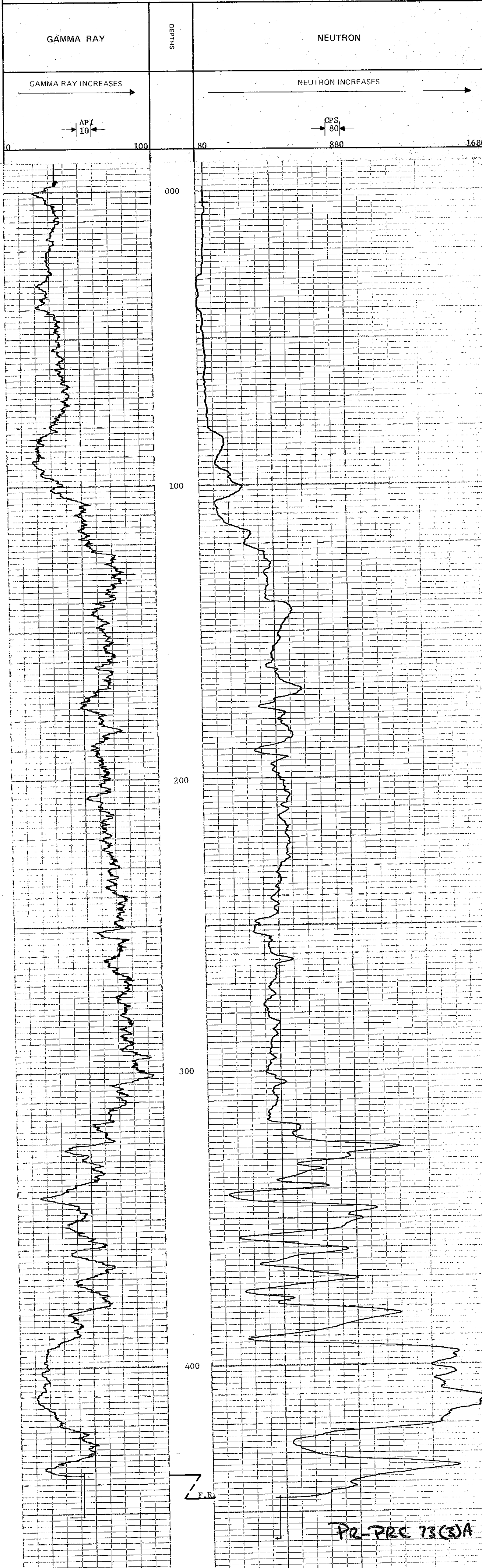
EQUIPMENT DATA

GAMMA RAY		NEUTRON	
RUN NO.	ONE	RUN NO.	ONE
TOOL MODEL NO.		LOG TYPE	NEUTRON/NEUTRON
DIAMETER	1 11/16	TOOL MODEL NO.	
DETECTOR MODEL NO.		DIAMETER	1 11/16
TYPE	GEIGER	DETECTOR MODEL NO.	
LENGTH	18 INCH	TYPE	PROPORTIONAL
DISTANCE TO N. SOURCE	8.55 FT.	LENGTH	6 INCH
		SOURCE MODEL NO.	MRC-N-SS-W
GENERAL		SERIAL NO.	598
HOIST TRUCK NO.		SPACING	19 INCH
INSTRUMENT TRUCK NO.	33	TYPE	AmBe
TOOL SERIAL NO.	CGN27U 177	STRENGTH	6.94x10 ⁶ N/S

LOGGING DATA

GENERAL			GAMMA RAY				NEUTRON				
RUN NO.	DEPTHS FROM	SPEED FT/MIN	T.C. SEC	SENS SETTINGS	ZERO DIV. L OR R	API G. R. UNITS PER LOG DIV.	T. C. SEC	SENS SETTINGS	ZERO DIV. L OR R	API N. UNITS PER LOG DIV.	
1	0	445	12	3	100	0. L.	10	5	1000	1 L.	80 CPS.

REMARKS BRIDGED AT 446 FEET



ROKE

GAMMA RAY NEUTRON LOG

OIL ENTERPRISES LTD. CALGARY, ALBERTA

FILE NO. COMPANY L.B. HALPERNAHL & ASSOCIATES LTD.

WELL # 5

LOCATION HUDSON HOPE

FIELD HUDSON HOPE

PROVINCE BRITISH COLUMBIA

Permanent Datum GROUND LEVEL. Log Measured from CASING. Well Depths Measured from CASING.

Run No. ONE Date 30 SEPT 73

First Reading 135 Last Reading 0

Footage Logged 135

Depth Reached 136

Depth Driller 136

Casing Driller

Fluid Type AIR/WATER

Liquid Level 46 FEET

Min. Diam. 3.5 INCH

Operating Time 2 HOURS

Truck No. 33

572

Fig. 4.1.5 Gamma Ray Neutron Log of Drill Hole 5 of PEACE RIVER CANYON PROPERTIES Drawing No. CP-73-15

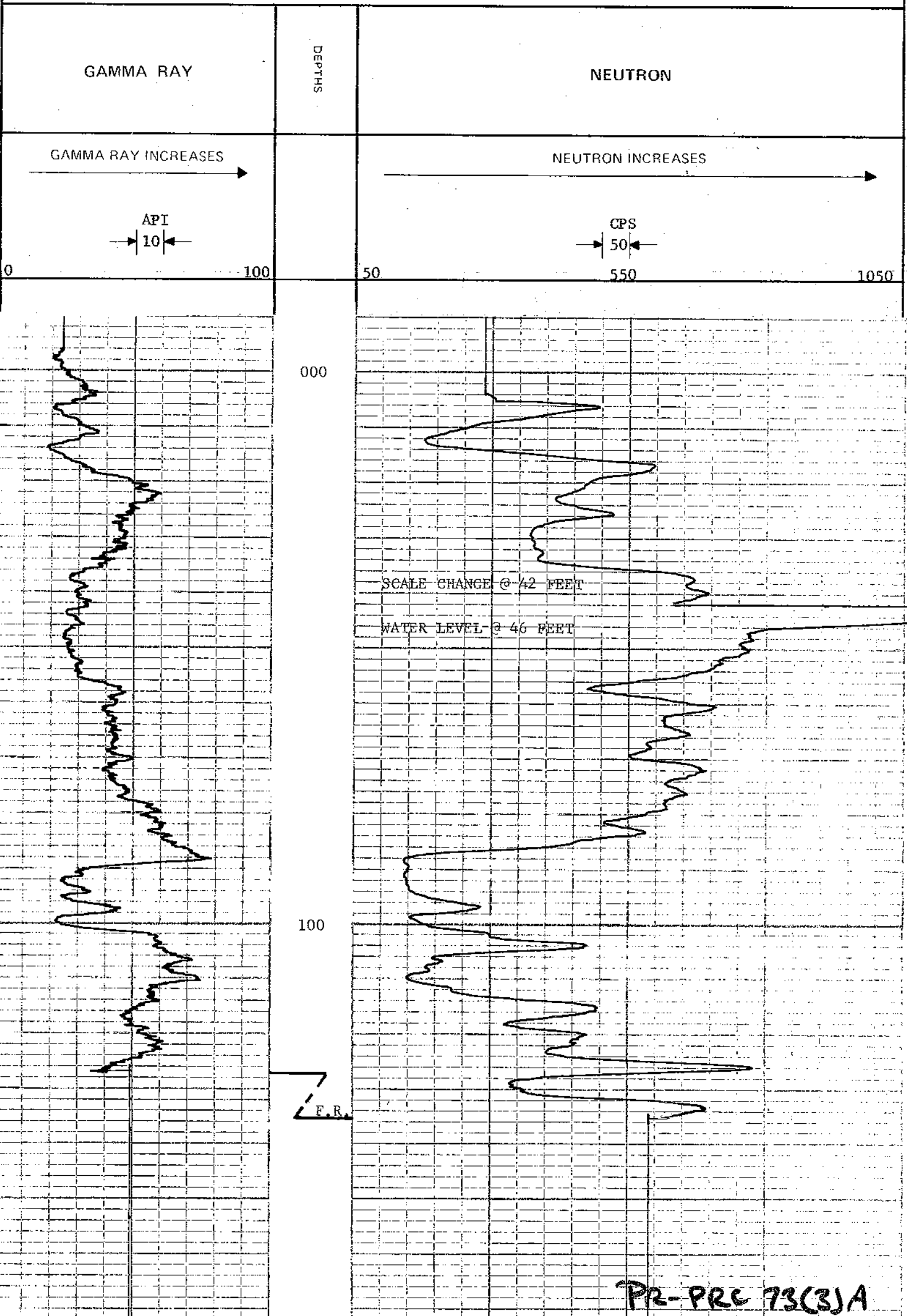
EQUIPMENT DATA

GAMMA RAY				NEUTRON			
RUN NO.	ONE			RUN NO.	ONE		
TOOL MODEL NO.				LOG TYPE	NEUTRON/NEUTRON		
DIAMETER	1 11/16			TOOL MODEL NO.			
DETECTOR MODEL NO.				DIAMETER	1 11/16		
TYPE	GEIGER			DETECTOR MODEL NO.			
LENGTH	18 INCH			TYPE	PROPORTIONAL		
DISTANCE TO N. SOURCE	8.55 FT.			LENGTH	6 INCH		
GENERAL				SOURCE MODEL NO.	MRC-N-SS-W		
HOIST TRUCK NO.				SERIAL NO.	598		
INSTRUMENT TRUCK NO.	33			SPACING	19 INCH		
TOOL SERIAL NO.	CGN27U4	177		TYPE	AmBe		
				STRENGTH	6.94x10 ⁶ N/S		

LOGGING DATA

RUN NO.	DEPTHS		SPEED FT/MIN	GAMMA RAY				NEUTRON			
	FROM	TO		T.C. SEC.	SENS SETTINGS	ZERO DIV. L OR R	API G. R. UNITS PER LOG DIV.	T. C. SEC.	SENS SETTINGS	ZERO DIV. L OR R	API N. UNITS PER LOG DIV.
1	0	42	12	5	100	O.L.	10	3	1000	1 L	50 CPS
	42	135	12	5	100	O.L.	10	3	500	1 L	25 CPS

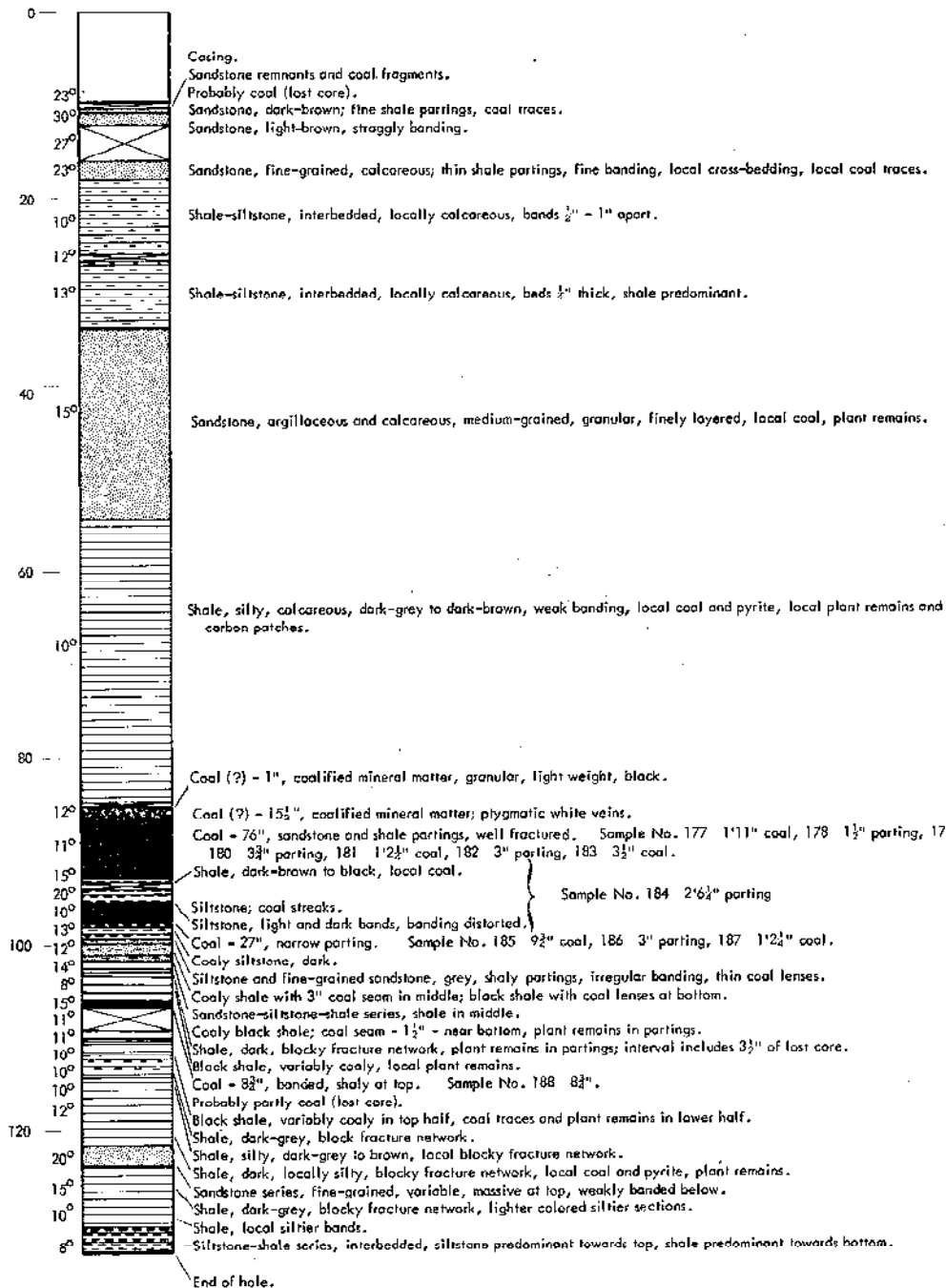
REMARKS



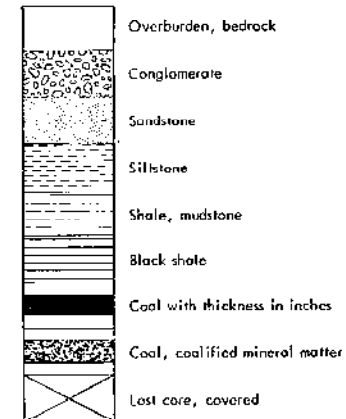
PR-PRC 73(3)A

Recorded By PETERSON Witnessed By CHICKLIN

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SYMBOLS



TROJAN SEAM
12'11½"

Composite
Sample #2 11'1½"

PR-PRC 73(3)A

CINNABAR PEAK MINES LTD

HALFERDAHL & ASSOCIATES LTD
EDMONTON, ALBERTA

Fig. 4.1.10. Stratigraphic Section of Drill Hole 5

PEACE RIVER CANYON PROPERTIES



DRAWN: G.A.C.

DECEMBER 1973

DRAWING No. CP-73-20

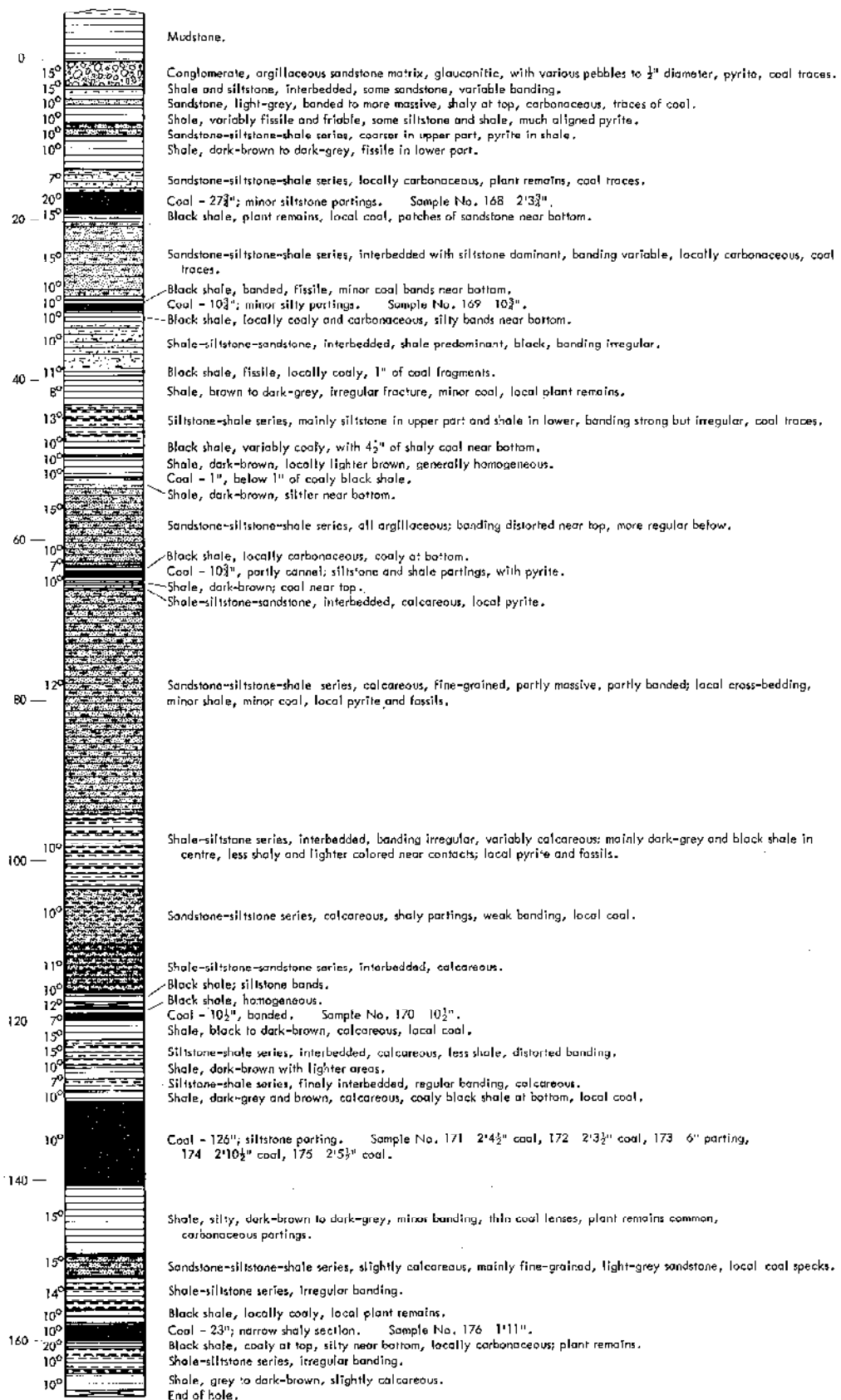
Notes

- 1) The datum for measurements in this hole is the Moosebar-Gething contact.
- 2) See logs with lithologic descriptions for information on intervals too thin to be shown.
- 3) Sample lengths are true stratigraphic thicknesses, and therefore differ from the core lengths in the analytical reports.
- 4) Dips obtained from intersections of banding and bedding with core axes adjacent the stratigraphic column on the left.



Expiry Date: August 5, 1974

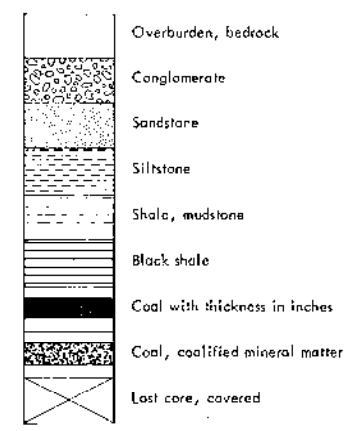
572



SUPERIOR SEAM Composite Sample #1 2'3 3/4"

TROJAN SEAM Composite Sample #2 10'6"

SYMBOLS



- Notes**
- 1) The datum for measurements in this hole is the collar.
 - 2) See logs with lithologic descriptions for information on intervals too thin to be shown.
 - 3) Sample lengths are true stratigraphic thicknesses, and therefore differ from the core lengths in the analytical reports.
 - 4) Dips obtained from intersections of banding and bedding with core axes adjoin the stratigraphic column on the left.



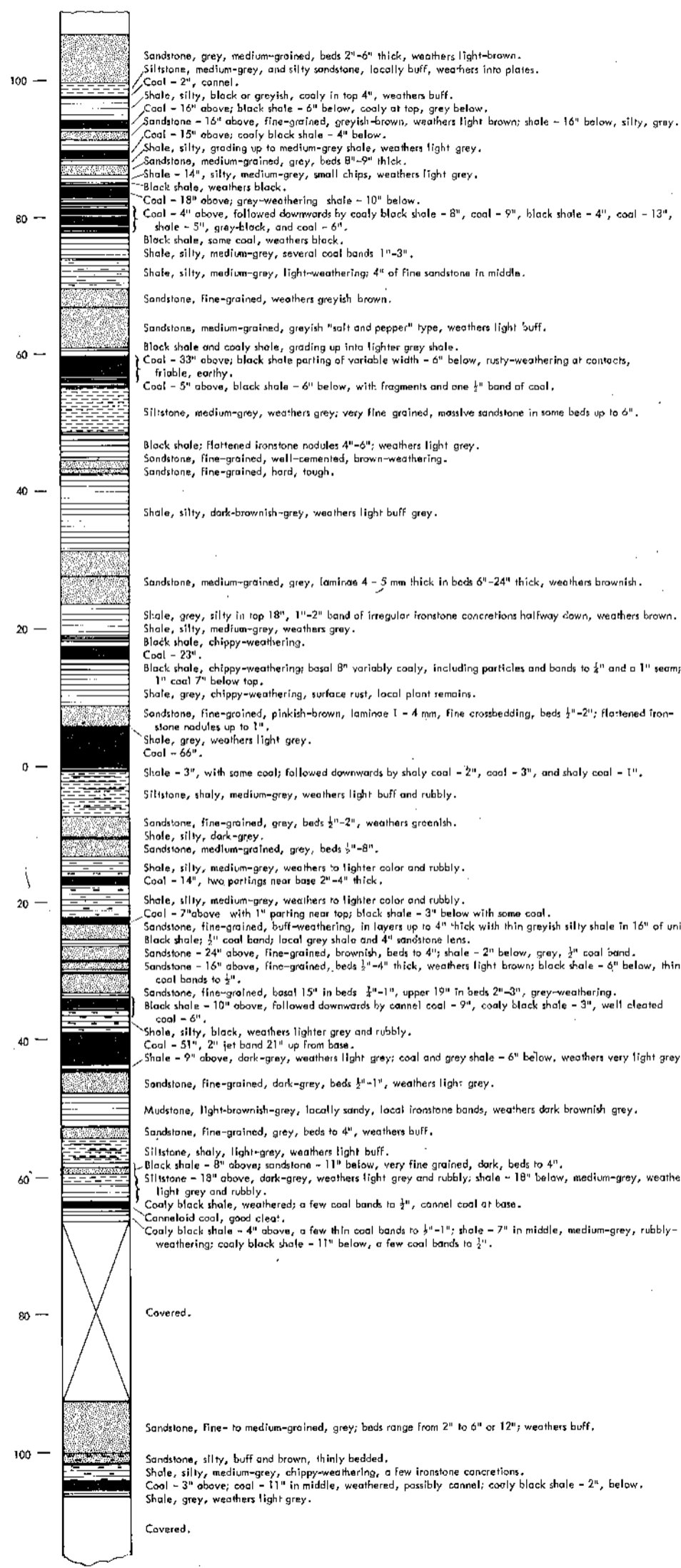
Expiry Date: August 5, 1974

PR-PRC 73(3)A

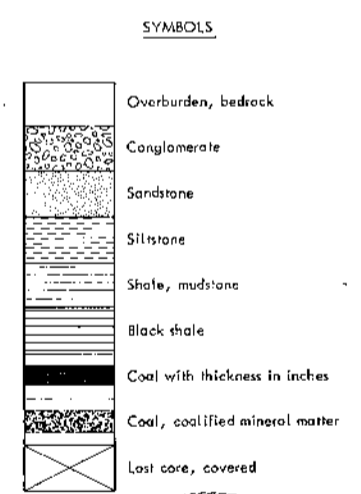
CINNABAR PEAK MINES LTD	
HALFERDAHL & ASSOCIATES LTD EDMONTON, ALBERTA	
Fig. 4.1.9. Stratigraphic Section of Gething Formation in Drill Hole 4A. PEACE RIVER CANYON PROPERTIES	
0 20 40 60 SCALE IN FEET	
DRAWN: G.A.C.	DECEMBER 1973
DRAWING No. CP-73-19	

7304A

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LITTLE MOGUL SEAM
MOGUL SEAM



PR-PRC 73(3)A Expiry Date: August 5, 1974

CINNABAR PEAK MINES LTD.
HALFERDAHL & ASSOCIATES LTD
EDMONTON, ALBERTA

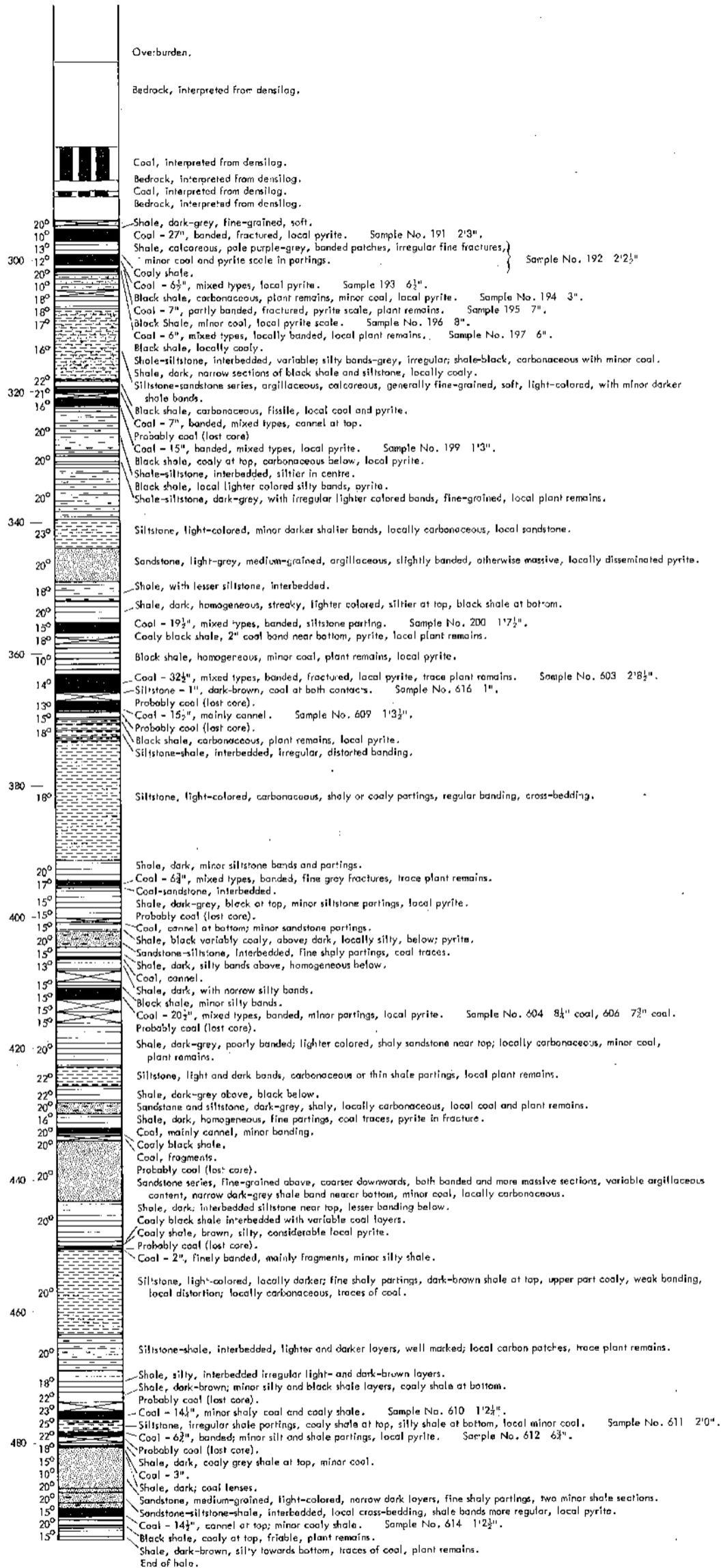
Fig. 4.1.12. Stratigraphic Section in Trenches 2 & 3
on South Slope of Mount Johnson
PEACE RIVER CANYON PROPERTIES

0 20 40 60
SCALE IN FEET

DRAWN: G.A.C. DECEMBER 1973
DRAWING No. CP-73-22

Note
The datum for measurements is the base of the Mogul Seam.

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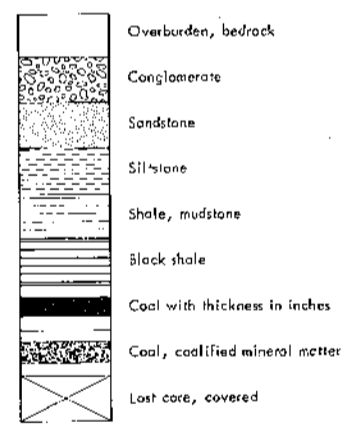


Composite Sample #4 6'6"

LITTLE MOGUL SEAM

MOGUL SEAM Composite Sample #5 5'9"

SYMBOLS



CASTLE POINT SEAM Composite Sample #6 3'9"

- Notes
- 1) The datum for measurements in this hole is the collar.
 - 2) See logs with lithologic descriptions for information on intervals too thin to be shown.
 - 3) Sample lengths are true stratigraphic thicknesses, and therefore differ from the core lengths in the analytical reports.
 - 4) Dips obtained from intersections of banding and bedding with core axes adjoin the stratigraphic column on the left.



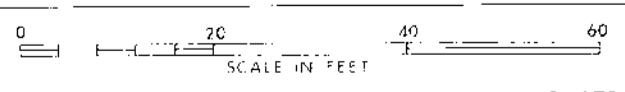
PR-PRC 73(3)A

CINNABAR PEAK MINES LTD.

HALFERDAHL & ASSOCIATES LTD

EDMONTON, ALBERTA

Fig. 4.11. Stratigraphic Section of Drill Hole 6 PEACE RIVER CANYON PROPERTIES



DRAWN: G.A.C. DECEMBER 1973

DRAWING No. CP-73-21

INNABAR PEAK MINES LTD.

1973 PRELIMINARY FEASIBILITY STUDY AND DRILLING
ON
PEACE RIVER CANYON COAL PROPERTIES
NORTHEASTERN BRITISH COLUMBIA

Geographic Coordinates
(Centre of Properties)
55° 56' N
122° 8' W
NTS Sheet 93-O/16E

~~CONFIDENTIAL~~

by

G.A. Haslett, B.Sc., C. Eng., P. Eng.

G.A. Checklin, B.Sc., P. Eng.

L.B. Halferdahl, Ph.D., P. Eng.

January 21, 1974

Halferdahl & Associates Ltd.
401 - 10049 Jasper Avenue
Edmonton, Alberta
T5J 1T7

*Rec'd at ...
L.B. 1975 Feb. 12/74*

SECTION 5.0

ANALYSES OF COAL

In general, samples of coal were collected and the raw coal analyzed from cored seams more than 10 inches thick in order to obtain preliminary information on the thicker seams, to help in correlating the thinner seams, and to learn variations in composition of the coal throughout the coal measures. The analytical reports on the raw coal samples in Appendix 2 show that most of the coals are medium volatile bituminous, and that some have F.S.I. values characteristic of coking coal.

Most of the samples from the cored seams that are thick enough to consider for mining either now or in the future were composited in composite samples 1, 2, 3, 4, 5, and 6, which were extensively tested and analysed as described in the following paragraphs. However, more than 2 feet of coal, as interpreted from the density log, are included in lost core from the seam about 40 feet below the Mogul Seam. Thus, the two samples, Ho. 604 and Ho. 606, from this seam total only 16½ inches of coal and were not composited. The analyses of the raw coal from this seam show that it is not coking coal but can be expected to be an excellent thermal coal.

Composite samples, 1, 2, and 3 represent all samples including partings from the Superior and Trojan Seams. Complete results are in Appendix 3, and are summarized in Table 1. They show very low ash and low sulfur, and that the Superior Seam has a higher F.S.I. than the Trojan Seam. Yields for the Trojan Seam vary inversely with the thickness and number of partings in the composite samples. Many more samples including bulk samples are required to predict the yield that could be obtained in a processing plant, but 70 to 75 per cent appears likely. The samples from the Trojan Seam adjusted to a moisture-free ash-free basis are remarkably consistent with 29½ to 32 per cent volatiles and 68 to 70½

per cent fixed carbon.

Composite samples 4, 5, and 6 represent all samples including partings from the seam 65 feet above the Mogul Seam, the Mogul Seam, and the Castle Point Seam, respectively. Complete results are in Appendix 4, and are summarized in Table 2. As these are the first analyses from drill cores of these seams from the Peace River Canyon Properties of Cinnabar Peak Mines Ltd., fewer sink-float tests were made on the + 100 mesh fractions than for composite samples 1, 2, and 3. The analyses in Table 2 show that the Mogul Seam may well contain excellent thermal coal, and that the Castle Point Seam has coking properties. The low yield for the Castle Point Seam is caused by a thick parting, and by lost core interpreted as coal from the density log and not included in the composite sample.

SECTION 6.0

RESERVES

In this section mineable reserves are based on outcrop and drill-hole data and projections generally less than $1\frac{1}{2}$ miles from them. They are practically available on the basis of current economic operation levels and with current technical knowledge. They are estimated only in the Trojan and Mogul Seams and the unnamed seam about 40 feet below the Mogul Seam, to depths of about 1500 feet. As sufficient data are not yet available to establish very precise estimates of reserves mineable by open-pit methods, the mineable reserves are estimated for each of the three seams, and then considerations of the reserves mineable by open-pit are presented.

The reserves in the Trojan Seam, based on an average thickness of 8 feet of coal, a specific gravity of 1.42, and underlying an area of 4.5 square miles in Lots 1048, 1055, 1056, 1057, 1058, 1059, 1060, 1065, and 1066, are estimated at 39.6 million long tons. In Fig. 1.3 these reserves lie between the surface trace of the Trojan Seam shown and the 1500-foot isobath whose surface projection lies approximately along the Moosebar-Gething contact. At a 60 per cent extraction rate, the mineable reserves in the Trojan Seam within the nine lots just listed are 23.8 million long tons.

TABLE 1: CLEAN COAL COMPOSITE DATA FOR COMPOSITE SAMPLES 1, 2, AND 3

Composite Sample No.	1	2	3
<u>Composition</u>			
+ 100 Mesh Floats at 1.80	81.94	90.06	89.90
- 100 Mesh Froth	18.06	9.94	10.10
<u>Total Yield</u>	64.57	88.61	60.56
<u>Proximate Analysis</u>			
Ash	5.87	5.11	7.78
Volatile Matter	33.89	26.18	26.78
Residual Moisture	0.59	0.84	0.44
Fixed Carbon	59.65	67.87	65.00
F.S.I.	9	5½	6
Sulfur	0.60	0.49	0.67
B.T.U./lb.	14,330	14,570	14,090

Figures show percentage by weight except for F.S.I. and B.T.U./lb.

1. Superior Seam 2'3¾" total seam in drill hole 4A.
2. Trojan Seam 10'6" total seam in drill hole 4A.
3. Trojan Seam 11'1¼" of 12'11¼" total seam in drill hole 5.

TABLE 2: SUMMARY OF ANALYSES FOR COMPOSITE SAMPLES 4, 5, AND 6
(Specific Gravity 1.60)

Composite Sample No.	4	5	6
<u>Size Consist</u>			
+ 100 mesh	96.11	90.33	90.10
- 100 mesh	3.89	9.67	9.90
<u>Yield of + 100 mesh</u>	36.40	93.20	26.81
<u>Proximate Analysis of + 100 Mesh Floats</u>			
Ash	3.39	3.15	9.82
Volatile Matter	22.86	22.40	25.56
Residual Moisture	0.45	0.63	0.54
Fixed Carbon	73.30	73.82	64.07
F.S.I.	1½	1½	7
Sulfur	0.76	0.64	1.16
<u>Proximate Analyses of - 100 Mesh</u>			
Ash	39.11	4.68	61.93
Volatile Matter	28.20	22.90	11.85
Residual Moisture	0.60	0.74	0.54
Fixed Carbon	32.09	71.68	25.68
F.S.I.	½	1	1½
Sulfur	0.38	0.77	0.59

Figures show percentage by weight except for F.S.I.

4. Seam 65 feet above Mogul Seam 6'6" total seam in drill hole 6.
5. Mogul Seam 4'1" of 5'9" total seam in drill hole 6.
6. Castle Point Seam 3'9" of 6'8¾" total seam in drill hole 6.

The reserves in the Mogul Seam, based on an average thickness of $5\frac{1}{2}$ feet of coal, a specific gravity of 1.42, and underlying an area of 3.8 square miles in Lots 1048, 1050, 1055, 1056, 1057, 1059, 1060, and 1065 are 23.0 million long tons. Similar reserves in the unnamed seam are 17.8 million long tons for a total of 40.8 million long tons. At a 60 per cent extraction rate for underground mining, the mineable reserves in the Mogul Seam and the unnamed seam within the eight lots just listed are 24.5 million long tons.

Preliminary information suggests that an open-pit mine on the southern and southwestern slopes of Mount Johnson might have reserves of 1.7 million long tons per thousand feet of axis. Estimates based on combined total pit lengths ranging from 4000 to 12,000 feet indicate open-pit reserves ranging from 6.8 to 20.4 million long tons. Some of these reserves are in the Mogul Seam and the unnamed seam, and if data from additional work show that they are recoverable by open-pit methods, they would have to be subtracted from the underground reserves in these seams estimated in the previous paragraph.

Additional reserves are present in the Trojan Seam: at depths of less than 1500 feet in Lots 1064 and 1069 west of the major northerly trending fault, and in Lots 1045, 1046, 1044, and 1039 to the northwest; at depths greater than 1500 feet in Lots 1057, 1058, 1065, 1066, 1067, 1068, and 1069 with the actual depth limit being determined by mining experience; and in some of the coal licences east of the major northerly-trending fault. Other additional reserves exist in the Mogul and other seams near it stratigraphically, but data are insufficient to estimate those recoverable. Other additional possible recoverable reserves in the Grant-King and the Murray - "48" Seams are estimated at 50 million long tons.

APPENDIX 2 : ANALYTICAL REPORTS ON RAW COAL SAMPLES

HALFERDAHL & ASSOCIATES

SAMPLE NO.: 168
2'5½", Coal

ANALYSIS ON AIR DRY BASIS:

Ash	26.23 %
Volatile Matter	37.89 %
Residual Moisture	0.25 %
Fixed Carbon	35.63 %
Free Swelling Index	6
Sulphur	0.40 %

C.E.S. #168

November 1, 1973

CYCLONE ENGINEERING SALES LTD.
Edmonton, Alberta, Canada.

HALFERDAHL & ASSOCIATES LTD.

SAMPLE NO.: 169
0'11", Coal

ANALYSIS ON AIR DRY BASIS:

Ash	22.38 %
Volatile Matter	36.22 %
Residual Moisture	0.26 %
Fixed Carbon	41.14 %
Free Swelling Index	6
Sulphur	0.75 %

C.E.S. #169

November 1, 1973

CYCLONE ENGINEERING SALES LTD.
Edmonton, Alberta, Canada.

HALFERDAHL & ASSOCIATES LTD.

SAMPLE NO.: 170
0'10½", Coal

ANALYSIS ON AIR DRY BASIS:

Ash	50.33 %
Volatile Matter	18.27 %
Residual Moisture	0.36 %
Fixed Carbon	31.04 %
Free Swelling Index	3
Sulphur	0.43 %

C.E.S. #170

November 1, 1973

CYCLONE ENGINEERING SALES LTD.
Edmonton, Alberta, Canada.

HALFERDAHL & ASSOCIATES LTD.

SAMPLE NO.: 171
2'5", CoalANALYSIS ON AIR DRY BASIS:

Ash	3.90 %
Volatile Matter	25.32 %
Residual Moisture	0.40 %
Fixed Carbon	70.38 %
Free Swelling Index	3
Sulphur	0.46 %

C.E.S. #171

November 1, 1973

CYCLONE ENGINEERING SALES LTD.
Edmonton, Alberta, Canada.

HALFERDAHL & ASSOCIATES LTD.

SAMPLE NO.: 172
2'4", Coal

ANALYSIS ON AIR DRY BASIS:

Ash	16.32 %
Volatile Matter	24.02 %
Residual Moisture	0.39 %
Fixed Carbon	59.27 %
Free Swelling Index	1½
Sulphur	0.36 %

C.E.S. #172

November 1, 1973

CYCLONE ENGINEERING SALES LTD.
Edmonton, Alberta, Canada.

HALFERDAHL & ASSOCIATES

SAMPLE NO.: 174
2'11", CoalANALYSIS ON AIR DRY BASIS:

Ash	3.63 %
Volatile Matter	27.18 %
Residual Moisture	0.24 %
Fixed Carbon	68.95 %
Free Swelling Index	5½
Sulphur	0.38 %

C.E.S. # 174

November 1, 1973

CYCLONE ENGINEERING SALES LTD.
Edmonton, Alberta, Canada.

HALFERDAHL & ASSOCIATES LTD.

SAMPLE NO.: 175
2'6", Coal

ANALYSIS ON AIR DRY BASIS:

Ash	3.99 %
Volatile Matter	29.42 %
Residual Moisture	0.34 %
Fixed Carbon	66.25 %
Free Swelling Index	7½
Sulphur	0.52 %

C.E.S. #175

November 1, 1973

CYCLONE ENGINEERING SALES LTD.
Edmonton, Alberta, Canada.

HALFERDAHL & ASSOCIATES LTD.

SAMPLE NO.: 176
1'11", Coal

ANALYSIS ON AIR DRY BASIS:

Ash	17.89 %
Volatile Matter	25.33 %
Residual Moisture	0.32 %
Fixed Carbon	56.46 %
Free Swelling Index	7½
Sulphur	1.60 %

C.E.S. #176

November 1, 1973

CYCLONE ENGINEERING SALES LTD.
Edmonton, Alberta, Canada.

HALFERDAHL & ASSOCIATES LTD.

SAMPLE NO.: 177
1'11½", Coal

ANALYSIS ON AIR DRY BASIS:

Ash	12.57 %
Volatile Matter	24.26 %
Residual Moisture	0.40 %
Fixed Carbon	62.77 %
Free Swelling Index	1½
Sulphur	0.57 %

C.E.S. #177

November 1, 1973

CYCLONE ENGINEERING SALES LTD.
Edmonton, Alberta, Canada.

HALFERDAHL & ASSOCIATES LTD.

SAMPLE NO.: 179
2'3½", Coal

ANALYSIS ON AIR DRY BASIS:

Ash	7.81 %
Volatile Matter	27.04 %
Residual Moisture	0.26 %
Fixed Carbon	64.89 %
Free Swelling Index	4
Sulphur	0.57 %

C.E.S. #179

November 1, 1973

CYCLONE ENGINEERING SALES LTD.
Edmonton, Alberta, Canada.

HALFERDAHL & ASSOCIATES LTD.

SAMPLE NO.: 181
1'2½", Coal

ANALYSIS ON AIR DRY BASIS:

Ash	6.94 %
Volatile Matter	29.68 %
Residual Moisture	0.13 %
Fixed Carbon	63.25 %
Free Swelling Index	8
Sulphur	0.48 %

C.E.S. #181

November 1, 1973

CYCLONE ENGINEERING SALES LTD.
Edmonton, Alberta, Canada.

HALFERDAHL & ASSOCIATES LTD.

SAMPLE NO.: 185
0'10", Coal

ANALYSIS ON AIR DRY BASIS:

Ash	8.68%
Volatile Matter	29.33 %
Residual Moisture	0.36 %
Fixed Carbon	61.63 %
Free Swelling Index	8½
Sulphur	0.80 %

C.E.S. #185

November 1, 1973

CYCLONE ENGINEERING SALES LTD.
Edmonton, Alberta, Canada.

HALFERDAHL & ASSOCIATES LTD.

SAMPLE NO.: 187
1'2½", Coal

ANALYSIS ON AIR DRY BASIS:

Ash	3.85 %
Volatile Matter	31.63 %
Residual Moisture	0.18 %
Fixed Carbon	64.34 %
Free Swelling Index	9
Sulphur	0.77 %

C.E.S. #187

November 1, 1973

CYCLONE ENGINEERING SALES LTD.
Edmonton, Alberta, Canada.

HALFERDAHL & ASSOCIATES LTD.

SAMPLE NO.: 188
0'9", Coal

ANALYSIS ON AIR DRY BASIS:

Ash	32.52 %
Volatile Matter	22.79 %
Residual Moisture	0.35 %
Fixed Carbon	44.34 %
Free Swelling Index	6
Sulphur	1.42 %

C.E.S. #188

November 1, 1973

CYCLONE ENGINEERING SALES LTD.
Edmonton, Alberta, Canada.

HALFERDAHL & ASSOCIATES LTD.

SAMPLE NO.: 191
1'9½", Coal

ANALYSIS ON AIR DRY BASIS:

Ash	2.74 %
Volatile Matter	22.17 %
Residual Moisture	0.21 %
Fixed Carbon	74.88 %
Free Swelling Index	1
Sulphur	0.61 %

C.E.S. #191

November 1, 1973

CYCLONE ENGINEERING SALES LTD.
Edmonton, Alberta, Canada.

HALFERDAHL & ASSOCIATES LTD.

SAMPLE NO.: 193
0'6½", Coal

ANALYSIS ON AIR DRY BASIS:

Ash	5.16 %
Volatile Matter	25.85 %
Residual Moisture	0.38 %
Fixed Carbon	68.61 %
Free Swelling Index	3
Sulphur	0.84 %

C.E.S. #193

November 1, 1973

CYCLONE ENGINEERING SALES LTD.
Edmonton, Alberta, Canada.

HALFERDAHL & ASSOCIATES LTD.

SAMPLE NO.: 195
0'7½", Coal

ANALYSIS ON AIR DRY BASIS:

Ash	9.85 %
Volatile Matter	22.06 %
Residual Moisture	0.16 %
Fixed Carbon	67.93 %
Free Swelling Index	1½
Sulphur	1.16 %

C.E.S. #195

November 1, 1973

CYCLONE ENGINEERING SALES LTD.
Edmonton, Alberta, Canada.

HALFERDAHL & ASSOCIATES LTD.

SAMPLE NO.: 197
0'6", Coal

ANALYSIS ON AIR DRY BASIS:

Ash	5.31 %
Volatile Matter	25.95 %
Residual Moisture	0.24 %
Fixed Carbon	68.50 %
Free Swelling Index	6½
Sulphur	0.86 %

G.E.S. #197

November 1, 1973

CYCLONE ENGINEERING SALES LTD.
Edmonton, Alberta, Canada.

HALFERDAHL & ASSOCIATES LTD.

SAMPLE NO.: 199
1'3½", Coal

ANALYSIS ON AIR DRY BASIS:

Ash	5.42 %
Volatile Matter	22.42 %
Residual Moisture	0.38 %
Fixed Carbon	71.78 %
Free Swelling Index	1
Sulphur	0.95 %

G.E.S. #199

November 1, 1973

CYCLONE ENGINEERING SALES LTD.
Edmonton, Alberta, Canada.

HALFERDAHL & ASSOCIATES LTD.

SAMPLE NO.: 200
1'8", Coal

ANALYSIS ON AIR DRY BASIS:

Ash	16.68 %
Volatile Matter	28.18 %
Residual Moisture	0.17 %
Fixed Carbon	54.97 %
Free Swelling Index	4
Sulphur	1.55 %

C.E.S. #200

November 1, 1973

CYCLONE ENGINEERING SALES LTD.
Edmonton, Alberta, Canada.

HALFERDAHL & ASSOCIATES LTD.

SAMPLE NO.: 603
2'9½", Coal

ANALYSIS ON AIR DRY BASIS:

Ash	5.53 %
Volatile Matter	23.26 %
Residual Moisture	0.23 %
Fixed Carbon	70.98 %
Free Swelling Index	1
Sulphur	0.53 %

C.E.S. #603

November 1, 1973

CYCLONE ENGINEERING SALES LTD.
Edmonton, Alberta, Canada.

HALFERDAHL & ASSOCIATES LTD.

SAMPLE NO.: 609
1'4", Coal

ANALYSIS ON AIR DRY BASIS:

Ash	4.09 %
Volatile Matter	21.92 %
Residual Moisture	0.15 %
Fixed Carbon	73.84 %
Free Swelling Index	1
Sulphur	0.60 %

C.E.S. #609

November 1, 1973

CYCLONE ENGINEERING SALES LTD.
Edmonton, Alberta, Canada.

HALFERDAHL & ASSOCIATES LTD.

SAMPLE NO.: 604
0'8½", Coal

ANALYSIS ON AIR DRY BASIS:

Ash	5.21 %
Volatile Matter	23.12 %
Residual Moisture	0.18 %
Fixed Carbon	71.49 %
Free Swelling Index	1½
Sulphur	0.56 %

C.E.S. #604

November 1, 1973

CYCLONE ENGINEERING SALES LTD.
Edmonton, Alberta, Canada.

HALFERDAHL & ASSOCIATES LTD.

SAMPLE NO.: 606
0'8", Coal

ANALYSIS ON AIR DRY BASIS:

Ash	15.77 %
Volatile Matter	28.37 %
Residual Moisture	0.14 %
Fixed Carbon	55.72 %
Free Swelling Index	$\frac{1}{2}$
Sulphur	0.47 %

C.E.S. #606

November 1, 1973

CYCLONE ENGINEERING SALES LTD.
Edmonton, Alberta, Canada.

HALFERDAHL & ASSOCIATES LTD.

SAMPLE NO.: 610

ANALYSIS ON AIR DRY BASIS:

Ash	14.02 %
Volatile Matter	23.97 %
Residual Moisture	0.43 %
Fixed Carbon	61.58 %
Free Swelling Index	5½
Sulphur	1.02 %

C.E.S. #610

November 1, 1973

CYCLONE ENGINEERING SALES LTD.
Edmonton, Alberta, Canada.

HALFERDAHL & ASSOCIATES LTD.

SAMPLE NO: 612
0'7", Coal

ANALYSIS ON AIR DRY BASIS:

Ash	21.44 %
Volatile Matter	24.92 %
Residual Moisture	0.50 %
Fixed Carbon	53.14 %
Free Swelling Index	7½
Sulphur	1.07 %

C.E.S. #612

November 1, 1973

CYCLONE ENGINEERING SALES LTD.
Edmonton, Alberta, Canada.

HALFERDAHL & ASSOCIATES LTD.

SAMPLE NO.: 614
1'3", Coal

ANALYSIS ON AIR DRY BASIS:

Ash	10.43 %
Volatile Matter	20.85 %
Residual Moisture	0.38 %
Fixed Carbon	68.34 %
Free Swelling Index	1
Sulphur	0.79 %

C.E.S. #614

November 1, 1973

CYCLONE ENGINEERING SALES LTD.
Edmonton, Alberta, Canada.

APPENDIX 3 : ANALYTICAL REPORTS ON COMPOSITE SAMPLES

HALFERDAHL & ASSOCIATES LTD.

SAMPLE NO.: COMPOSITE #1 Superior Seam in Drill Hole 4A

TABLE 1: ANALYSES OF HEAD SAMPLE

Ash	26.23 %
Volatile Matter	37.89 %
Residual Moisture	0.25 %
Fixed Carbon	35.63 %
F.S.I.	6
Sulphur	0.40 %

C.E.S. #15
November 29, 1973

CYCLONE ENGINEERING SALES LTD.
Edmonton, Alberta, Canada.

HALFERDAHL & ASSOCIATES LTD.

SAMPLE NO.: COMPOSITE #1

TABLE 2: SIZE CONSIST OF HEAD SAMPLE

	<u>Weight %</u>
+100 Mesh	86.44
-100 Mesh	<u>13.56</u>
Total	100.00

C.E.S. #15
November 29, 1973CYCLONE ENGINEERING SALES LTD.
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HALFERDAHL & ASSOCIATES LTD.

SAMPLE NO.: COMPOSITE #1

TABLE 3: HEAD ANALYSES OF +100 MESH

Wt.	86.44 %
Ash	25.12 %
Volatile Matter	37.46 %
Residual Moisture	0.58 %
Fixed Carbon	36.84 %
F.S.I.	5½
Sulphur	0.44 %

C.E.S. #15
November 29, 1973

CYCLONE ENGINEERING SALES LTD.
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HALFERDAHL & ASSOCIATES LTD.

SAMPLE NO.: COMPOSITE #1

TABLE 4: WEIGHT % AND PROXIMATE ANALYSIS OF SPECIFIC GRAVITY FRACTIONS FOR +100 MESH

Sp. Gr.	Wt. %	Ash%	V.M. %	R.M. %	F.C. %	S%
- 1.30	47.36	1.30	34.70	0.61	63.39	0.67
1.30 - 1.40	6.52	8.91	31.86	0.74	58.49	0.66
1.40 - 1.50	4.69	16.12	28.13	0.70	55.05	0.61
1.50 - 1.60	1.49	25.30	28.01	0.81	45.88	0.51
1.60 - 1.80	1.15	32.97	31.71	0.66	34.66	0.48
+ 1.80	38.79	58.80	40.21	0.17	0.82	0.12
Total	100.00	25.51	36.20	0.46	37.83	0.45

C.E.S. #15
November 29, 1973

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SAMPLE NO.: COMPOSITE #1

TABLE 5: WEIGHT %, PROXIMATE ANALYSIS AND FREE SWELLING
INDEX OF CUMULATIVE FLOATS: +100 MESH

Sp. Gr.	Wt. %	Ash%	V.M. %	R.M. %	F.C. %	S. %	F.S.I.*
- 1.30	47.36	1.30	34.70	0.61	63.39	0.67	9
- 1.40	53.88	2.22	34.36	0.63	62.79	0.67	9
- 1.50	58.57	3.33	33.86	0.64	62.17	0.66	9
- 1.60	60.06	3.88	33.71	0.65	61.76	0.66	9
- 1.80	61.21	4.43	33.67	0.65	61.25	0.66	9
Total	100.00	25.51	36.20	0.46	37.83	0.45	5½

* F.S.I. by actual determination.

C.E.S. #15
 November 29, 1973.

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SAMPLE NO.: COMPOSITE #1

TABLE 6: WASHABILITY DATA: +100 MESH

Specific Gravity	Fractional		Cumulative			
	Wt. %	Ash %	Floats		Sinks	
			Wt. %	Ash %	Wt. %	Ash %
- 1.30	47.36	1.30	47.36	1.30	100.00	25.51
1.30 - 1.40	6.52	8.91	53.88	2.22	52.64	47.31
1.40 - 1.50	4.69	16.12	58.57	3.33	46.12	52.74
1.50 - 1.60	1.49	25.30	60.06	3.88	41.43	56.88
1.60 - 1.80	1.15	32.97	61.21	4.43	39.94	58.06
+ 1.80	38.79	58.80	100.00	25.51	38.79	58.80
Total	100.00	25.51				

C.E.S. #15
November 29, 1973.

CYCLONE ENGINEERING SALES LTD.
Edmonton, Alberta, Canada.

HALFERDAHL & ASSOCIATES LTD.

SAMPLE NO.: COMPOSITE #1

TABLE 7: HEAD ANALYSES OF -100 MESH

Wt.	13.56 %
Ash	17.39 %
Volatile Matter	35.97 %
Residual Moisture	0.72 %
Fixed Carbon	45.92 %
F.S.I.	8½
Sulphur	0.42 %

C.E.S. #15
November 29, 1973

CYCLONE ENGINEERING SALES LTD.
Edmonton, Alberta, Canada.

HALFERDAHL & ASSOCIATES LTD.

SAMPLE NO.: COMPOSITE #1

TABLE 8: FROTH FLOTATION TEST ON -100 MESHTest Conditions

Solids, by weight in Slurry	10%
Time of Flotation	1 minute
Flotation Recovery	86.00%
Reagents	MIBC and Fuel Oil (1:3)
Reagent Consumption	0.70 lb/ton

Analyses of the Products

	<u>Concentrate</u>	<u>Tailings</u>
Ash	11.28 %	59.96 %
Volatile Matter	34.45 %	38.21 %
Residual Moisture	0.61 %	0.17 %
Fixed Carbon	53.66 %	1.66 %
F.S.I.	9	N/A
Sulphur	0.50 %	0.02 %

C.E.S. #15
November 29, 1973.

CYCLONE ENGINEERING SALES LTD.
Edmonton, Alberta, Canada.

HALFERDAHL & ASSOCIATES LTD.

SAMPLE NO.: COMPOSITE #1

TABLE 9: CLEAN COAL COMPOSITE

<u>Composition:</u>	+100 Mesh Floats at 1.80	81.94 %
	-100 Mesh Froth	18.06 %
<u>Total Yield</u>		64.57 %

Proximate Analysis

Ash	5.87 %
Volatile Matter	33.89 %
Residual Moisture	0.59 %
Fixed Carbon	59.65 %
F.S.I.	9
Sulphur	0.60 %
BTU/lb.	14,330

C.E.S. #15
December 10, 1973.

CYCLONE ENGINEERING SALES LTD.
Edmonton, Alberta, Canada.

HALFERDAHL & ASSOCIATES LTD.

SAMPLE NO.: COMPOSITE #1

TABLE 10: MINERAL ANALYSIS OF ASH

SiO ₂	27.81 %
Al ₂ O ₃	25.84 %
Fe ₂ O ₃	22.34 %
CaO	6.72 %
MgO	5.47 %
Na ₂ O	0.56 %
K ₂ O	0.30 %
SO ₃	6.31 %

HALFERDAHL & ASSOCIATES LTD.

SAMPLE NO.: COMPOSITE #2 Trojan Seam in Drill Hole 4A

TABLE 1: ANALYSES ON HEAD SAMPLE

Ash	13.24 %
Volatile Matter	25.43 %
Residual Moisture	0.78 %
Fixed Carbon	60.55 %
F.S.I.	4½
Sulphur	0.45 %

C.E.S. #16
November 29, 1973CYCLONE ENGINEERING SALES LTD.
Edmonton, Alberta, Canada.

HALFERDAHL & ASSOCIATES LTD.

SAMPLE NO.: COMPOSITE #2

TABLE 2: SIZE CONSIST OF HEAD SAMPLE

	<u>Weight %</u>
+100 Mesh	89.20
-100 Mesh	<u>10.80</u>
Total	100.00

C.E.S. #16
November 29, 1973

CYCLONE ENGINEERING SALES LTD.
Edmonton, Alberta, Canada.

HALFERDAHL & ASSOCIATES LTD.

SAMPLE NO.: COMPOSITE #2

TABLE 3: HEAD ANALYSES OF +100 MESH

Wt.	89.20 %
Ash	13.60 %
Volatile Matter	25.03 %
Residual Moisture	0.78 %
Fixed Carbon	60.59 %
F.S.I.	4
Sulphur	0.44 %

C.E.S. #16
November 29, 1973.

CYCLONE ENGINEERING SALES LTD.
Edmonton, Alberta, Canada.

HALFERDAHL & ASSOCIATES LTD.

SAMPLE NO.: COMPOSITE #2

TABLE 4: WEIGHT % AND PROXIMATE ANALYSIS OF SPECIFIC GRAVITY FRACTIONS FOR +100 MESH

Sp. Gr.	Wt.%	Ash%	V.M.%	R.M.%	F.C.%	S%
- 1.30	55.73	1.84	28.11	0.88	69.17	0.49
1.30 - 1.40	26.27	5.97	23.49	0.83	69.71	0.48
1.40 - 1.50	3.84	17.61	21.76	0.71	59.92	0.43
1.50 - 1.60	2.03	28.13	20.48	0.75	50.64	0.42
1.60 - 1.80	1.58	39.88	18.83	0.50	40.79	0.41
+ 1.80	10.55	83.30	15.40	0.20	1.10	0.13
Total	100.00	13.26	25.01	0.78	60.95	0.44

C.E.S. #16
November 29, 1973

CYCLONE ENGINEERING SALES LTD.
Edmonton, Alberta, Canada.

HALFERDAHL & ASSOCIATES LTD.

SAMPLE NO.: COMPOSITE #2

TABLE 5: WEIGHT %, PROXIMATE ANALYSIS AND FREE SWELLING
INDEX OF CUMULATIVE FLOATS: +100 MESH

Sp. Gr.	Wt. %	Ash%	V.M. %	R.M. %	F.C. %	S. %	F.S.I. *
- 1.30	55.73	1.84	28.11	0.88	69.17	0.49	7
- 1.40	82.00	3.16	26.63	0.86	69.35	0.49	5
- 1.50	85.84	3.81	26.41	0.85	68.93	0.48	5
- 1.60	87.87	4.37	26.27	0.85	68.51	0.48	5
- 1.80	89.45	5.00	26.14	0.84	68.02	0.48	5
Total	100.00	13.26	25.01	0.78	60.95	0.44	4

* F.S.I. by actual determination.

C.E.S. #16
 November 29, 1973.

CYCLONE ENGINEERING SALES LTD.
 Edmonton, Alberta, Canada.

HALFERDAHL & ASSOCIATES LTD.

SAMPLE NO.: COMPOSITE #2

TABLE 6: WASHABILITY DATA: +100 MESH

Specific Gravity	Fractional		Cumulative			
	Wt.%	Ash%	Floats		Sinks	
			Wt.%	Ash%	Wt.%	Ash%
- 1.30	55.73	1.84	55.73	1.84	100.00	13.26
1.30 - 1.40	26.27	5.97	82.00	3.16	44.27	27.63
1.40 - 1.50	3.84	17.61	85.84	3.81	18.00	59.25
1.50 - 1.60	2.03	28.13	87.87	4.37	14.16	70.54
1.60 - 1.80	1.58	39.88	89.45	5.00	12.13	77.64
+ 1.80	10.55	83.30	100.00	13.26	10.55	83.30
Total	100.00	13.26				

C.E.S. #16
November 29, 1973.

CYCLONE ENGINEERING SALES LTD.
Edmonton, Alberta, Canada.

HALFERDAHL & ASSOCIATES LTD.

SAMPLE NO.: COMPOSITE #2

TABLE 7: HEAD ANALYSES OF -100 MESH

Weight	10.80 %
Ash	15.98 %
Volatile Matter	25.60 %
Residual Moisture	0.70 %
Fixed Carbon	57.72 %
F.S.I.	5½
Sulphur	0.48 %

C.E.S. #16
November 29, 1973

CYCLONE ENGINEERING SALES LTD.
Edmonton, Alberta, Canada.

HALFERDAHL & ASSOCIATES LTD.

SAMPLE NO.: COMPOSITE #2

TABLE 8: FROTH FLOTATION TEST ON -100 MESHTest Conditions

Solids, by weight in Slurry	10 %
Time of Flotation	1 minute
Flotation Recovery	81.67 %
Reagents	MIBC and Fuel Oil (1:3)
Reagent Consumption	0.35 lb./ton

Analyses of the Products

	<u>Concentrate</u>	<u>Tailings</u>
Ash	5.73 %	62.15 %
Volatile Matter	26.42 %	16.91 %
Residual Moisture	0.81 %	0.16 %
Fixed Carbon	67.04 %	20.78 %
F.S.I.	6	$\frac{1}{2}$
Sulphur	0.51 %	0.15 %

C.E.S. #16
November 29, 1973.

CYCLONE ENGINEERING SALES LTD.
Edmonton, Alberta, Canada.

HALFERDAHL & ASSOCIATES LTD.

SAMPLE NO.: COMPOSITE #2

TABLE 9: CLEAN COAL COMPOSITE

<u>Composition:</u>	+100 Mesh Floats at 1.80	90.06 %
	-100 Mesh Froth	9.94 %
<u>Total Yield</u>		88.61 %

Proximate Analysis

Ash	5.11 %
Volatile Matter	26.18 %
Residual Moisture	0.84 %
Fixed Carbon	67.87 %
F.S.I.	5½
Sulphur	0.49 %
BTU/lb.	14,570

HALFERDAHL & ASSOCIATES LTD.

SAMPLE NO.: COMPOSITE #2

TABLE 10: MINERAL ANALYSIS OF ASH

SiO ₂	54.10 %
Al ₂ O ₃	33.82 %
Fe ₂ O ₃	1.66 %
CaO	4.00 %
MgO	0.37 %
Na ₂ O	0.82 %
K ₂ O	0.61 %
SO ₃	0.83 %

HALFERDAHL & ASSOCIATES LTD.

SAMPLE NO.: COMPOSITE #3 Trojan Seam in Drill Hole 5

TABLE 1: ANALYSES ON HEAD SAMPLE

Ash	37.57 %
Volatile Matter	19.90 %
Residual Moisture	0.63 %
Fixed Carbon	41.90 %
F.S.I.	3
Sulphur	0.49 %

C.E.S. #17
November 29, 1973.

CYCLONE ENGINEERING SALES LTD.
Edmonton, Alberta, Canada.

HALFERDAHL & ASSOCIATES LTD. ,

SAMPLE NO.: COMPOSITE #3

TABLE 2: SIZE CONSIST OF HEAD SAMPLE

	<u>Weight %</u>
+100 Mesh	90.47
-100 Mesh	<u>9.53</u>
Total	100.00

C.E.S. #17
November 29, 1973

CYCLONE ENGINEERING SALES LTD.
Edmonton, Alberta, Canada.

HALFERDAHL & ASSOCIATES LTD.

SAMPLE NO.: COMPOSITE #3

TABLE 3: HEAD ANALYSES OF +100 MESH

Wt.	90.47 %
Ash	38.69 %
Volatile Matter	19.55 %
Residual Moisture	0.53 %
Fixed Carbon	41.23 %
F.S.I.	3
Sulphur	0.48 %

C.E.S. #17
November 29, 1973

CYCLONE ENGINEERING SALES LTD.
Edmonton, Alberta, Canada.

HALFERDAHL & ASSOCIATES LTD.

SAMPLE NO.: COMPOSITE #3

TABLE 4: WEIGHT % AND PROXIMATE ANALYSIS OF SPECIFIC GRAVITY FRACTIONS FOR +100 MESH

Sp. Gr.	Wt.%	Ash%	V.M.%	R.M.%	F.C.%	S%
- 1.30	36.36	2.30	29.06	0.64	68.00	0.71
1.30 - 1.40	14.90	8.03	24.60	0.60	66.77	0.63
1.40 - 1.50	4.24	16.99	23.28	0.52	59.21	0.60
1.50 - 1.60	2.52	28.09	22.20	0.50	49.21	0.59
1.60 - 1.80	2.16	39.46	20.49	0.41	39.64	0.59
- 1.80	39.82	83.94	7.67	0.22	8.17	0.24
Total	100.00	37.74	19.27	0.45	42.53	0.50

C.E.S. #17
November 29, 1973

CYCLONE ENGINEERING SALES LTD.
Edmonton, Alberta, Canada.

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SAMPLE NO.: COMPOSITE #3

TABLE 5: WEIGHT %, PROXIMATE ANALYSIS AND FREE SWELLING
INDEX OF CUMULATIVE FLOATS: +100 MESH

Sp. Gr.	Wt. %	Ash%	V.M. %	R.M. %	F.C. %	S. %	F.S.I.*
- 1.30	36.36	2.30	29.06	0.64	68.00	0.71	8
- 1.40	51.26	3.97	27.76	0.63	67.64	0.69	7½
- 1.50	55.50	4.96	27.42	0.62	66.99	0.68	7
- 1.60	58.02	5.96	27.19	0.61	66.22	0.68	6½
- 1.80	60.18	7.16	26.95	0.60	65.27	0.68	6
Total	100.00	37.74	19.27	0.45	42.53	0.50	3

* F.S.I. by actual determination.

C.E.S. #17
 November 29, 1973

CYCLONE ENGINEERING SALES LTD.
 Edmonton, Alberta, Canada.

HALFERDAHL & ASSOCIATES LTD.

SAMPLE NO.: COMPOSITE #3

TABLE 6: WASHABILITY DATA: +100 MESH

Specific Gravity	Fractional		Cumulative			
	Wt. %	Ash%	Floats		Sinks	
			Wt. %	Ash%	Wt. %	Ash%
- 1.30	36.36	2.30	36.36	2.30	100.00	37.74
1.30 - 1.40	14.90	8.03	51.26	3.97	63.64	57.99
1.40 - 1.50	4.24	16.99	55.50	4.96	48.74	73.26
1.50 - 1.60	2.52	28.09	58.02	5.96	44.50	78.62
1.60 - 1.80	2.16	39.46	60.18	7.16	41.98	81.65
+ 1.80	39.82	83.94	100.00	37.74	39.82	83.94
Total	100.00	37.74				

C.E.S. #17
November 29, 1973.

CYCLONE ENGINEERING SALES LTD.
Edmonton, Alberta, Canada.

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SAMPLE NO.: COMPOSITE #3

TABLE 7: HEAD ANALYSES OF -100 MESH

Weight	9.53 %
Ash	33.42 %
Volatile Matter	21.03 %
Residual Moisture	0.64 %
Fixed Carbon	44.91 %
F.S.I.	3½
Sulphur	0.64 %

C.E.S. #17
November 29, 1973CYCLONE ENGINEERING SALES LTD.
Edmonton, Alberta, Canada.

HALFERDAHL & ASSOCIATES LTD.

SAMPLE NO.: COMPOSITE #3

TABLE 8: FROTH FLOTATION TEST ON -100 MESHTest Conditions

Solids, by weight in Slurry	10 %
Time of Flotation	1 minute
Flotation Recovery	64.16 %
Reagents	MIBC and Fuel Oil (1:3)
Reagent Consumption	0.35 lb./ton

Analyses of the Products

	<u>Concentrate</u>	<u>Tailings</u>
Ash	13.12 %	68.98 %
Volatile Matter	25.65 %	11.46 %
Residual Moisture	0.59 %	0.22 %
Fixed Carbon	60.64 %	19.34 %
F.S.I.	7	N/A
Sulphur	0.64 %	0.61 %

C.E.S #17
November 29, 1973.

CYCLONE ENGINEERING SALES LTD.
Edmonton, Alberta, Canada.

HALFERDAHL & ASSOCIATES LTD.

SAMPLE NO.: COMPOSITE #3

TABLE 9: CLEAN COAL COMPOSITE

<u>Composite</u>	+100 Mesh at 1.80	89.90 %
	-100 Mesh Froth	10.10 %
<u>Total Yield</u>		60.56 %

Proximate Analysis

Ash	7.78 %
Volatile Matter	26.78 %
Residual Moisture	0.44 %
Fixed Carbon	65.00 %
F.S.I.	6
Sulphur	0.67 %
BTU/lb.	14,090

HALFERDAHL & ASSOCIATES LTD.

SAMPLE NO.: COMPSOITE #3

TABLE 10: MINERAL ANALYSIS OF ASH

SiO ₂	59.45 %
Al ₂ O ₃	25.87 %
Fe ₂ O ₃	5.82 %
CaO	2.07 %
MgO	0.32 %
Na ₂ O	0.44 %
K ₂ O	0.63 %
SO ₃	0.42 %

HALFERDAHL & ASSOCIATES LTD.

SAMPLE NO.: COMPOSITE #4 Unnamed Seam about 65 Feet above Mogul Seam
in Drill Hole 6TABLE 1: ANALYSES OF HEAD SAMPLE

Ash	42.03 %
Volatile Matter	31.00 %
Residual Moisture	0.37 %
Fixed Carbon	26.60 %
F.S.I.	$\frac{1}{2}$
Sulphur	0.34 %

C.E.S. #18
November 29, 1973CYCLONE ENGINEERING SALES LTD.
Edmonton, Alberta, Canada.

HALFERDAHL & ASSOCIATES LTD.

SAMPLE NO.: COMPOSITE #4

TABLE 2: SIZE CONSIST OF HEAD SAMPLE

	<u>Weight %</u>
+100 Mesh	96.11
-100 Mesh	<u>3.89</u>
Total	100.00

C.E.S. #18
November 29, 1973CYCLONE ENGINEERING SALES LTD.
Edmonton, Alberta, Canada.

HALFERDAHL & ASSOCIATES LTD.

SAMPLE NO.: COMPOSITE #4

TABLE 3: HEAD ANALYSES OF +100 MESH

Wt.	96.11 %
Ash	41.25 %
Volatile Matter	31.71 %
Residual Moisture	0.38 %
Fixed Carbon	26.66 %
F.S.I.	$\frac{1}{2}$
Sulphur	0.34 %

C.E.S. #18
November 29, 1973

CYCLONE ENGINEERING SALES LTD.
Edmonton, Alberta, Canada.

HALFERDAHL & ASSOCIATES LTD.

SAMPLE NO.: COMPOSITE #4

TABLE 4: WEIGHT % AND PROXIMATE ANALYSIS OF SPECIFIC GRAVITY FRACTIONS FOR +100 MESH

Sp. Gr.	Wt. %	Ash%	V.M. %	R.M. %	F.C. %	S%
- 1.40	34.31	2.56	22.86	0.45	74.13	0.73
1.40 - 1.50	1.51	14.45	22.42	0.41	62.72	0.94
1.50 - 1.60	0.58	23.93	23.80	0.27	52.00	2.26
+ 1.60	63.60	61.00	36.82	0.34	1.84	0.14
Total	100.00	40.03	31.74	0.38	27.85	0.37

C.E.S. #18
November 29, 1973

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Edmonton, Alberta, Canada.

HALFERDAHL & ASSOCIATES LTD.

SAMPLE NO.: COMPOSITE #4

TABLE 5: WEIGHT %, PROXIMATE ANALYSIS AND FREE SWELLING
INDEX OF CUMULATIVE FLOATS: + 100 MESH

Sp. Gr.	Wt. %	Ash %	V.M. %	R.M. %	F.C. %	S. %	F.S.I.*
- 1.40	34.31	2.56	22.86	0.45	74.13	0.73	2
- 1.50	35.82	3.06	22.84	0.45	73.65	0.74	2
- 1.60	36.40	3.39	22.86	0.45	73.30	0.76	1½
Total	100.00	40.03	31.74	0.38	27.85	0.37	½

*. F.S.I. by actual determination

C.E.S. #18
 November 29, 1973

CYCLONE ENGINEERING SALES LTD.
 Edmonton, Alberta, Canada.

HALFERDAHL & ASSOCIATES LTD.

SAMPLE NO.: COMPOSITE #4

TABLE 6: WASHABILITY DATE: +100 MESH

Specific Gravity	Fractional		Cumulative			
	Wt. %	Ash%	Floats		Sinks	
			Wt. %	Ash%	Wt. %	Ash%
- 1.40	34.31	2.56	34.31	2.56	100.00	40.03
1.40 - 1.50	1.51	14.45	35.82	3.06	65.69	59.60
1.50 - 1.60	0.58	23.93	36.40	3.39	64.18	60.66
+ 1.60	63.60	61.00	100.00	40.03	63.60	61.00
Total	100.00	40.03				

C.E.S. #18
November 29, 1973.

CYCLONE ENGINEERING SALES LTD.
Edmonton, Alberta, Canada.

HALFERDAHL & ASSOCIATES LTD.

SAMPLE NO.: COMPOSITE #4

TABLE 7: HEAD ANALYSIS OF -100 MESH

Weight	3.89 %
Ash	39.11 %
Volatile Matter	28.20 %
Residual Moisture	0.60 %
Fixed Carbon	32.09 %
F.S.I.	$\frac{1}{2}$
Sulphur	0.38 %

C.E.S. #18
November 29, 1973

CYCLONE ENGINEERING SALES LTD.
Edmonton, Alberta, Canada.

HALFERDAHL & ASSOCIATES LTD.

SAMPLE NO.: COMPOSITE #5 Mogul Seam in Drill Hole 6

TABLE 1: ANALYSES OF HEAD SAMPLE

Ash	6.35 %
Volatile Matter	23.54 %
Residual Moisture	0.52 %
Fixed Carbon	69.59 %
F.S.I.	1
Sulphur	0.64 %

C.E.S. #19
November 29, 1973

CYCLONE ENGINEERING SALES LTD.
Edmonton, Alberta, Canada.

HALFERDAHL & ASSOCIATES LTD.

SAMPLE NO.: COMPOSITE #5

TABLE 2: SIZE CONSIST OF HEAD SAMPLE

	<u>Weight %</u>
+100 Mesh	90.33
-100 Mesh	<u>9.67</u>
Total	100.00

C.E.S. #19
November 29, 1973

CYCLONE ENGINEERING SALES LTD.
Edmonton, Alberta, Canada.

HALFERDAHL & ASSOCIATES LTD.

SAMPLE NO.: COMPOSITE #5

TABLE 3: HEAD ANALYSES OF +100 MESH

Wt.	90.33 %
Ash	6.25 %
Volatile Matter	23.31 %
Residual Moisture	0.59 %
Fixed Carbon	69.85 %
F.S.I.	1
Sulphur	0.63 %

C.E.S. #19
November 29, 1973CYCLONE ENGINEERING SALES LTD.
Edmonton, Alberta., Canada.

HALFERDAHL & ASSOCIATES LTD.

SAMPLE NO.: COMPOSITE #5

TABLE 4: WEIGHT % AND PROXIMATE ANALYSIS OF SPECIFIC GRAVITY FRACTIONS FOR + 100 MESH

Sp. Gr.	Wt. %	Ash%	V.M. %	R.M. %	F.C. %	S%
- 1.40	88.63	2.62	22.18	0.64	74.56	0.64
1.40 - 1.50	3.55	11.84	25.62	0.49	62.05	0.75
1.50 - 1.60	1.02	19.28	30.21	0.43	50.08	0.69
+ 1.60	6.80	49.11	45.61	0.32	4.96	0.53
Total	100.00	6.28	23.97	0.61	69.13	0.64

C.E.S. #19
November 29, 1973.

CYCLONE ENGINEERING SALES LTD.
Edmonton, Alberta, Canada.

HALFERDAHL & ASSOCIATES LTD.

SAMPLE NO.: COMPOSITE #5

TABLE 5: WEIGHT %, PROXIMATE ANALYSIS AND FREE SWELLING
INDEX OF CUMULATIVE FLOATS: +100 MESH

Sp. Gr.	Wt. %	Ash%	V.M. %	R.M. %	F.C. %	S. %	F.S.I.*
- 1.40	88.63	2.62	22.18	0.64	74.56	0.64	1½
- 1.50	92.18	2.97	22.31	0.63	74.08	0.64	1½
- 1.60	93.20	3.15	22.40	0.63	73.82	0.64	1½
Total	100.00	6.28	23.97	0.61	69.13	0.64	1

*F.S.I. by actual determination.

C.E.S. #19
November 29, 1973.

CYCLONE ENGINEERING SALES LTD.
Edmonton, Alberta, Canada.

HALFERDAHL & ASSOCIATES LTD.

SAMPLE NO.: COMPOSITE #5

TABLE 6: WASHABILITY DATA: +100 MESH

Specific Gravity	Fractional		Cumulative			
	Wt. %	Ash%	Floats		Sinks	
			Wt. %	Ash%	Wt. %	Ash%
- 1.40	88.63	2.62	88.63	2.62	100.00	6.28
1.40 - 1.50	3.55	11.84	92.18	2.97	11.37	34.80
1.50 - 1.60	1.02	19.28	93.20	3.15	7.82	45.22
+ 1.60	6.80	49.11	100.00	6.28	6.80	49.11
Total	100.00	6.28				

C.E.S. #19
November 29, 1973

CYCLONE ENGINEERING SALES LTD.
Edmonton, Alberta, Canada.

HALFERDAHL & ASSOCIATES LTD.

SAMPLE NO.: COMPOSITE #5

TABLE 7: HEAD ANALYSES OF -100 MESH

Weight	9.67 %
Ash	4.68 %
Volatile Matter	22.90 %
Residual Moisture	0.74 %
Fixed Carbon	71.68 %
F.S.I.	1
Sulphur	0.77 %

C.E.S. #19
November 29, 1973.

CYCLONE ENGINEERING SALES LTD.
Edmonton, Alberta, Canada.

HALFERDAHL & ASSOCIATES LTD.

SAMPLE NO.: COMPOSITE #6 Castle Point Seam in Drill Hole 6

TABLE 1: ANALYSES ON HEAD SAMPLE

Ash	68.86 %
Volatile Matter	9.83 %
Residual Moisture	0.50 %
Fixed Carbon	20.81 %
F.S.I.	1
Sulphur	0.46 %

C.E.S. #20
November 29, 1973CYCLONE ENGINEERING SALES LTD.
Edmonton, Alberta, Canada.

HALFERDAHL & ASSOCIATES

SAMPLE NO.: COMPOSITE #6

TABLE 2: SIZE CONSIST OF HEAD SAMPLE

	<u>Weight %</u>
+100 Mesh	90.10
-100 Mesh	<u>9.90</u>
Total	100.00

C.E.S. #20
November 29, 1973

CYCLONE ENGINEERING SALES LTD.
Edmonton, Alberta, Canada.

HALFERDAHL & ASSOCIATES LTD.

SAMPLE NO.: COMPOSITE #6

TABLE 3: HEAD ANALYSES OF +100 MESH

Wt.	90.10 %
Ash	69.51 %
Volatile Matter	9.80 %
Residual Moisture	0.48 %
Fixed Carbon	20.21 %
F.S.I.	1
Sulphur	0.46 %

G.E.S. #20
November 29, 1973CYCLONE ENGINEERING SALES LTD.
Edmonton, Alberta, Canada.

HALFERDAHL & ASSOCIATES LTD.

SAMPLE NO.: COMPOSITE #6

TABLE 4: WEIGHT % AND PROXIMATE ANALYSIS OF SPECIFIC GRAVITY FRACTIONS FOR +100 MESH

Sp. Gr.	Wt. %	Ash%	V.M. %	R.M. %	F.C. %	S%
- 1.40	20.56	5.97	26.39	0.58	67.00	1.16
1.40 - 1.50	4.02	17.97	23.53	0.33	58.17	1.27
1.50 - 1.60	2.23	30.68	21.59	0.60	47.13	1.01
+ 1.60	73.19	91.43	3.89	0.45	4.23	0.24
Total	100.00	69.55	9.70	0.48	20.27	0.48

C.E.S. #20
November 29, 1973.

CYCLONE ENGINEERING SALES LTD.
Edmonton, Alberta, Canada.

HALFERDAHL & ASSOCIATES LTD.

SAMPLE NO.: COMPSOITE #6

TABLE 5: WEIGHT %, PROXIMATE ANALYSIS AND FREE SWELLING
INDEX OF CUMULATIVE FLOATS: +100 MESH

Sp. Gr.	Wt. %	Ash %	V.M.%	R.M.%	F.C.%	S.%	F.S.I.*
- 1.40	20.56	5.97	26.39	0.58	67.06	1.16	9
- 1.50	24.58	7.93	25.92	0.54	65.61	1.18	8
- 1.60	26.81	9.82	25.56	0.54	64.07	1.16	7
Total	100.00	69.55	9.70	0.48	20.27	0.48	1

* F.S.I. by actual determination.

C.E.S. #20
November 29, 1973.

CYCLONE ENGINEERING SALES LTD.
Edmonton, Alberta, Canada.

HALFERDAHL & ASSOCIATES LTD.

SAMPLE NO.: COMPOSITE #6

TABLE 6: WASHABILITY DATA: +100 MESH

Specific Gravity	Fractional		Cumulative			
	Wt. %	Ash%	Floats		Sinks	
			Wt. %	Ash%	Wt. %	Ash%
- 1.40	20.56	5.97	20.56	5.97	100.00	69.55
1.40 - 1.50	4.02	17.97	24.58	7.93	79.44	86.00
1.50 - 1.60	2.23	30.68	26.81	9.82	75.42	89.63
+ 1.60	73.19	91.43	100.00	69.55	73.19	91.43
Total	100.00	69.55				

C.E.S. #20
November 29, 1973

CYCLONE ENGINEERING SALES LTD.
Edmonton, Alberta, Canada.

HALFERDAHL & ASSOCIATES LTD.

SAMPLE NO.: COMPOSITE #6

TABLE 7: HEAD ANALYSES OF -100 MESH

Weight	9.90 %
Ash	61.93 %
Volatile Matter	11.85 %
Residual Moisture	0.54 %
Fixed Carbon	25.68 %
F.S.I.	1½
Sulphur	0.59 %

C.E.S. #20
November 29, 1973.

CYCLONE ENGINEERING SALES LTD.
Edmonton, Alberta, Canada.

WASHABILITY CURVES FOR COMPOSITE
SAMPLES 1 THROUGH 6

CINNABAR PEAK MINES LTD.

FIGURE: 5.1.1

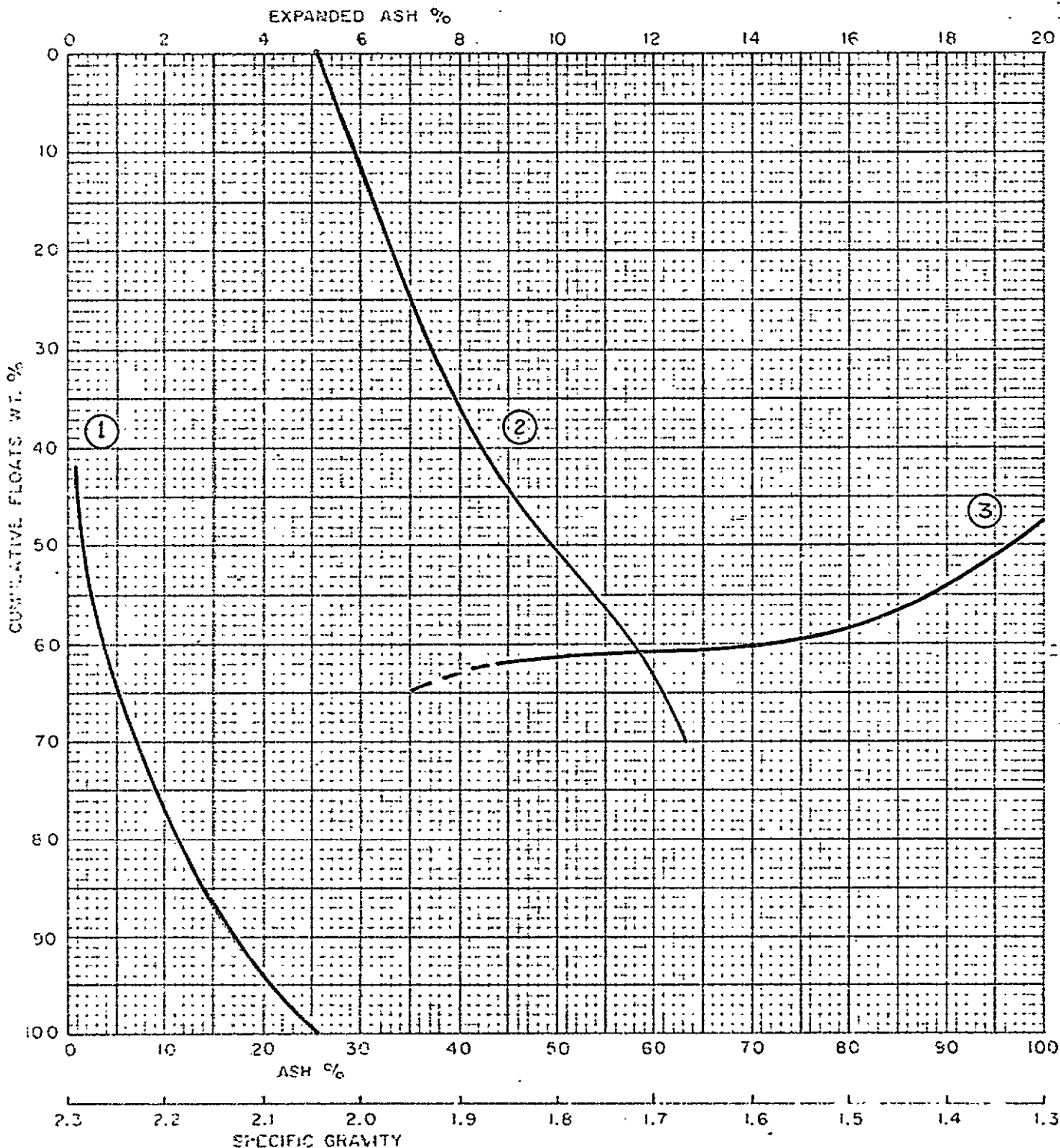
PEACE RIVER CANYON PROPERTIES

COMPANY : HALFERDAHL & ASSOCIATES LTD.
 SAMPLE : COMPOSITE #1 Superior Seam in Drill Hole 4A
 SIZE : + 100 MESH

CURVE LEGEND

- 1 - FLOATS
- 2 - SINKS
- 3 - SPECIFIC GRAVITY
- 4 - ELEMENTARY ASH
- 5 - NEAR GRAVITY MATERIAL
- 6 - EXPANDED FLOATS

WASHABILITY CURVES



CINNABAR PEAK MINES LTD.

FIGURE : 5.1.2

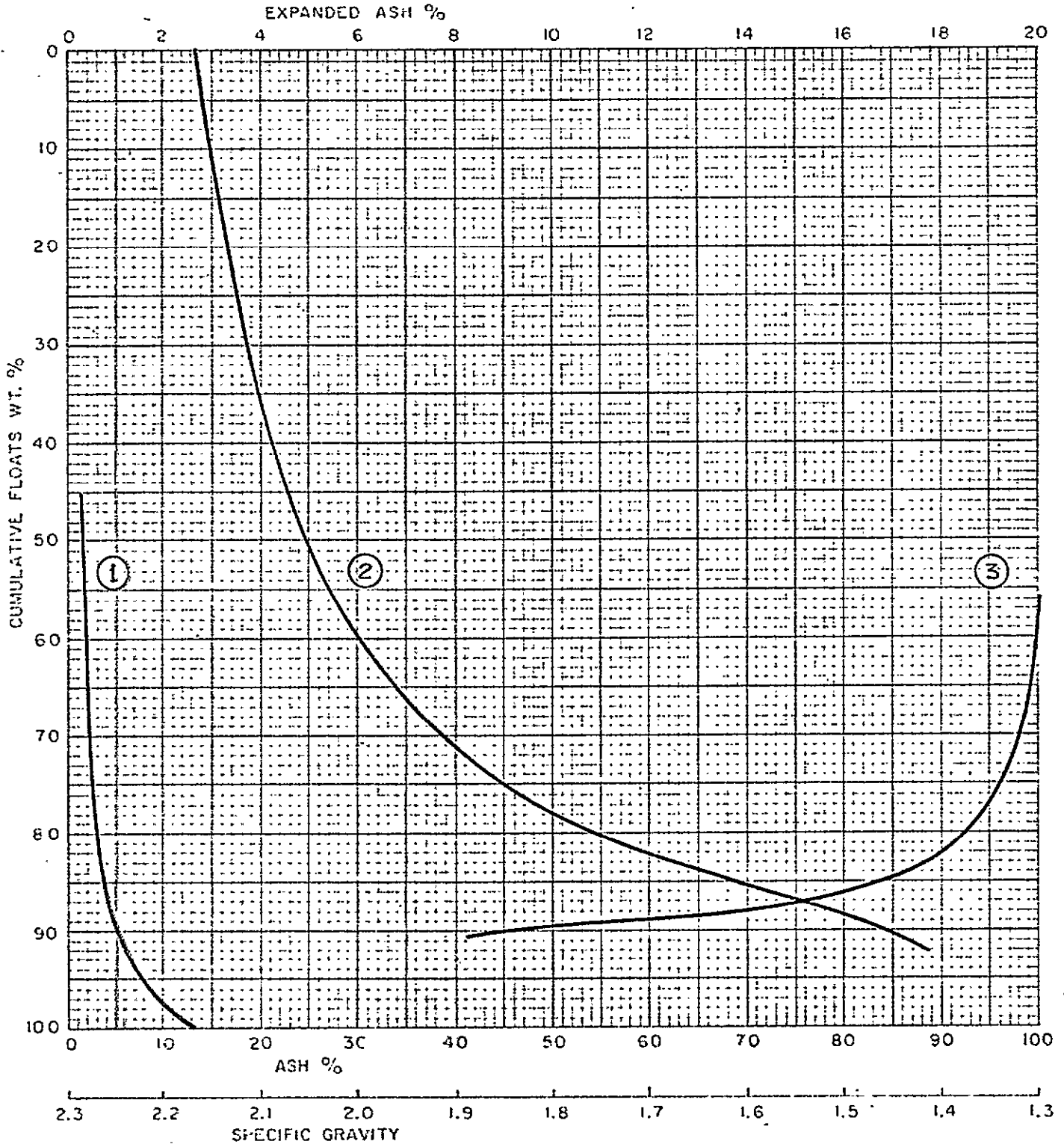
PEACE RIVER CANYON PROPERTIES

CURVE LEGEND

COMPANY : HALFERDAHL & ASSOCIATES LTD.
 SAMPLE : COMPOSITE #2 Trojan Seam in Drill Hole 4A
 SIZE : + 100 MESH

- 1 - FLOATS
- 2 - SINKS
- 3 - SPECIFIC GRAVITY
- 4 - ELEMENTARY ASH
- 5 - NEAR GRAVITY MATERIAL
- 6 - EXPANDED FLOATS

WASHABILITY CURVES



CINNABAR PEAK MINES LTD.

FIGURE - 5.1.3

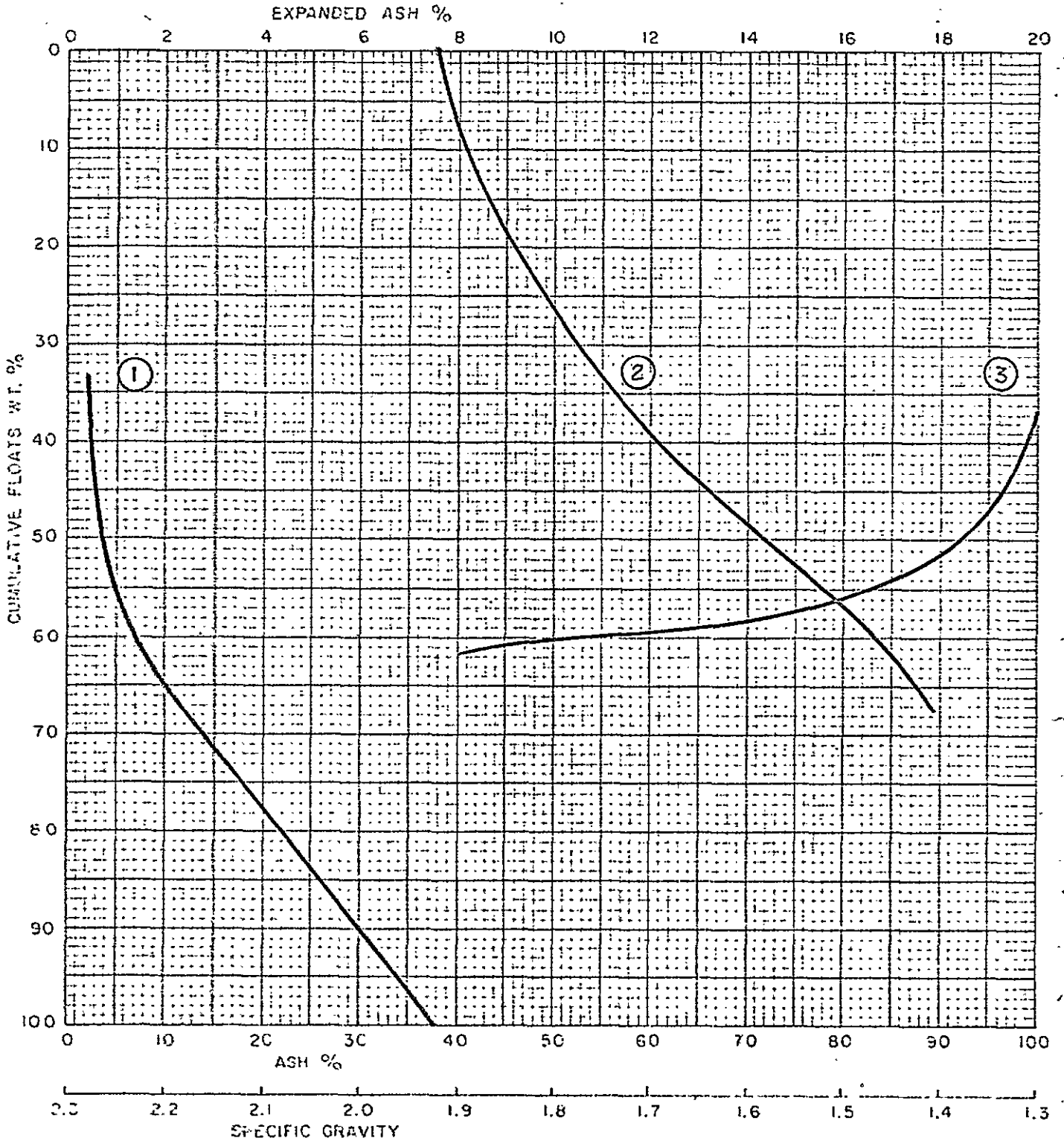
PEACE RIVER CANYON PROPERTIES

CURVE LEGEND

COMPANY : HALFERDAHL & ASSOCIATES LTD.
 SAMPLE : COMPOSITE #3 Trojan Seam in
 SIZE : + 100 MESH Drill Hole 5

- 1 - FLOATS
- 2 - SINKS
- 3 - SPECIFIC GRAVITY
- 4 - ELEMENTARY ASH
- 5 - NEAR GRAVITY MATERIAL
- 6 - EXPANDED FLOATS

WASHABILITY CURVES



CINNABAR PEAK MINES LTD.

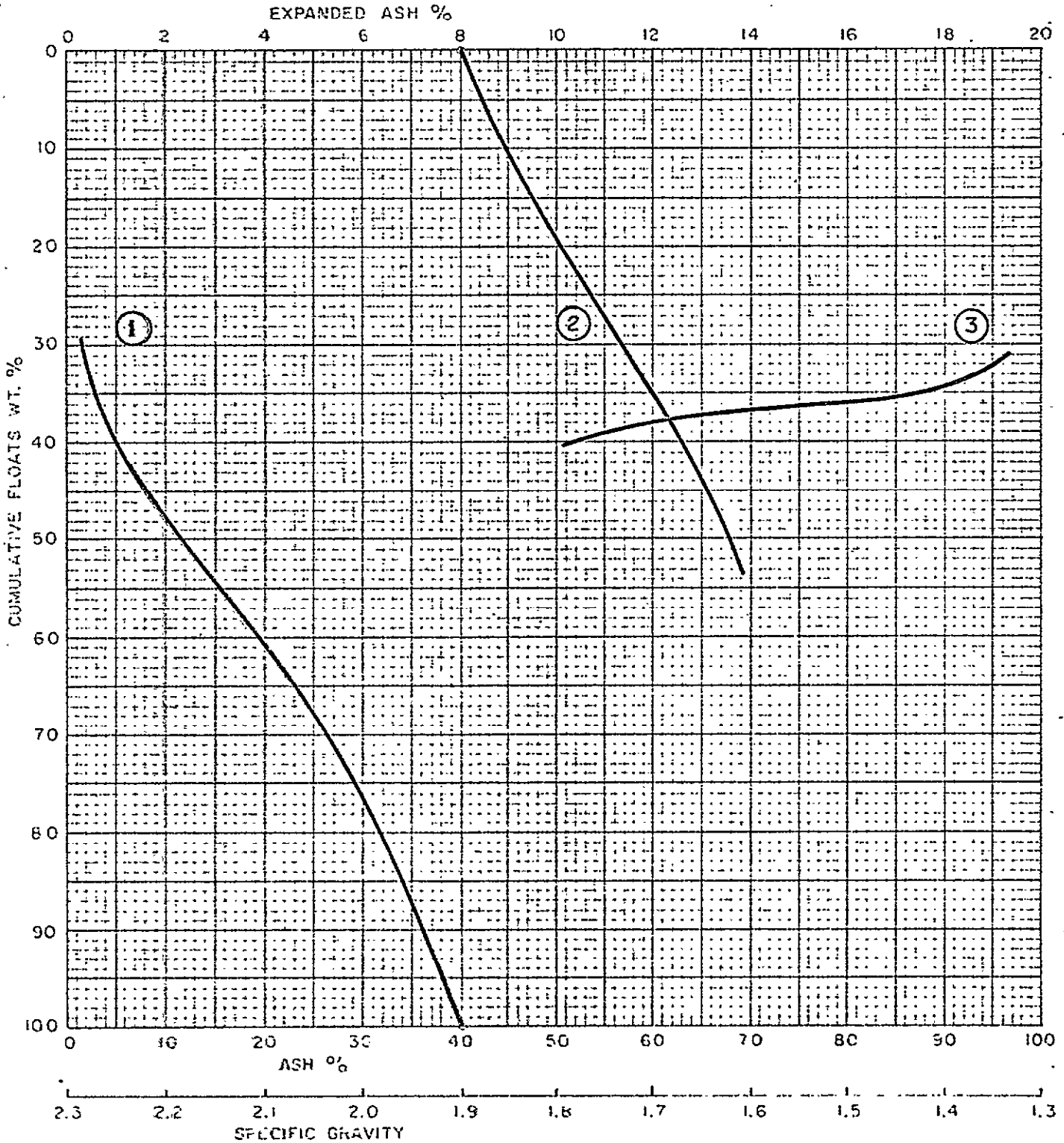
FIGURE: 5.1.4 PEACE RIVER CANYON PROPERTIES

COMPANY : HALFERDAHL & ASSOCIATES LTD.
 SAMPLE : COMPOSITE #4 Unnamed Seam about
 SIZE : + 100 MESH 65 feet above Mogul
 Seam in Drill Hole 6

CURVE LEGEND

- 1 - FLOATS
- 2 - SINKS
- 3 - SPECIFIC GRAVITY
- 4 - ELEMENTARY ASH
- 5 - NEAR GRAVITY MATERIAL
- 6 - EXPANDED FLOATS

WASHABILITY CURVES



CINNABAR PEAK MINES LTD.

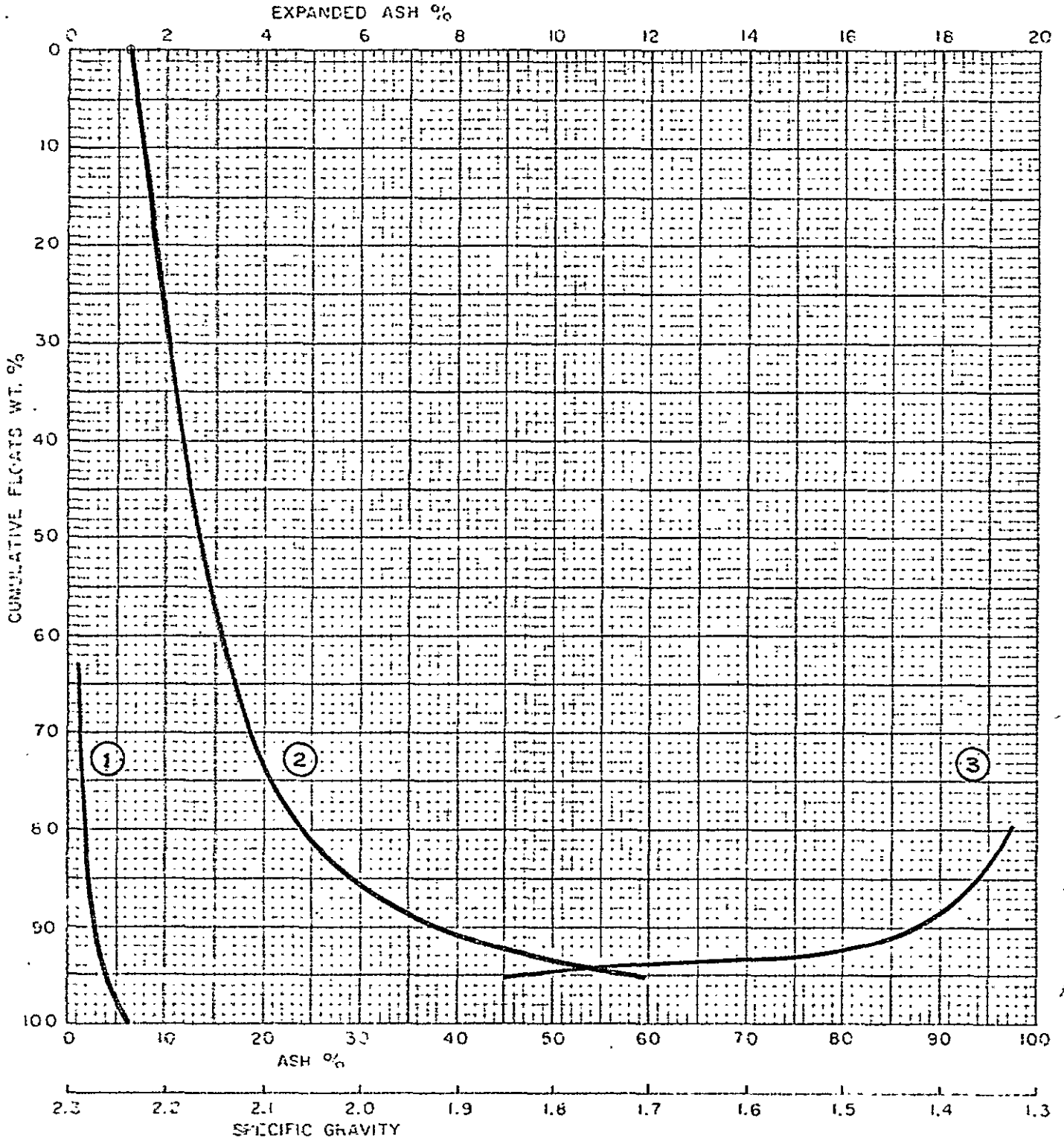
FIGURE: 5.1.5 PEACE RIVER CANYON PROPERTIES

COMPANY : HALFERDAHL & ASSOCIATES LTD.
 SAMPLE : COMPOSITE #5 Mogul Seam in Drill Hole 6
 SIZE : + 100 MESH

CURVE LEGEND

- 1 - FLOATS
- 2 - SINKS
- 3 - SPECIFIC GRAVITY
- 4 - ELEMENTARY ASH
- 5 - NEAR GRAVITY MATERIAL
- 6 - EXPANDED FLOATS

WASHABILITY CURVES



CINNABAR PEAK MINES LTD.

FIGURE: 5.1.6

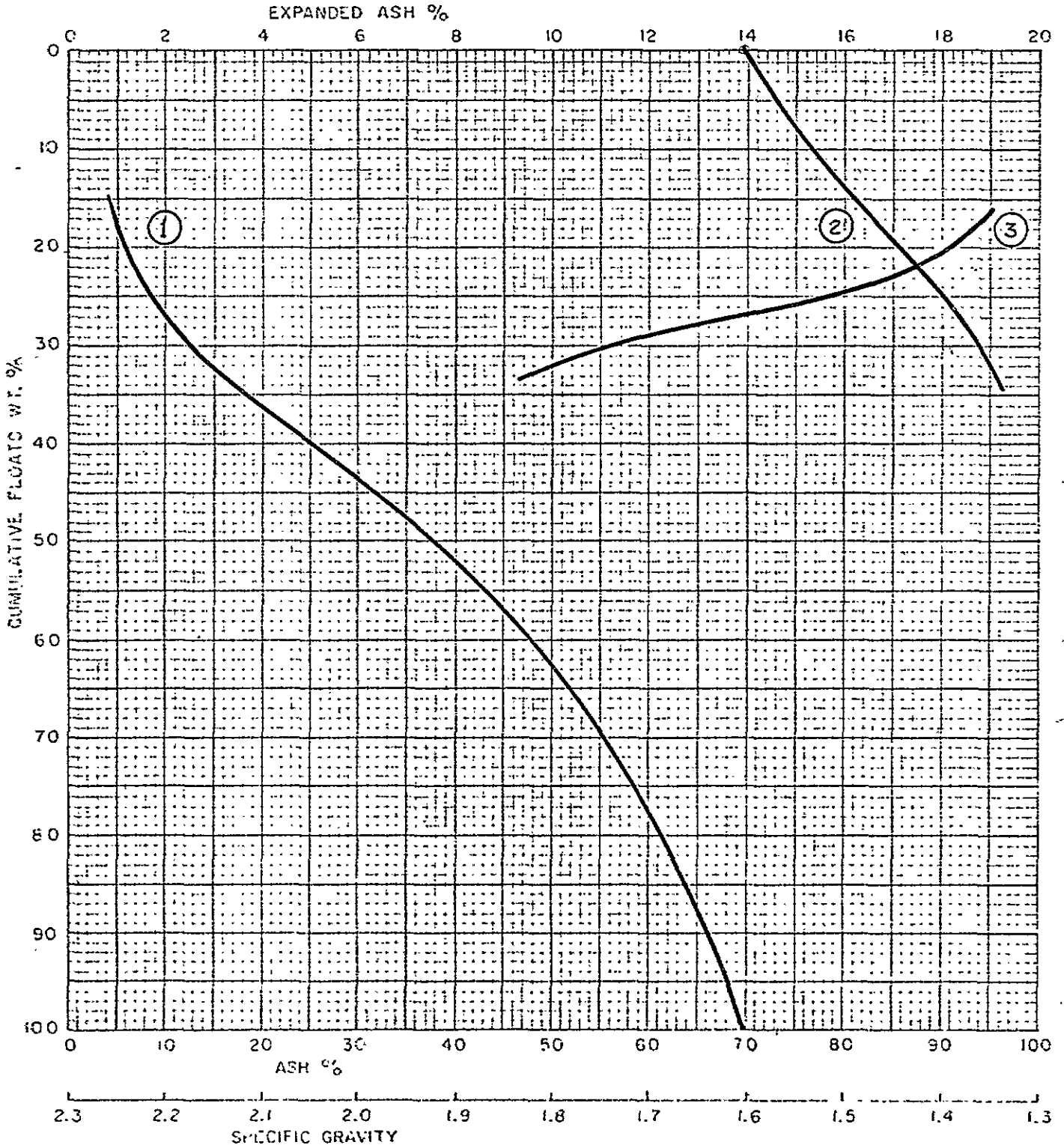
PEACE RIVER CANYON PROPERTIES

CURVE LEGEND

COMPANY : HALFERDAHL & ASSOCIATES LTD.
 SAMPLE : COMPOSITE #6 Castle Point Seam in
 SIZE : + 100 MESH Drill Hole 6

- 1 - FLOATS
- 2 - SINKS
- 3 - SPECIFIC GRAVITY
- 4 - ELEMENTARY ASH
- 5 - NEAR GRAVITY MATERIAL
- 6 - EXPANDED FLOATS

WASHABILITY CURVES





CINNABAR PEAK MINES LTD

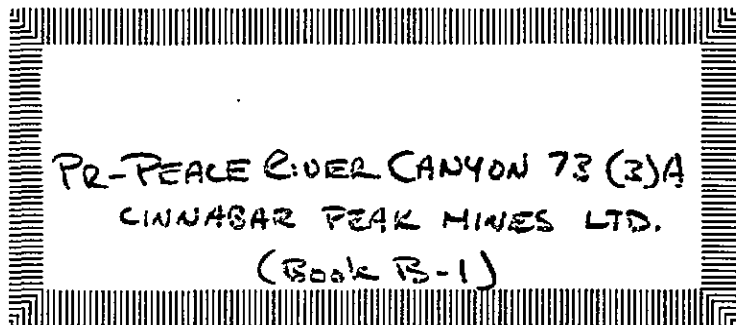
PEACE RIVER CANYON COAL PROPERTIES

APPENDIX 1

LITHOLOGIC LOGS OF DRILL HOLES

73-4A, 73-5 & 73-6

JANUARY 21st 1974



GEOLOGICAL BRANCH
ASSESSMENT REPORT

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PR-PEACE RIVER CANYON 73(3)A
(Book B-1)

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APPENDIX 1 : LITHOLOGIC LOGS OF DRILL HOLES

Company: Cinnabar Peak Mines Ltd.
Drill Hole No. 4A

Property: Peace River Canyon Properties
Page 2

Footage	Interval	Description
		151'0" - fracture at 20° to core axis, slightly curved.
		158'0" - plant remains in fracture.
		161'5"-162'1" - lighter colored zone, associated with fracture.
		161'9" - fracture at 10° to core axis.
		170'3"-170'11" - lighter colored zone, associated with fracture.
		171'0"-171'1" - two fractures at 45° and 38° to core axis with pyrite and calcite filling.
		174'1" - fracture at 77° to core axis, with associated shearing.
		174'1"-174'7" - pyrite blebs and minor carbonaceous material and coal; calcite around or inside pyrite.
		174'7"-175'1" - lighter colored.
		177'6" - shearing at 55° to core axis.
		186'7"-187'0" - curved fracture at low angle to core axis.
		190'0" - fracture at 75° to core axis with mud and fragments.
		191'0"-191'5" - ground core.
		191'5"-193'0" - lost core.
		206'5"-207'0" - lost core, in run to 207'.
		216'0" - partings at 80° to core axis.
		216'6"-216'10½" - lighter grey.
		219'0"-237'5" - fine white veinlets in fractures in friable mudstone; fractures at 82°, 77°, to core axis, variable.
		226'6"-227'4" - pyrite blebs.
		229'10" - start of fracture at 10° to core axis.
		232'3"-232'6" - lighter colored.
		233'1"-233'7" - lost core, in run 227'-233'7".

Company: Cinnabar Peak Mines Ltd.
Drill Hole No. 4A

Property: Peace River Canyon Properties
Page 3

Footage	Interval	Description
		235'3"-236'3" - local blebs of pyrite.
		237'0" - fracture at 30° to core axis, slightly across parting at 75° to core axis.
		237'5"-296'11" - darker, almost black; sheared locally; many minor fractures but mostly without the white veinlets seen uphole; local silty patches.
		242'11" - crumbly white material with angular fragments of shale.
		245'4½" - fracture at 78° to core axis; crumbly white material.
		245'6½"-245'7" - shearing at 80° to core axis.
		245'7½" - mud vein with fragments of shale; calcareous.
		245'10"-245'11" - mud vein with shale fragments in dull white calcareous material.
		245'11"-246'0" - lost core.
		247'8" - pyrite in irregular silty band.
		249'1" - irregular band of pyrite with bleb of pyrite at 249'1½".
		249'9" - shearing at 70° to core axis.
		249'10"-249'11" - light-colored, with granular pyrite on fracture face; fine calcite-filled fracture.
		251'0" - shearing near fracture at 70° to core axis.
		251'2" - plant impression in fracture at 15° to core axis.
		251'9"-252'0" - lost core.
		252'7"-254'0" - lost core.
		254'0"-254'3" - light-colored band, roughly parallel to core axis, with calcite and pyrite veinlets.

Company: Cinnabar Peak Mines Ltd.
Drill Hole No. 4A

Property: Peace River Canyon Properties
Page 4

Footage	Interval	Description
	254'3"-255'11½"	- very fissile at 85° to core axis, and friable.
	255'11½"-257'0"	- lost core.
	257'0"-257'10"	- core friable and broken.
	257'10"-263'1½"	- fissile, friable, very dark grey, with minor blebs of pyrite; partings at about 80° to core axis.
	263'1½"-264'1½"	- shaly, lighter colored; with breaks at darker bands.
	264'1½"-274'11"	- shaly, dark, friable, fissile, with parting at 75°-78° to core axis; pyrite blebs, as at 269'9"; ribbed core.
	274'11"-275'8"	- lighter colored, slightly harder.
	275'8"-277'9"	- dark-grey, shaly; friable, highly fissile at about 80° to core axis.
	277'9"-278'11"	- light-colored, with green tinge.
	278'1"-280'0"	- shaly.
	From 280'0"	- partings farther apart.
	281'4"-281'8"	- lighter colored; "rabbit-ear" pattern of pyrite blebs at 281'8".
	282'1"-282'4"	- light-colored.
	282'10"-283'5"	- more pyrite than before, particularly as irregular streaks at about 8° to core axis.
	285'6"-285'11"	- silty bands at 80° to core axis and irregular.
	286'4"-286'6"	- irregular pyrite streak at 10° to core axis.
	From 286'11"	- friable and very fissile at 80° to core axis.
	287'5"	- bleb of pyrite.
	288'2"-288'3½"	- irregular pyrite streak at about 10° to core axis.

Company: Cinnabar Peak Mines Ltd.
Drill Hole No. 4A

Property: Peace River Canyon Properties
Page 5

Footage	Interval	Description
	288'11"-289'5"	- dark, with scattered light-colored material; pyrite blebs downhole.
	292'10"-293'5"	- lighter colored, slightly silty; streaky banded pattern.
	295'8½"	- band of whitish siltstone; upper contact irregular; lower contact at 80° to core axis; rounded shale inclusions.
	296'2½"-296'3½"	- whitish siltstone band; irregular upper contact.
	296'6"-296'11"	- paler, greenish-tinged, with many blebs of pyrite; lower contact gradational.
	296'11"-317'4½"	- dark, shaly, fissile, friable, with partings at 80°-82° to core axis; very soft; much pyrite locally in blebs and streaks aligned with tiny veinlets in fractures or partings, but rarely in fractures themselves.
	302'2" - ¾"	band of white fine-grained sandstone at 81° to core axis.
	304'3" - ¾"	band of white-grey sandstone at 80° to core axis; feldspathic, silty at bottom, slightly calcareous; soft.
	304'3¾"-304'8"	- shaly with tiny grains of siliceous material, both oval and irregular in shape; increasingly mixed downhole; becoming sandier towards lower contact.
	304'8"-304'9¼"	- band of fine-grained sandstone and siltstone, at 80° to core axis; tinged with rust locally.
	305'1"-305'11"	- lighter brown, with darker gradational contacts; pyrite blebs and streaks.
	308'7"	- elongated pyrite blebs, partly parallel to partings at 82° to core axis.
	309'3"	- numerous pyrite blebs.
	309'10"-310'2"	- brownish shale.

Company: Cinnabar Peak Mines Ltd.
Drill Hole No. 4A

Property: Peace River Canyon Properties
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Footage	Interval	Description
		313'2"-313'8" - much pyrite in "chromosomal" strands.
		314'4"-314'6" - pyrite blebs.
		315'0"-315'5" - "chromosomal strands" of pyrite in elongated group trending at 6° to core axis.
		315'6"-316'0" - many pyrite blebs, generally elongated in approximate direction of parting planes at 80° to core axis.
		317'3½" - flecks of coal.
		317'4½" - plant remains on uphole fracture face; glauconite on downhole face.
		317'4½"-319'10" - glauconitic.
		317'7"-318'0" - glauconitic; "chromosomal" pyrite complex. Pyrite blebs here and elsewhere are not always all pyrite, but are in places partly of indeterminate pale-brown material which may be more or less replaced by the pyrite, especially near margins.
		318'0"-318'11½" - light-brown shale, darkened with glauconite.
		318'3"-318'5½" - irregular pyrite blebs.
		318'7½"-318'11½" - partings change from 80° to 70° to core axis.
		318'11½" - fracture at 55° to core axis, at contact.
		318'11½"-319'3" - medium hard, very fine grained, compact, light-brown, silicified; lower contact at 83° to core axis; contains darker shale masses.
		319'3"-319'4½" - darker, glauconitic, with pyrite blebs; gradational lower contact.
		319'4½"-319'10" - brown, fine-grained, similar to above, gradational lower contact.

Company: Cinnabar Peak Mines Ltd.
Drill Hole No. 4A

Property: Peace River Canyon Properties
Page 7

Footage	Interval	Description
		319'10"-326'0" - fissile, friable, with partings at 80° to core axis, locally varying to 75°-78°; pyrite very common, with lenses and streaks more or less aligned with parting direction; minor lighter colored silty bands.
		319'10"-320'10" - much pyrite, as large aligned blebs and lenses, and cross-cutting.
		324'6½" and 324'9½" - minor silty bands, some pyrite.
		325'6"-325'9" - several pyrite lenses aligned at 85° to core axis.
		GETHING FORMATION
326'0"	- 328'9" 2'9"	<u>Conglomerate</u> , pebbles up to ½" of dark chert, white and light-grey sandstone, hard dull-brown and greenish-grey material, pyrite and pyrite-bearing material, all more or less rounded but not closely packed; matrix highly impure argillaceous sandstone, with sub-rounded to angular grains of quartz and feldspar and locally considerable glauconite; coal trace.
328'9"	- 329'0" 0'3"	<u>Contact zone</u> indicating that parts of the conglomerate slumped into the plastic beds below.
329'0"	- 330'10" 1'10"	<u>Shale and siltstone</u> - interbedded shale and dark- and light-colored siltstone, some sandstone; banding variable in range 81°-70° to core axis; locally distorted.
330'10"	- 331'6½" 0'8½"	<u>Sandstone</u> , light-grey, banded uphole, homogeneous downhole, mainly of white or light-grey angular grains, with tiny angular fragments of black shale giving a "pepper-and-salt" appearance; uphole bands are shaly and locally carbonaceous; coal traces.
331'6½"	- 333'11" 2'4½"	<u>Shale</u> , mainly; alternating silty and shaly bands near both contacts at 80°-82° to core axis; much aligned pyrite.
		332'0"-333'4" - fissile, partings about 3/8" apart.
		333'4"-333'9" - finely fissile, friable, black.

Company: Cinnabar Peak Mines Ltd.
Drill Hole No. 4A

Property: Peace River Canyon Properties
Page 8

Footage	Interval	Description
333'11" - 335'6"	1'7"	<p><u>Sandstone-siltstone-shale series.</u></p> <p>333'11"-334'4½" - sandstone, "salt-and-pepper" type, with some shale inclusions; mainly without pyrite except near or in shale.</p> <p>334'4½"-335'6" - silty and shaly bands alternating irregularly.</p> <p>334'9"-335'0½" - shalier, more pyritic.</p>
335'6" - 339'9"	4'3"	<p><u>Shale.</u></p> <p>335'6"-338'3" - mainly dark-brown; fissile; partings ¼" to ½" apart.</p> <p>338'3"-339'9" - mainly dark-grey to black; very fissile; with irregular silty masses near bottom.</p>
339'9" - 342'8"	2'11"	<p><u>Sandstone-siltstone-shale series.</u></p> <p>339'9"-340'9" - mainly fine-grained sandstone and siltstone.</p> <p>340'0" - irregular fracture at 47° to core axis containing carbonaceous material.</p> <p>340'9"-342'8" - silty and darker shaly bands at 82° - 85° to core axis; local plant remains.</p> <p>342'6"-342'8" - minor coal layers, one thicker than ½".</p>
342'8" - 345'1½"	2'5½"	<p><u>Coal, SUPERIOR SEAM, bright, clean, with main fractures at 80° to core axis.</u></p> <p>344'3" - fractures at 5° to core axis.</p> <p>343'7¾"-343'8¼" - parting, irregular silty band.</p> <p>343'8½"-344'9½" - fractures at 60° to core axis; others nearly parallel to core axis.</p> <p>343'9½"-343'11" - band of brown siltstone at 70° to core axis; coal lenses with rims of white material normal to the lenses.</p> <p>344'0½" - slickensides at 75° to core axis.</p>

Company: Cinnabar Peak Mines Ltd.
Drill Hole No. 4A

Property: Peace River Canyon Properties
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Footage	Interval	Description
		344'1" - 344'2½" - brown, silty parting, distorted.
		344'5½" - 344'7" - irregular brown silty calcareous parting, with a lens of coal.
		<u>Sample 168</u> 342'8" - 345'1½" 2'5½"
345'1½" - 346'6"	1'4½"	<u>Black shale</u> , dense, slightly silty; with plant remains and minor local coal; gypsum; towards the bottom, irregular patches of fine-grained sandstone.
		345'5" - 345'8½" - plant remains and minor coal.
346'6" - 356'1"	9'7"	<u>Sandstone, siltstone and shale.</u>
		346'6" - 349'3" - mixed fine-grained argillaceous sandstone and siltstone, poorly banded, but one distinct band at 70° to core axis and one shale band at 80° to core axis; sandier uphole, shalier downhole.
		349'3" - 350'2" - well banded and finely interbedded siltstones and thinner shales; most shale bands fracture in S-shapes; regular bands at 85° to core axis.
		350'2" - 355'5" - siltstone and shale interbedded, irregular; partings locally carbonaceous; traces of coal locally; banding at 78° - 82° to core axis.
		355'5" - 356'1" - mainly black shale with banding at 83° to core axis.
356'1" - 357'0½"	0'11½"	<u>Black shale</u> - banded; fine-grained, dense; fissile at 80° to core axis; two minor coal bands close to lower contact.
357'0½" - 357'11½"	0'11"	<u>Coal</u> , mainly clean coal with bright and duller bands.
		357'0½" - 357'2¼" - mixed coal and brown siltstone.
		357'2¼" - 357'3¾" - brown siltstone with interbedded coal at 80° to core axis; pyrite.
		357'2¾" - pyrite streak.

Company: Cinnabar Peak Mines Ltd.
Drill Hole No. 4A

Property: Peace River Canyon Properties
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Footage	Interval	Description
		357'3 $\frac{3}{4}$ "-357'6 $\frac{3}{4}$ " - fractures at 8°-10° to core axis.
		357'10 $\frac{1}{2}$ "-357'11 $\frac{1}{2}$ " - brown on surface; alternating dull and bright coal.
		<u>Sample 169</u> 357'0 $\frac{1}{2}$ " - 357'11 $\frac{1}{2}$ " 0'11"
357'11 $\frac{1}{2}$ " - 359'3 $\frac{1}{2}$ "	1'4"	<u>Black shale</u> , locally coaly and carbonaceous, especially uphole, and with some plant remains; thin coal lenses uphole at 87° to core axis, but breaks are irregular. 358'11"-359'3 $\frac{1}{2}$ " - silty bands at 80° to core axis.
359'3 $\frac{1}{2}$ " - 365'8 $\frac{1}{2}$ "	6'5"	<u>Shale-siltstone</u> , interbedded; minor fine-grained sandstone; shale predominant, black; banding irregular at 80° to core axis; fissile.
365'8 $\frac{1}{2}$ " - 366'2"	0'5 $\frac{1}{2}$ "	<u>Black shale</u> , fissile at 80° to core axis, weakly banded.
366'2" - 366'3"	0'1"	<u>Coal</u> , fragments of banded, glossy-bright conchoidal, steely-bright and dull coal.
366'3" - 366'10"	0'7"	<u>Black shale</u> , locally coaly, especially uphole; numerous irregular partings at 75°-80° to core axis.
366'10" - 369'11 $\frac{1}{2}$ "	3'1 $\frac{1}{2}$ "	<u>Shale</u> , brown, becoming dark grey; slightly silty; irregular break; minor coal and carbonaceous plant remains locally. 369'3" - brown band or lens at 82° to core axis. 369'10"-369'11 $\frac{1}{2}$ " - contact zone, weakly banded.
369'11 $\frac{1}{2}$ " - 374'5"	4'5 $\frac{1}{2}$ "	<u>Siltstone and shale</u> , banded. 369'11 $\frac{1}{2}$ "-371'8 $\frac{1}{2}$ " - mainly siltstone and fine-grained sandstone with shale bands, both brown and dark-grey; irregular siltstone and sandstone bands of up to 2" at 75° to core axis. 371'8 $\frac{1}{2}$ "-374'5" - shale mainly, black, especially near bottom, finely interbedded with silty bands at 78°-80° to core axis; fissile; minor coal.

Company: Cinnabar Peak Mines Ltd.
Drill Hole No. 4A

Property: Peace River Canyon Properties
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Footage	Interval	Description
374'5" - 375'11"	1'6"	<u>Black shale</u> , progressively coaly downhole; thin layers of coal at 80° to core axis; locally carbonaceous; numerous coal lenses.
375'11" - 376'3½"	0'4½"	<u>Coal</u> , shaly; thinly interbedded coal and shale.
376'3½" - 376'6½"	0'3"	<u>Black shale</u> , locally coaly.
376'6½" - 379'2"	2'7½"	<u>Shale</u> , dark-brown; a few bands of harder light-brown shale at 80° to core axis. 377'6"-377'8" - two well-marked light-brown harder bands.
379'2" - 379'3"	0'1"	<u>Black shale</u> , coaly.
379'3" - 379'4"	0'1"	<u>Coal</u> , shaly, banded at 85° to core axis.
379'4" - 380'2½"	0'10½"	<u>Shale</u> , dark-brown, with streaks, lenses, and distorted bands of siltstone towards lower contact.
380'2½" - 390'7"	10'4½"	<u>Sandstone-siltstone-shale series.</u> 380'2½"-381'5" - shaly initial phase; one 2" band of fine-grained sandstone. 381'5"-383'11" - main sandstone phase, fine-grained, lighter colored, locally cross-bedded; banding variable, including 77° to core axis, 88° to core axis across it, 65°-70° to core axis across that; grains irregular, indistinct, including quartz, feldspar, argillaceous fragments; dark, shaly partings, locally carbonaceous. 383'11"-390'7" - mainly finely interbedded, variable siltstone and darker shale; banding near 80° to core axis, slightly distorted or variable; much included argillaceous material, more shaly downhole. From 388'0" - mainly dark shale. 390'1"-390'3½" - alternating black shale and siltstone bands.

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Footage	Interval	Description
390'7" - 391'2"	0'7"	<u>Black shale</u> , homogeneous, fine-grained, locally carbonaceous; fracture at 2° to core axis.
391'2" - 391'3"	0'1"	<u>Coaly black shale</u> , with thin coal bands at 80° to core axis.
391'3" - 392'2"	0'11"	<u>Coal</u> , interbedded and banded coal, and partings. 391'3"-391'4½" - fragments, including: cannel, partly rectangular, some conchoidal faces; banded coal, subrectangular; ½" parting of brown shale with local coal. 391'4½"-391'8½" - variable coal, including banded coal at 80° to core axis; glossy-bright conchoidal; mixed steely-bright and duller coal, similar to cannel, dull coal with plant tissue structure; fractures at 10° and 3° to core axis. 391'8½"-392'0" - parting, brown shale and siltstone, with thin layers of coal especially near contacts; dark buff earthy specks. 391'10"-391'11" - pyrite streaks and patches, partly aligned with banding at about 87° to core axis. 392'0"-392'1" - coal, steely-bright and glossy-bright; subrectangular fragments. 392'1"-392'2" - coal, banded; cannel at lower contact.
392'2" - 392'10"	0'8"	<u>Shale</u> , dark-brown; coal in lenses and thin bands uphole. 392'4½" - 1/8" coal band at 83° to core axis.
392'10" - 393'9"	0'11"	<u>Shale-siltstone-sandstone</u> , calcareous; interbedded; irregular bands; dark-brown shale; fine-grained sandstone; pyrite in fine-grained aggregates between grains locally.
393'9" - 422'2½"	28'5½"	<u>Sandstone-siltstone-shale series</u> , calcareous; some massive, some banded, mainly at 75°-80° to core axis, but cross-bedding also present; minor differences in composition between different bands; minor shale sections, narrow beds; coal traces and pyrite scale in partings, locally.

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Footage	Interval	Description
		393'9"-400'5" - banded sandstone, fine-grained, cross-bedding in places.
		394'2½" - ½" band of shale at 77° to core axis.
		395'8½" - plant remains, coal.
		396'0" - thin shale band; a little coal.
		396'8" - shale parting with coal and pyrite; calcite vein.
		397'1" - pyrite in parting.
		399'3" - thin shale lens.
		400'5" - black shale band; thin coal lens.
		400'5"-414'0" - "pepper and salt" sandstone, mainly massive, homogeneous; darker bands in short sections, some at 70°-73° to core axis; cross-bedding; minor coal, locally fossiliferous.
		400'7½" - lens of shale, rusty outline.
		401'8½" - minor lens of coal at 80° to core axis.
		402'6½" - coalified plant remains, fibrous pyrite.
		403'6"-403'9" - black shaly filling in irregular fracture at about 15° to core axis, cross-cutting banding traces at 80° to core axis.
		405'11" - thin band of shale at 85° to core axis.
		407'2"-408'5" - shaly fillings, in irregular streaky fractures.
		407'2" - carbonaceous material in main trend of fracture.
		408'0" - trace of coal in shaly fracture.
		409'8" - shale parting at 80° to core axis.
		409'11½"-412'11" - white flecks and pelecypod shell fossils.
		411'3½" - fossil shell profile, both valves present.

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Footage	Interval	Description
		413'0 $\frac{1}{2}$ " - thin calcite veinlet at 75° to core axis; some banding at 70°-73° to core axis; local cross-bedding.
		414'0"-422'2 $\frac{1}{2}$ " - mainly banded, partly more massive; bands sharp and closely spaced, at 80°-85° to core axis and 70°-75° to core axis; cross-bedding; plant remains, carbon, coal and scale pyrite in partings; locally calcareous.
		414'9" - thin shale band at 75° to core axis; wavy fracture, carbonaceous.
		415'4" - thin shale band at 83° to core axis.
		416'11" - "notching" of bands downwards.
		417'2 $\frac{1}{2}$ " - thin calcite veinlet approximately parallel to core axis.
		418'3 $\frac{1}{2}$ " - wavy shale parting, smooth face.
		418'5" and 418'6" - smooth face of break.
		418'10" - small mass of darkly-banded material.
		420'8" - coal in shale parting; traces of pyrite.
		421'2" - coalified plant remains in shale parting; elongated pyrite blades.
		422'0"-422'2 $\frac{1}{2}$ " - somewhat darker, gradational to more shaly series below.
422'2 $\frac{1}{2}$ " - 431'9 $\frac{1}{2}$ "	9'7"	<u>Shale-siltstone series</u> ; interbedded; mainly dark-grey and black shale, in centre, locally carbonaceous; lighter colored, more silty near upper and lower contacts; bands mainly irregular in thickness and distorted, but where regular are at 80° to core axis; easy but irregular partings along shale bands; pyrite locally, especially as scale in shale partings; locally calcareous, siltstones more so; pelecypod fossils locally.
		422'2 $\frac{1}{2}$ "-424'11" - more silty beds.
		424'11"-428'2 $\frac{1}{2}$ " - more shaly beds, close network of fractures; friable.
		426'9"-426'10" - pebble or part of siltstone band around which shale is bent.

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Footage	Interval	Description
		428'2½"-431'9½" - siltier, some interbedded shale. 428'3½" - two pelecypod fossils. 431'3"-431'4" - black shale between fractures at 80° and 75° to core axis; silty lenses.
431'9" - 438'11"	7'1½"	<u>Sandstone and siltstone</u> with minor shale as fine dark partings; calcareous; weak banding at 80° to core axis; coal traces locally; several calcite veinlets. 436'8"-438'11" - contact zone; more shale in irregular bands and partings.
438'11" - 444'11½"	6'0½"	<u>Shale-siltstone-sandstone series</u> , interbedded; brown shale; light-colored fine-grained sandstone; wide bands, especially shale, sharp and regular about 78°-80° to core axis; blocky fracture network of shale locally; calcareous. 439'3"-439'4½" - banded material, rather dark, mixed shale and silt. 441'5½" - fine-grained sandstone, lenses. 444'4"-444'11½" - siltstone and black shale, closely interbedded; contact zone.
444'11½" - 446'0"	1'0½"	<u>Black shale</u> , fine bands of siltstone at 80° to core axis; typical blocky fracture network.
446'0" - 446'9½"	0'9½"	<u>Lost core</u> . This interval represents the accumulated difference between drillers' and core logger's measurements; it does not represent core lost at this point.
446'9½" - 447'7"	0'9½"	<u>Black shale</u> , dense; blocky fracture network, with main partings at 78° to core axis; fracture with calcite approximately parallel to core.
448'7" - 448'5½"	0'10½"	<u>Coal</u> , banded duller and brighter material, fractured. 447'7"-447'9" - coal, dull with some bright bands at 83° to core axis; fractures parallel to core axis and along banding.

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Footage	Interval	Description
		447'9" - 448'5½" - coal, much as before; alternating thin bands of dull and bright coal; minor slickensiding.
		447'9" - 448'0" - mainly bright coal, well fractured.
		<u>Sample 170</u> 447'7" - 448'5½" 0'10½"
448'5½" - 448'6½"	0'1"	<u>Black shale</u> , with coal in lenses at about 75° to core axis; blocky fracture network; locally carbonaceous.
448'6½" - 451'1"	2'6½"	<u>Shale</u> , grading from black near upper contact to dark brown below; plant structures, carbon, coal traces locally; blocky fracture network, main partings at 75° to core axis; calcareous.
451'1" - 454'7"	3'5"	<u>Siltstone and shale</u> , interbedded; narrower shale bands, at 75° when regular, some distorted; cross-bedding; rock dark from shale partings and shaly component in siltstone; calcareous.
454'7" - 455'11"	1'4"	<u>Shale</u> , dark-brown; lighter colored, siltier, locally; blocky fracture network, main partings ¼"-½" apart.
455'11" - 457'6"	1'7"	<u>Siltstone and shale</u> , finely interbedded, at 82°-85° to core axis, regular; calcareous. 456'4½"-456'9½" - lost core in the run of 446'9½"-456'9½".
457'6" - 458'10"	1'4"	<u>Shale</u> , dark-grey and brown, calcareous uphole, less so downhole; plant remains locally; carbonaceous locally; traces of coal; blocky fracture network; main partings vary, 85° to 75° to core axis.
458'10" - 458'11"	0'1"	<u>Coaly black shale</u> ; lenses and part-bands of coal, some glossy-bright.
458'11" - 469'7"	10'8"	<u>Coal</u> , TROJAN SEAM. 458'11"-460'3" - dull coal with bright sections; fractures at 3°, 5°, 7°, 10° to core axis; intact core.

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Footage	Interval	Description
	460'3"-460'9½"	- bright coal, partly as elongated rectangles; broken core.
	460'9½"-461'4"	- bright coal, banded at 80° to core axis; fracturing about 5° to core axis, variable; intact core.
	461'4"-462'10½"	- dull coal, bright coal bands and specks.
	461'9½"-461'10½"	- white "bone" band at 10° to core axis.
	462'10½"-463'8"	- dull coal, some glossy-bright specks, streaks; irregular patches of white "bone" material.
	463'7"-463'8"	- glossy-bright coal band.
	463'8"-464'2"	- siltstone parting, light-brown; streaks of coal.
	463'10"-463'11½"	- altered material, some coaly fragments.
	464'2"	- wavy contact between siltstone and coal.
	464'2"-464'7"	- glossy-bright coal; main fracture at 10° to core axis; intact core.
	464'7"-465'2"	- glossy-bright coal, rectangular fragments; broken core.
	465'2"-465'8½"	- glossy-bright coal; intact core.
	465'8½"-466'8"	- mixed glossy-bright and dull coal, fractured at 10° to core axis; bands of bright coal at 78°-80° to core axis.
	466'8"-466'10½"	- steely-bright coal; intact core.
	466'10½"-467'1"	- glossy-bright, steely-bright, and dull coal; broken core.
	467'1"-468'0"	- glossy-bright coal with some dull at the top, slightly banded at 80° to core axis; fractured at 10° to core axis.

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Footage	Interval	Description
		468'0"-469'7" - mainly glossy-bright, partly steely-bright coal; fractured at 10° to core axis.
		468'0"-468'8" - intact core.
		468'8"-469'7" - rectangular pieces and small fragments; broken core.
		<u>Sample 171</u> 458'11" - 461'4" 2'5"
		<u>Sample 172</u> 461'4" - 463'8" 2'4"
		<u>Sample 173</u> 463'8" - 464'2" 0'6"
		<u>Sample 174</u> 464'2" - 467'1" 2'11"
		<u>Sample 175</u> 467'1" - 469'7" 2'6"
469'7" - 478'4"	8'9"	<p>Shale, dark-brown to dark-grey, fine-grained, locally siltier; local banding in short sections, not regular; local blocky fracture network; carbonaceous partings locally; local thin coal lenses; plant remains common.</p> <p>470'7"-470'11" - banded at 62° to core axis.</p> <p>471'0"-471'4" - banding at 75° to core axis.</p> <p>471'5" - fracture at 8° to core axis.</p> <p>472'8"-472'9" - two narrow coal lenses, at 77° to core axis.</p> <p>472'9½" - fracture at 60° to core axis; with slicken-sided black carbonaceous material; badly broken core downhole.</p> <p>474'0"-474'8" - banding at 85°, then 81°, to core axis, and irregular.</p> <p>474'3"-474'8" - several thin coal lenses at 80°, 73°, 75° to core axis.</p> <p>475'0"-475'3" - banding at 75° to core axis and irregular.</p> <p>475'8" - banding at 80° to core axis.</p>

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Footage	Interval	Description
87'6 $\frac{1}{2}$ " - 88'0"	0'5 $\frac{1}{2}$ "	<u>Lost core</u> , in the run from 85'3" - 88'0".
88'0" - 89'4"	1'4"	<u>Coal</u> (coalified mineral matter?), material similar to that in 87'5 $\frac{1}{2}$ " - 87'6 $\frac{1}{2}$ ", but some sections are heavier in weight. 88'0"-88'2" - fragmented material, part of which shows banding at 78°-80° to core axis; rectangular fracture pattern. 88'2"-88'2 $\frac{1}{2}$ " - similar material; intact core. 88'2 $\frac{1}{2}$ "-88'2 $\frac{3}{4}$ " - $\frac{1}{4}$ " sandstone band at 78° to core axis. 88'2 $\frac{3}{4}$ "-88'6 $\frac{3}{4}$ " - similar dark, but white speckled, material, lighter colored downhole; the top 1" carries much white granular material in the form of pygmatic veins; faint banding locally by similar white material at 70° to core axis; weak fracturing at 2°-3° to core axis, and weak parting at 77° to core axis. 88'6 $\frac{3}{4}$ "-88'9 $\frac{1}{2}$ " - soft white felsic material; uphole contact at 78° to core axis. 88'9 $\frac{1}{2}$ "-89'0 $\frac{1}{2}$ " - lighter colored section with more white mica-like specks; heavier than darker material. 89'0 $\frac{1}{2}$ "-89'2 $\frac{1}{2}$ " - mainly fragmental material, darker in color, lighter in weight. 89'2 $\frac{1}{2}$ "-89'3" - band showing white material in a pygmatic vein structure, (about 50% of rock is vein). 89'3"-89'4" - white-speckled cancell material with thin coal lenses near lower contact.
89'4" - 95'9 $\frac{1}{2}$ "	6'5 $\frac{1}{2}$ "	<u>Coal, TROJAN SEAM</u> . 89'4"-91'3 $\frac{1}{2}$ " - coal, thin bands of glossy-bright alternating with dull coal sections; banding mainly at 78° to core axis, others at 80°-83° to core axis; rectangular fracture pattern, approximately parallel and normal to core axis; pyrite scale locally; intact core.

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Footage	Interval	Description
		487'3½"-487'7" - coaly shale; lenses of glossy-bright conchoidal coal at 70° to 80° to core axis.
		487'5" - irregular coal lens, glossy-bright conchoidal; thin calcite veinlet.
487'7" - 489'6"	1'11"	<u>Coal</u> , glossy-bright and steely-bright bands at 80°-83° to core axis, variable; common fracture 10° to core axis, others 15°, 7° to core axis.
		487'8½"-487'9½" - shaly coal; coal layers at 83° to core axis and also cross-cutting at 80° to core axis.
		489'3"-489'6" - finely interbedded dull and glossy-bright coal, at 77° to core axis; fractures at 10° to core axis.
		<u>Sample 176</u> 487'7" - 489'6" 1'11"
489'6" - 490'4½"	0'10½"	<u>Black shale</u> , locally coaly; dense, carbonaceous locally; blocky fracture network locally.
		489'6"-489'10" - thin coal lenses and streaks at 70° to core axis and variable; carbonaceous partings; plant remains.
		490'2"-490'4½" - gradational to silty shale below, dark-brown.
490'4½" - 493'8"	3'3½"	<u>Siltstone</u> , shaly, dark-grey or brownish to light-grey; interbedded more and less silty bands, mainly distorted and irregular, but locally at 78°-82° to core axis.
		490'4½"-490'9½" - very dark silty shale, gradational from section above.
493'8" - 495'9½"	2'1½"	<u>Shale</u> , grey to light-grey, and dark-brown downhole; blocky fracture network, with main partings at 80° to core axis; slightly calcareous.
		494'1"-494'3½" - light-grey shale, silty.
		494'7½"-495'9½" - silty shale, dark-brown, banded at 80° and 78° to core axis.

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Footage	Interval	Description
		495'9 $\frac{1}{2}$ " - narrow glossy-bright conchoidal coal and shale layers in wavy fracture.
495'9 $\frac{1}{2}$ " - 496'9 $\frac{1}{2}$ "	1'0"	<u>Lost core.</u>
496'9 $\frac{1}{2}$ "		<u>End of Hole.</u>

Note:

Water level at surface.

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	<u>Lost Core</u>		<u>From drill run</u>
191' 5" - 193' 0"	1' 7"	Lost core	183'3" - 193'0"
206' 5" - 207' 0"	0' 7"	" "	199'0" - 207'0"
233' 1" - 233' 7"	0' 6"	" "	227'0" - 233'7"
245' 11" - 246' 0"	0' 1"	" "	233'7" - 246'0"
251' 9" - 252' 0"	0' 3"	" "	246'0" - 252'0"
252' 7" - 254' 0"	1' 5"	" "	252'0" - 254'0"
255' 11 1/2" - 257' 0"	1' 0 1/2"	" "	254'0" - 257'0"
446' 0" - 446' 9 1/2"	0' 9 1/2"	" "	436'0" - 446' 9 1/2"
456' 4 1/2" - 456' 9 1/2"	0' 5"	" "	446' 9 1/2" - 456' 9 1/2"
476' 5 1/4" - 476' 9 1/2"	0' 4 1/4"	" "	466' 9 1/2" - 476' 9 1/2"
495' 9 1/2" - 496' 9 1/2"	1' 0"	" "	486' 9 1/2" - 496' 9 1/2"
	8' 0 1/4"		

Core Recovery = 98%

DRILL LOGS

Company: Cinnabar Peak Mines Ltd.
Drill Hole No. 5

Page 1

Property: Peace River Canyon Properties
Location: 1075' S, 2525' E of the NW
corner of Lot 1060

Azimuth: - Depth: 137'
Dip: -90° Core recovered: 91%
Core: NQ Casing: NW, 14' left in Started: August 21, 1973
Finished: August 24, 1973
Drilled by: Shepherd Enterprises Ltd.
Logged by: G.A. Checklin

Purpose: To test the Trojan Seam near its subcrop beneath overburden.

Footage	Interval	Description
0'0" - 10'0"	10'0"	<u>Casing</u> 10 feet; 4 feet added later.
10'0" - 10'0½"	0'0½"	<u>Sandstone</u> , finely banded; coal locally; trace plant remains.
10'0½" - 10'1"	0'0½"	<u>Coal</u> , fragments; platy rectangular, glossy-bright conchoidal; remnants of 10" seam exposed in bulldozer trench at drill site.
10'1" - 10'10½"	0'9½"	<u>Lost core</u> , coal (see above).
10'10½" - 11'2½"	0'4"	<u>Sandstone</u> , dark-brown; fine shale partings at 67° to core axis; traces of coal; partly broken core.
11'2½" - 12'9½"	1'7"	<u>Sandstone</u> , light-colored, leached; straggly coarse banding at 60° to core axis. 12'2½" - friable, dark-brown, slightly rusty weathered material.
12'9½" - 17'0"	4'2½"	<u>Lost core</u> .
17'0" - 19'2½"	2'2½"	<u>Sandstone</u> , calcareous, fine-grained, finely banded at various angles (63°-70°) to core axis; thin shale partings; shale and siltstone sections; coal traces locally. 17'8"-17'10" - interbedded shale and sandstone. 18'2"-18'4½" - interbedded shale and siltstone.

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Footage	Interval	Description
19'2½" - 27'2"	7'11½"	<u>Shale and siltstone</u> , interbedded, cyclothemtic; variably calcareous, with silty band of a pair more so; bands ½" to 1" apart, at 77° and 82° to core axis.
27'2" - 28'0"	0'10"	<u>Lost core.</u>
28'0" - 35'3"	7'3"	<u>Shale-siltstone series</u> , locally calcareous; shale predominant, interbedded with thinner siltstones, about ¼" apart; bands irregular but trending at 75°-80° to core axis; friable locally. 29'9"-29'11" - more silty section. 31'0"-31'6" - highly shaly section with regular banding at 82° to core axis. 33'0"-33'5" - more silty section. 33'10"-34'0" - <u>lost core.</u> 34'2½"-34'6½" - irregular banding. 34'6½"-35'3" - more shaly material, friable.
35'3" - 56'8"	21'5"	<u>Sandstone</u> , calcareous; medium-grained, granular; fine darker more argillaceous layers and streaks alternating with wider light-colored bands, at mainly 75° within range of 60°-85° to core axis; narrow coal layers, lenses and streaks locally, with pyrite and minor plant remains. 35'3"-36'11" - darker, more shaly. 38'8½" - two thin coal lenses at 60° to core axis. 40'9½" - thin coal lens, pyrite. 41'0" - thin coal lens; pyritized plant tissue structures. 42'2" - shaly band at 85° to core axis. 42'3"-44'3" - numerous narrow coal lenses at about 65°-70° to core axis. 48'6"-48'8" - several coal lenses at about 75° to core axis.

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Footage	Interval	Description
		49'11" - well-defined shale band, curved, roughly at 75° to core axis.
		50'1" - pyrite with coal in parting.
		51'0"-51'7½" - several coal lenses at 65° to core axis and irregular.
		52'11½" - thin lens of coal.
		55'2"-56'0" - <u>lost core</u> .
		56'0"-56'8" - harder, more silty; less calcareous; several thin coal layers and lenses.
		56'3½" - ¾" siltstone band about 80° to core axis; thin coal lens downhole.
56'8" - 87'5½"	30'9½"	<u>Shale</u> , silty, variably calcareous; dark-grey to dark-brown, depending on shale to silt ratio; soft, little variation; blocky fracture network locally; weakly banded at about 80°; coalified plant remains, carbon patches; minor coal locally, with pyrite.
		57'3"-57'8" - darker, more shaly, with typical fracture pattern; partings at 85° to core axis.
		59'0"-59'3½" - brown section; calcareous in patches.
		59'0" - pyrite associated with coal in break.
		59'2¾" - break with faint plant remains, patches of carbon and a little coal.
		59'3½" - band at contact at 78° to core axis.
		59'6" - thin coal lens.
		59'10½" - band of silt at 75° to core axis.
		60'4"-61'8" - highly calcareous, interbedded siltstone and shale at 70° to core axis.
		62'4½" - pyrite, carbon and coal in break.
		62'8"-62'11½" - silty; irregular shale bands at 80° to core axis, with carbon, coal, plant tissue structures.
		63'10"-64'5" - interbedded dark shale and greyer material at 75° to core axis.

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Footage	Interval	Description
		64'9"-68'11" - lighter brown; widely spaced partings; carbonaceous, plant remains, pyrite locally.
		68'10"-68'11" - siltstone band; lenses of silt within more shaly material.
		68'11"-70'2½" - more shaly section; blocky fracture network.
		69'7" - thin coal lenses branching from node of stem of coal, with pyrite; S-shaped fracture.
		73'9"-77'11" - light-colored section banded at about 75°-78° to core axis; blocky fracture network (more irregular).
		74'4½" - glossy-bright conchoidal coal mass in curved break, with pyrite.
		78'4½" - glossy-bright conchoidal coal lens.
		78'8"-80'10" - lighter-colored section; faint banding at 75° to core axis (shaly bands).
		82'8"-83'7" - lighter colored section; siltier bands at 80°-85° to core axis; some cross-bedding.
		83'8"-84'2" - banding at 73° to core axis, slightly irregular; lighter colored, siltier bands alternating with more straggly and finer shaly bands.
		84'2"-85'6" - blocky fracture network of shale common.
		85'6"-86'1" - siltier bands and lenses.
		86'1"-87'5½" - blocky fracture network of shale with main partings at 77°-80° to core axis.
		86'7½" - fine-grained, more silty, brown band at about 75° to core axis.
		87'5½" - contact, coaly material.
87'5½" - 87'6½"	0'1"	<u>Coal</u> (coalified mineral matter?), dark, nearly black; medium-grained, granular; isolated white mineral grains, not calcite, in black matrix; not typical channel; fractures at 3°-5° to core axis.

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Footage	Interval	Description
87'6 $\frac{1}{2}$ " - 88'0"	0'5 $\frac{1}{2}$ "	<u>Lost core</u> , in the run from 85'3" - 88'0".
88'0" - 89'4"	1'4"	<u>Coal</u> (coalified mineral matter?), material similar to that in 87'5 $\frac{1}{2}$ " - 87'6 $\frac{1}{2}$ ", but some sections are heavier in weight. 88'0"-88'2" - fragmented material, part of which shows banding at 78°-80° to core axis; rectangular fracture pattern. 88'2"-88'2 $\frac{1}{2}$ " - similar material; intact core. 88'2 $\frac{1}{2}$ "-88'2 $\frac{3}{4}$ " - $\frac{1}{4}$ " sandstone band at 78° to core axis. 88'2 $\frac{3}{4}$ "-88'6 $\frac{3}{4}$ " - similar dark, but white speckled, material, lighter colored downhole; the top 1" carries much white granular material in the form of pygmatic veins; faint banding locally by similar white material at 70° to core axis; weak fracturing at 2°-3° to core axis, and weak parting at 77° to core axis. 88'6 $\frac{3}{4}$ "-88'9 $\frac{1}{2}$ " - soft white felsic material; uphole contact at 78° to core axis. 88'9 $\frac{1}{2}$ "-89'0 $\frac{1}{2}$ " - lighter colored section with more white mica-like specks; heavier than darker material. 89'0 $\frac{1}{2}$ "-89'2 $\frac{1}{2}$ " - mainly fragmental material, darker in color, lighter in weight. 89'2 $\frac{1}{2}$ "-89'3" - band showing white material in a pygmatic vein structure, (about 50% of rock is vein). 89'3"-89'4" - white-speckled cannel material with thin coal lenses near lower contact.
89'4" - 95'9 $\frac{1}{2}$ "	6'5 $\frac{1}{2}$ "	<u>Coal, TROJAN SEAM</u> . 89'4"-91'3 $\frac{1}{2}$ " - coal, thin bands of glossy-bright alternating with dull coal sections; banding mainly at 78° to core axis, others at 80°-83° to core axis; rectangular fracture pattern, approximately parallel and normal to core axis; pyrite scale locally; intact core.

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Footage	Interval	Description
	91'3½"-91'5"	- grey sandstone parting; minor coal in thin bands at 81°-82° to core axis.
	91'5"-93'8½"	- coal; glossy-bright bands alternating with dull sections, the latter with plant tissue structures; dull streaks in bright coal; weak banding; intact core.
	91'5"-91'6½"	- duller section.
	91'6½"-92'0"	- generally brighter coal.
	92'0"-93'8½"	- bright and dull coal bands and streaks; fine-grained.
	93'5" and 93'6"	- layers of glossy-bright coal.
	93'8½"-94'0½"	- parting; black shale at contacts, with coal patches and streaks; fine-grained sandstone in centre with coal traces.
	94'0½"-94'2½"	- dull coal.
	94'2½"-95'3"	- coal, mainly glossy-bright; well-fractured; mainly broken core.
	95'3"-95'6"	- parting, carbonaceous shale.
	95'6"-95'9½"	- mixed coal slack; some coaly shale fragments.
<u>Sample 177</u>	89'4" - 91'3½"	1'11½"
<u>Sample 178</u>	91'3½" - 91'5"	0'1½"
<u>Sample 179</u>	91'5" - 93'8½"	2'3½"
<u>Sample 180</u>	93'8½" - 94'0½"	0'4"
<u>Sample 181</u>	94'0½" - 95'3"	1'2½"
<u>Sample 182</u>	95'3" - 95'6"	0'3"
<u>Sample 183</u>	95'6" - 95'9½"	0'3½"

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Footage	Interval	Description
95'9½" - 96'3"	0'5½"	<u>Shale</u> , dark-brown to black; thin bands and streaks of coal locally.
96'3" - 97'0"	0'9"	<u>Lost core</u> , from run of 88' - 97'.
97'0" - 97'7"	0'7"	<u>Siltstone</u> ; a little coal in streaks; more silty from 97'5".
97'7" - 98'5"	0'10"	<u>Siltstone</u> , light and dark bands; banding distorted, but trending at 65° to core axis uphole, and at 75° and 80° to core axis downhole. <u>Sample 184</u> 95'9½" - 98'5" 1'10½" (rock) 0'9" (lost core)
98'5" - 100'8½"	2'3½"	<u>Coal</u> (part of Trojan Seam). 98'5"-99'3" - coal, mainly glossy-bright; local pyrite; partly broken core, rectangular pieces. 98'6"-98'7" - duller section. 99'3"-99'6" - parting; sandstone with small lenses of white-rimmed coal at 90° and 80° to core axis; upper and lower contacts at 60° and 85° to core axis. 99'6"-100'8½" - coal; glossy-bright, banded at 75°-80° to core axis; mainly broken core. <u>Sample 185</u> 98'5" - 99'3" 0'10" <u>Sample 186</u> 99'3" - 99'6" 0'3" <u>Sample 187</u> 99'6" - 100'8½" 1'2½"
100'8½" - 101'1½"	0'5"	<u>Coaly siltstone</u> , dark, shaly, with considerable glossy-bright coal in numerous thin bands at 75° and 80° to core axis, variable.
101'1½" - 101'11½"	0'10"	<u>Siltstone</u> and fine-grained sandstone, grey; irregular banding at 60°-80° to core axis, some caused by shale partings and bands, some by coal bands and thin lenses.

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Footage	Interval	Description
		From 101'8" - more shaly downwards.
101'11½" - 102'2"	0'2½"	<u>Coaly shale</u> ; coal lenses and bands at 78° to core axis.
102'2" - 102'5"	0'3"	<u>Coal</u> , banded, glossy-bright.
102'5" - 102'6"	0'1"	<u>Coaly shale</u> ; thin coal bands and lenses.
102'6" - 102'7"	0'1"	<u>Black shale</u> ; minor coal lenses.
102'7" - 102'11"	0'4"	<u>Sandstone, siltstone and shale</u> ; cyclothem of coarser sandstone and siltstone with narrower shale layers, at 77° to core axis and irregular.
102'11" - 103'11½"	1'0½"	<u>Shale</u> - mainly shale; irregular siltier bands locally.
103'11½" - 104'8"	0'8½"	<u>Sandstone and shale</u> - fine-grained sandstone; thin partings of black shale at 75° to core axis; more shaly towards lower contact. 104'7½" - coalified plant remains with pyrite.
104'8" - 105'0"	0'4"	<u>Siltstone</u> , with fine shale layers at 77° to core axis and irregular.
105'0" - 105'2"	0'2"	<u>Black shale</u> ; minor coal lenses; plant remains in partings at 80° to core axis. 105'1½" - start of fracture at 40° to core axis, with pyrite.
105'2" - 105'11"	0'9"	<u>Coaly black shale</u> ; numerous coal lenses and layers; plant remains in partings at about 83° to core axis. 105'6" - ¼" coal layer, fracturing into tiny glossy-bright rectangles. 105'6½" - 105'7¼" - fine-grained sandstone band.
105'11" - 106'0½"	0'1½"	<u>Coal</u> , glossy-bright conchoidal alternating with steely-bright and duller coal, in bands at 80° to core axis; fracture system at 8°-10° to core axis; partings parallel to banding.

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Footage	Interval	Description
106'0 $\frac{1}{2}$ " - 106'4"	0'3 $\frac{1}{2}$ "	<u>Coaly black shale</u> , glossy-bright conchoidal lenses; partly fragmented; fragments of coal to $\frac{1}{2}$ ".
106'4" - 106'8 $\frac{1}{2}$ "	0'4 $\frac{1}{2}$ "	<u>Shale</u> , dark; blocky fracture pattern; plant remains; partings irregular.
106'8 $\frac{1}{2}$ " - 107'0"	0'3 $\frac{1}{2}$ "	<u>Lost core</u> .
107'0" - 107'6"	0'6"	<u>Shale</u> , dark (as in 106'4" - 106'8 $\frac{1}{2}$ "); lower contact at 75° to core axis. 107'5 $\frac{1}{2}$ " - fracture at 42° to core axis.
107'6" - 109'2"	1'8"	<u>Black shale</u> , variably coaly, and with plant remains locally. 107'6"-107'7 $\frac{1}{2}$ " - some coal lenses; partly broken core. 107'7 $\frac{1}{2}$ "-107'11" - coaly; much coal finely interbedded with shale. 107'11"-109'2" - fewer coal lenses and layers, of about 1/16".
109'2" - 109'3"	0'1"	<u>Coaly black shale</u> ; coal lenses and layers, shale between; plant remains.
109'3" - 109'4"	0'1"	<u>Coal</u> , shaly.
109'4" - 109'6"	0'2"	<u>Coal</u> , locally shaly; mainly dull coal with brighter bands at 78° to core axis; fractured at 2°-3° to core axis.
109'6" - 110'0"	0'6"	<u>Coal</u> , mixed bright and dull, banded at 80° to core axis. <u>Sample 188</u> 109'3" - 110'0" 0'9"
110'0" - 112'8"	2'8"	<u>Lost core</u> ; densilog and neutron log indicate mainly coal. (Drill pump and hydraulic system broke down).

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Footage	Interval	Description
112'8" - 113'4"	0'8"	<u>Coaly black shale</u> ; coal lenses up to 1/16"; intact core.
113'4" - 113'11"	0'7"	<u>Black shale</u> , coal and plant remains locally. 113'10"-113'11" - white veinlets at 80° to core axis.
113'11" - 115'3½"	1'4½"	<u>Shale</u> , dark-grey, with blocky fracture network.
115'3½" - 117'11"	2'7½"	<u>Shale</u> , silty, dark-grey to brown; lighter-colored, siltier bands at 80° to core axis locally; blocky fracture network locally. 116'0"-116'4" - banded at 80° to core axis.
117'11" - 125'3"	7'4"	<u>Shale</u> , dark, locally a little silty; blocky fracture network common; minor coal lenses locally; plant remains; partings at 78° to core axis. 120'5" - large pyrite mass. 124'4"-124'4½" - two coal lenses (1/16" and ¼"). 124'5½"-125'3" - contact zone; silty, with blocky fracture network.
125'3" - 127'6"	2'3"	<u>Sandstone</u> , fine-grained. 126'0"-126'4" - massive sandstone, shalier uphole. 126'4"-127'6" - weakly banded at 65°-75° to core axis, locally distorted; lighter colored sandier beds and narrower, darker, shalier beds.
127'6" - 131'2"	3'8"	<u>Shale</u> , dark-grey, with blocky fracture network absent in local lighter brown siltier sections. 127'7"-128'2½" - more silty. 129'11"-130'2½" - more silty. 130'5"-130'9" - several coal lenses at different angles.

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Footage	Interval	Description
131'2" - 134'4"	3'2"	<u>Shale</u> , silty, brownish-grey; banded locally at 80° to core axis. 131'2"-132'0" - traces of blocky fracture network. 131'5"-131'9" - weakly banded with siltier, lighter colored bands at 80°-85° to core axis.
134'4" - 136'4"	2'0"	<u>Siltstone-shale</u> , interbedded at 80°-85° to core axis. 134'4"-134'11" - siltstone bands predominant. 134'11"-136'4" - shale predominates; siltstone occurs as irregular bands and lenses at 85° to core axis.
136'4" - 136'9½"	0'5½"	<u>Shale</u> , silty, dark brown, homogeneous, fine-grained.
136'9½" - 137'0"	0'2½"	<u>Lost core</u> .
137'0"		<u>End of DDH #5</u>

Note:

Water level at 46 feet.

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		<u>Lost Core</u>		<u>From drill run</u>
10'1" - 10'10 $\frac{1}{2}$ "	0'9 $\frac{1}{2}$ "	Lost core	"	10'0" - 12'0"
12'9 $\frac{1}{2}$ " - 17'0"	4'2 $\frac{1}{2}$ "	" "	"	12'0" - 17'0"
27'2" - 28'0"	0'10"	" "	"	20'0" - 28'0"
33'10" - 34'0"	0'2"	" "	"	28'0" - 34'0"
55'2" - 56'0"	0'10"	" "	"	48'0" - 56'0"
87'6 $\frac{1}{2}$ " - 88'0"	0'5 $\frac{1}{2}$ "	" "	"	85'3" - 88'0"
96'3" - 97'0"	0'9"	" "	"	88'0" - 97'0"
106'8 $\frac{1}{2}$ " - 107'0"	0'3 $\frac{1}{2}$ "	" "	"	97'0" - 107'0"
110'0" - 112'8"	2'8"	" "	"	107'0" - 117'0"
136'9 $\frac{1}{2}$ " - 137'0"	0'2 $\frac{1}{2}$ "	" "	"	127'0" - 137'0"
	<u>11'2$\frac{1}{2}$"</u>			

Core Recovery = 91%

DRILL LOGS

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Property: Peace River Canyon Properties
 Location: 1560' S, 550' W of the NE
 corner of Lot 1060

Azimuth: - Depth: 137'
 Dip: -90° Core recovered: 92%
 Core: NQ Casing: NW, 290' left in

Started: August 25, 1973
 Finished: September 18, 1973
 (abandoned)
 Drilled by: Shepherd Enterprises Ltd.
 Logged by: G.A. Checklin

Purpose: To test coal seams including the Little Mogul and Mogul in the Gething
 Formation below the Trojan Seam.

Footage	Interval	Description
0'0" - 294'0"	294'0"	<u>Overburden</u> ; triconed depth 294'; casing 290'.
294'0" - 294'11"	0'11"	<u>Lost core</u> ; probably not coal; some pieces of cave in this section.
294'11" - 295'5"	0'6"	<u>Shale</u> , soft, dark-grey, very fine grained; not Moosebar type; parting at 70° to core axis (may not be bedding plane); some fragments included.
295'5" - 297'2½"	1'9½"	<u>Coal</u> , intact core, banded at 80° to core axis, with one fracture system parallel to core, another across this approximately at right angles; partly dull (plant structures) and partly steely-bright; minor glossy-bright coal; local pyrite. 296'10" - fracture at 10° to core axis. 296'3½" - plant remains in parting at about 75° to core axis. 296'10"-297'2½" - strong fractures at 20° to core axis: two parallel to each other, and one cross-cutting.
	<u>Sample 191</u>	295'5" - 297'2½" 1'9½"

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Footage	Interval	Description
297'2½" - 299'4"	2'1½"	<p><u>Shale</u>, calcareous; soft; pale purple-grey; fine-grained, with patches of agate-like banded material; rock cut by numerous small calcite veinlets, generally irregular, with widths variable, trending at 75°-85° to core axis; minor coal or carbonaceous material locally, along fractures and partings, with pyrite scale.</p> <p>297'6" - start of irregular fracture at 10° to core axis.</p>
299'4" - 299'5½"	0'1½"	<p><u>Coaly shale</u>, upper contact gradational from calcareous shale above; lower contact with coal at 77° to core axis.</p> <p><u>Sample 192</u> 297'2½" - 299'5½" 2'3"</p>
299'5½" - 300'0"	0'6½"	<p><u>Coal</u>, mixed dull with plant structures and steely-bright with some glossy-bright; local pyrite, mostly in fractures or partings at 78° to core axis; intersecting fractures at 20° and 10° to core axis. The drill blocked at 300', evidently at a shale contact.</p> <p><u>Sample 193</u> 299'5½" - 300'0" 0'6½"</p>
300'0" - 300'3"	0'3"	<p><u>Black shale</u>, carbonaceous, with local "ribbing" as of plant structures, along with pyrite; minor coal locally in thin plates.</p> <p><u>Sample 194</u> 300'0" - 300'3" 0'3"</p>
300'3" - 300'10½"	0'7½"	<p><u>Coal</u>, intact core generally, mainly steely-bright with minor glossy-bright and some dull; local glossy-bright bands at 70° to core axis. Uphole section has strong parallel fractures at 25° to core axis; second fracture direction at 35° to the core axis, approximately normal to the 25° direction.</p> <p>300'6" - fracture at 25° to core axis, with gouge of 1/32".</p> <p>300'7"-300'10½" - some fractures at 10° to core axis.</p> <p>300'9" - plant remains, dull, earthy.</p> <p><u>Sample 195</u> 300'3" - 300'10½" 0'7½"</p>

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Footage	Interval	Description
300'10 $\frac{1}{2}$ " - 301'7"	0'8 $\frac{1}{2}$ "	<u>Black shale</u> , local minor coal, locally carbonaceous; pyrite scale locally; ribbed structures of plant remains locally; partings irregular, about 70° to core axis. <u>Sample 196</u> 300'10 $\frac{1}{2}$ " - 301'7" 0'8 $\frac{1}{2}$ "
301'7" - 302'11"	0'6"	<u>Coal</u> , mainly steely-bright, partly glossy-bright, with a few dull plant remains; locally banded at 80° to the core axis, or a little less; upper contact at 75° to core axis; lower contact at 70° to core axis. <u>Sample 197</u> 301'7" - 302'11" 0'6"
302'1" - 302'6"	0'5"	<u>Black shale</u> , locally coaly (glossy-bright) especially near upper contact; fine-grained.
302'6" - 304'9 $\frac{1}{2}$ "	2'3 $\frac{1}{2}$ "	<u>Shale and siltstone</u> , interbedded black shale and grey siltstone or fine-grained sandstone, locally more shaly or more silty; silty bands pinch and swell, are locally cross-bedded; shaly bands carbonaceous with minor coal, commonly in preferred partings parallel with banding; banding, where regular, at 72° to core axis. 303'11"-304'7" - mainly silty; lenses, pinching and swelling.
304'9 $\frac{1}{2}$ " - 305'0"	0'2 $\frac{1}{2}$ "	<u>Black shale</u> , carbonaceous with minor coal locally.
305'0" - 306'0"	1'0"	<u>Lost core</u> , coal not indicated by densilog.
306'0" - 306'11"	0'1"	<u>Coaly black shale</u> .
306'11" - 306'4 $\frac{1}{2}$ "	0'3 $\frac{1}{2}$ "	<u>Shale</u> , dark, brownish; minor coal locally.
306'4 $\frac{1}{2}$ " - 306'8"	0'3 $\frac{1}{2}$ "	<u>Siltstone and shale</u> ; two siltstone bands with dark shale between.
306'8" - 306'9 $\frac{1}{2}$ "	0'1 $\frac{1}{2}$ "	<u>Shale</u> , dark.
306'9 $\frac{1}{2}$ " - 306'11"	0'1 $\frac{1}{2}$ "	<u>Black shale</u> , carbonaceous; thin layers of coal locally.
306'11" - 307'0"	0'1"	<u>Lost core</u> .

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Footage	Interval	Description
307'0" - 307'11"	0'11"	<p><u>Shale</u>, dark, more silty downhole; small lenses of sandstone locally; specks of coal, more coaly near upper contact; local pyrite, gypsum crystals; irregular fracture.</p> <p>307'6"-307'6½" - zone of fracture or shearing at 75° to core axis; some broken core.</p> <p>307'6½" - parting; plant impressions and minor coal.</p>
307'11" - 310'10½"	2'11½"	<p><u>Siltstone and sandstone</u>, with some shaly bands; soft, with shaly particles in the sandier bands; partly calcareous; banding poorly developed, variable in direction.</p>
310'10½" - 311'4"	0'5½"	<p><u>Shale</u>, dark, fine-grained, homogeneous.</p>
311'4" - 319'3"	7'11"	<p><u>Siltstone or fine-grained sandstone</u>, light-colored; white, grey, buff and dark grains; thin bands of dark fine-grained shale locally; banding where regular at 74° to core axis, but variable (75°-80° to core axis, as near 315'); partings parallel to banding; few fractures.</p> <p>311'7½"-311'11½" - fractures cross banding.</p> <p>311'11" - fracture (3/32") filled with "mud".</p> <p>313'6½"-313'8" - broken core.</p> <p>314'0½" - "mud vein" with broken core.</p> <p>315'4"-316'0" - lost core.</p> <p>316'3½" - "mud vein".</p> <p>317'7"-317'8" - broken core, fracture at 60° to core axis; banding at 70° to core axis.</p>
319'3" - 320'8½"	1'5½"	<p><u>Black shale</u>, carbonaceous, fissile at 68° to core axis, with banding to 320'2"; finely divided sulfides, apparently pyrite; minor coal locally, especially near lower contact.</p>
320'8½" - 320'10"	0'1½"	<p><u>Coal</u>, cannel, with some better-grade bands and lenses.</p>

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Footage	Interval	Description
320'10" - 321'4"	0'6"	<p><u>Coal</u>, mainly steely-bright, with dull lenses and bands at about 68°-70° to core axis; local glossy-bright bands and patches; local sooty material in fractures and partings.</p> <p>320'8½"-320'10" - broken core.</p> <p>320'10"-321'1½" - intact core, with weak fracture at 20°-25° to core axis.</p> <p>321'2½" - fracture at 60° to core axis containing sooty coal.</p>
321'4" - 322'0"	0'8"	<u>Lost core</u> , probably coal, in run from 316' - 322'.
322'0" - 322'2"	0'2"	<u>Lost core</u> , probably coal, in run from 322' - 326'.
322'2" - 323'5½"	1'3½"	<p><u>Coal</u>, steely-bright, with dull patches with faint plant structure; a few glossy-bright, conchoidal bands or lenses; minor pyrite locally.</p> <p>322'2"-322'3½" - broken core, duller, with loose white grains on some faces.</p> <p>322'3½"-323'1" - two fractures at 5°-8° to core axis, both with carbonate veinlets.</p> <p>323'1"-323'5½" - broken core, clean, steely-bright with some glossy.</p> <p><u>Sample 199</u> 322'2" - 323'5½" 1'3½"</p>
323'5½" - 323'7"	0'1½"	<u>Coaly black shale</u> , carbonaceous, with partings of coal, including glossy-bright type; pyrite scale.
323'7" - 323'8½"	0'1½"	<u>Shale</u> , carbonaceous, with minor coal and pyrite.
323'8½" - 331'3"	7'6½"	<p><u>Shale and siltstone</u>, interbedded; shalier above, grading into siltier below and downhole again becoming more shaly; bands at 68°-72° to core axis.</p> <p>326'5"-327'1" - mainly siltstone.</p>

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Footage	Interval	Description
331'3" - 332'10 $\frac{1}{2}$ "	1'7 $\frac{1}{2}$ "	<u>Black shale</u> , with fine light-colored silty bands at 70° to core axis; pyrite. 331'3"-331'9" - lighter colored, silty bands.
332'10 $\frac{1}{2}$ "-341'11"	9'0 $\frac{1}{2}$ "	<u>Shale and siltstone</u> , dark-grey, fine-grained, with local plant remains along partings and fractures; indistinct irregular light-colored bands, at 55°-65° to core axis uphole at 333'6", 70° to core axis at 334'7", 60° to core axis at 337'6", 75° to core axis at 337'7"-337'8 $\frac{1}{2}$ "; towards bottom, little banded but breaks at about 73° to core axis.
341'11" - 346'7 $\frac{1}{2}$ "	4'8 $\frac{1}{2}$ "	<u>Siltstone</u> , with local sandstone; locally carbonaceous and with mica-like crystals; lighter bands with some darker shalier bands, at 70° and 66° to core axis and irregular. 345'6" - banding at 63° to core axis. 346'6" - banding at 67° to core axis.
346'7 $\frac{1}{2}$ " - 352'1 $\frac{1}{2}$ "	5'6"	<u>Sandstone</u> , slightly banded but more massive and homogeneous than before, light-grey, medium-grained, soft, with black shale granules and fragments, and others cream-colored and pale-brown; disseminated pyrite locally. 346'7 $\frac{1}{2}$ "-347'6" - banding at 75° to core axis when regular, but locally cross-bedded; darker bands fine-grained, silty. 352'1 $\frac{1}{2}$ " - banding at 70° to core axis, possibly cross-bedding; but contact at 70° to core axis is in a plane normal to this banding and parallel to adjoining fainter banding.
352'1 $\frac{1}{2}$ " - 355'1"	2'11 $\frac{1}{2}$ "	<u>Shale</u> , interbedded with less siltstone; grading into rock below; banding at 70°-75° to core axis; mainly intact core with some broken. 352'1 $\frac{1}{2}$ "-353'6" - initial bedded section. 353'6"-355'1" - mainly shale, poorly banded section.

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Footage	Interval	Description
355'1" - 358'8"	3'7"	<p><u>Shale</u>, generally dark and homogeneous, but streaky and lighter colored uphole; a few bands at 70° to core axis; darker downhole, with black shale at the bottom.</p> <p>357'6"-358'8" - black shale, with a few thin silty, lighter colored bands at 70° to core axis, cut by several thin calcite veinlets at 50°, 35° and 30° to core axis.</p>
358'8" - 360'4"	1'8"	<p><u>Coal</u>, LITTLE MOGUL SEAM.</p> <p>358'8"-359'1" - coal, generally steely-bright with plane fracture, and some glossy-bright with conchoidal fracture; considerable pyrite locally, granular; some calcite veining at 30° to core axis; coal tends to be granular near bottom.</p> <p>359'1"-359'2" - parting of coaly siltstone; disseminated pyrite, mostly in coal bands at 80° to core axis.</p> <p>359'2"-359'4" - coal, granular, including glossy-bright conchoidal as well as steely-bright; intact core.</p> <p>359'4"-360'0" - coal, banded at 70° to core axis, including mainly steely-bright, some glossy-bright conchoidal and bands of dull; pyrite common, some thin calcite veinlets; intact core.</p> <p>360'0"-360'2½" - coal, broken, mainly dull, but some steely-bright material and some glossy-bright conchoidal.</p> <p>360'2½"-360'4" - coal, mainly banded at 70° to core axis, mostly dull; pyrite; fracture parallel to core axis; intact core.</p> <p>360'4" -¼" band of glossy-bright conchoidal coal.</p> <p><u>Sample 200</u> 358'8" - 360'4" 1'8"</p>

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Footage	Interval	Description
360'4" - 360'8½"	0'4½"	<u>Coaly black shale</u> , with a thin band of silty material at 72° to core axis; coal in lenses, streaks, patches and veinlets here and there, mainly plane-fracturing, but some conchoidally-fracturing glossy-bright; irregular and weak fractures, one at 20° to core axis; preferred parting and some thin layers of coal at 60° to core axis; pyrite common.
360'8½" - 360'10½"	0'2"	<u>Coal</u> , glossy-bright bands alternating with steely-bright bands at 72° to core axis; fractured strongly at 20° to core axis; some dull coal with plant remains; pyrite scale common in fracture faces and band contacts.
360'10½" - 360'11"	0'0½"	<u>Coaly black shale</u> , thin bands of glossy-bright coal separated by shale; plant structures locally; core partly broken.
360'11" - 362'0"	1'1"	<u>Lost core</u> , in the run from 355'1" - 362'; probably shale.
362'0" - 366'8½"	4'8½"	<u>Black shale</u> , homogeneous; with an irregular (conchoidal) fracture at 80° to core axis; minor coal with thin layers of coal locally giving preferred parting; carbonaceous material. 363'7" - thin coal layer and plant structures. 363'9"-364'4" - several partings at 60° to core axis, more or less parallel. 364'2½" - bifurcated coal lens. 364'10" - thin band of dull coal with rectangular fracture. 365'0"-366'2" - several partings at 68°-72° to core axis, and irregular. 366'4½" - coal lens, glossy black, conchoidal.
366'8½" - 369'6"	2'9½"	<u>Coal</u> , MOGUL SEAM, mainly intact core, some broken, and slack at the end.

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Footage	Interval	Description
	366'8½" - 366'10"	- coal, banded at 75° to core axis; mainly steely-bright, clean, breaking with plane faces; bands of glossy-bright coal; broken into roughly rectangular pieces; calcite vein.
	366'10" - 367'1"	- coal, similar to previous; intact core; banding at 73° to core axis; main fracture at 13° to core axis.
	367'1" - 367'3"	- coal, same as previous; broken core; dull bands at 85° and other bands at 70° to core axis; fractures at 50°-53° to core axis and minor fractures at about 15° to core axis between them.
	367'3" - 368'5"	- coal; faint bands at 78° to core axis with other bands slightly different; generally duller than previous coal, but with some steely-bright, glossy-bright conchoidal and sooty; fibrous plant structures; local pyrite nodules; intact core.
	367'3"	- fracture at 53° to core axis.
	367'5"	- fracture at 45° to core axis.
	368'0" - 368'5"	- two strong fractures at 22° and 15° to core axis respectively.
	368'5" - 368'6"	- coal, similar to previous; glossy-bright bands at 78° or so to core axis; pyrite nodules; broken core.
	368'6" - 369'4"	- coal, variously steely-bright, conchoidal, dull conchoidal, dull with fibrous plant structures, or sooty; banded at 80° to core axis; rounded pyrite grains or scales; intact core.
	368'11"	- strong fracture at 30° to core axis, across banding at 75° to core axis.
	369'0" - 369'2½"	- two bands of glossy-bright coal with parallel platy and conchoidal fracture.
	369'4" - 369'6"	- coal slack, containing all types of coal.
Sample 603	366'8½" - 369'6"	2'9½"

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Footage	Interval	Description
369'6" - 369'7"	0'1"	<u>Siltstone</u> , dark-brown, interbedded with coal; coal at both contacts. <u>Sample 616</u> 369'6" - 369'7" 0'1"
369'7" - 371'0"	1'5"	<u>Lost core</u> in the run from 362' - 371'; densilog indicates coal; probably part of Mogul Seam.
371'0" - 372'4"	1'4"	<u>Coal</u> , mainly cannel, fine-grained, light in weight, with matte surfaces in breaks; better grade and sooty bands; core partly broken. 371'0"-371'3½" - cannel, steely-bright but matte; bluish tinge, conchoidal breakage; streaks of glossy-bright coal; banded locally at 75° to core axis; fractures at 5° to core axis; pyrite traces; broken core. 371'3½"-371'6¼" - thin bands of dull coal at 79° and 75° to core axis; fractured at 15° to core axis; intact core. 371'6¼"-371'9" - weakly banded, fractured at 20° to core axis with plane surface; conchoidal "twist-effect" on broken surface; core partly intact. 371'9"-371'11½" - similar to above; faint banding at 77° to core axis; local ribbed plant tissue structure; two pieces of broken core. 371'11½"-372'1½" - similar, broken core; calcite veinlet with pyrite. 372'1½"-372'2¾" - intact core; parting at 72° to core axis, fractured at 20° to core axis. 372'2¾"-372'4" - broken core, similar to previous. <u>Sample 609</u> 371'0" - 372'4" 1'4"
372'4" - 372'7½"	0'3½"	<u>Lost core</u> , probably coal.

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Footage	Interval	Description
372'7½" - 373'11"	1'3½"	<u>Black shale</u> , carbonaceous, plant remains locally; preferred partings at 75° to core axis; pyrite. From 373'4" - gradational to rock below.
373'11" - 377'4"	3'5"	<u>Siltstone and shale</u> - predominantly siltstone, minor interbedded shale; irregular distorted banding.
377'4" - 396'5"	19'1"	<u>Siltstone</u> , fine-grained, but variable, light-colored; carbonaceous or shaly or coaly partings; regular banding at 77°-70° to core axis; cross-bedding.
396'5" - 399'9½"	3'4½"	<u>Shale</u> , dark, fine-grained; gypsum-like crystals; minor siltstone bands and partings at 70° and 65° to core axis; darker downhole, bands at 68° to core axis.
399'9½" - 400'4½"	0'7"	<u>Coal</u> , mainly steely-bright, with glossy-bright conchoidal streaks and bands at 70°-75° to core axis; dull coal locally, faint plant tissue structure; irregular fine fractures with grey filling. 399'11" - thin sandstone parting at 65° to core axis.
400'4½" - 400'9"	0'4½"	<u>Coal and sandstone</u> , interbedded; coal predominant uphole at 75° to core axis, sandstone downhole at 85° to core axis. 400'4½"-400'6¾" - mainly coal, banded at 75° to core axis; sandy particles. 400'6¾"-400'8½" - mainly sandstone, initially banded at 85° to core axis; minor coal. 400'8½"-400'9" - glossy-bright coal band at 75°; dull coal parting.
400'9" - 401'6"	0'9"	<u>Black shale</u> , coaly near upper contact; carbonaceous locally; minor silty partings; pyrite scale; gypsum crystals.
401'6" - 405'7"	4'1"	<u>Shale</u> , dark; fine silty bands at 75° to core axis uphole; preferred partings at 73° to core axis downhole; pyrite; darker near bottom; light-weight, cancell-like fragments at base.

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Footage	Interval	Description
		405'2½" - fracture at 3° to core axis; finely divided pyrite.
405'7" - 406'0"	0'5"	<u>Lost core</u> in run 396' - 406'; densilog indicates coal.
406'0" - 406'1"	0'1"	<u>Coal</u> , bands of glossy-bright conchoidal; minor partings of fine-grained sandstone.
406'1" - 406'1½"	0'0½"	<u>Coal</u> , cannel fragments; conchoidal surfaces; light weight.
406'1½" - 406'2½"	0'1"	<u>Coaly shale</u> , glossy-bright coal partings and streaks.
406'2½" - 407'2½"	1'0"	<u>Black shale</u> , fine-grained; coal and pyrite in preferred partings at 75°-77° to core axis. 406'9½" - plant remains in parting. 407'0"-407'2½" - carbonaceous shale; coal locally.
407'2½" - 407'9"	0'6½"	<u>Shale</u> , dark, with sandy and silty material.
407'9" - 410'4"	2'7"	<u>Sandstone and siltstone</u> ; interbedded; fine shaly partings, with coal traces; banding at 68° and irregular; cross-bedding; breakage direction and bottom contact at 75° to core axis.
410'4" - 411'4"	1'0"	<u>Shale</u> , dark; silty bands at 75° to core axis; variable.
411'4" - 411'9"	0'5"	<u>Shale</u> , dark, very fine grained, more homogeneous than above; partings at 75° to core axis.
411'9" - 412'2½"	0'5½"	<u>Coal</u> , cannel, banded at 77° to core axis; fracture at 7° to core axis.
412'2½" - 413'10"	1'7½"	<u>Shale</u> , dark, banded at 75° to core axis with narrow silty bands.
413'10" - 415'8"	1'10"	<u>Lost core</u> in run from 406' - 416'.

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Footage	Interval	Description
415'8" - 416'7½"	0'11½"	<u>Black shale</u> , fine-grained, brown streaks, gypsum crystals; partings, minor silty bands at 75° to core axis.
416'7½" - 418'4½"	1'9"	<u>Coal</u> , with minor partings. 416'7½"-417'4" - coal, mainly steely-bright, with minor glossy-bright, duller, and metallic-bright granular bands at 75°-77° to core axis; pyrite locally; main fracture parallel to core. <u>Sample 604</u> 416'7½" - 417'4" 0'8½" 417'4"-417'7½" - parting, brown sandstone with finer mineral matter in it; with specks and patches and irregular, impure bands of coal at 75° to core axis; pyrite scale. 417'4"-417'4½" - contact phase of coal and sandstone; isolated mineral grains in network of coal; tree growth rings in glossy-bright coal; fracture at 75° to core axis, with inert white scale. 417'7½"-418'3½" - coal, mainly steely-bright and dull coal with plant tissue structures, partly glossy-bright conchoidal, banded at 73°-77° to core axis; ground core locally. <u>Sample 606</u> 417'7½" - 418'3½" 0'8" 418'3½"-418'4" - black shale, slightly carbonaceous, with thin glossy-bright conchoidal band. 418'4"-418'4½" - coal fragments, ground and shattered core remains; glossy-bright, steely-bright banded, rectangular fragments, minor shale.
418'4½" - 420'5"	2'0½"	<u>Lost core</u> , coal indicated by densilog.
420'5" - 422'0"	1'7"	<u>Lost core</u> , probably not coal.
422'0" - 423'5"	1'5"	<u>Shale</u> , dark, carbonaceous, with minor coal layers and lenses; plant remains locally; irregular partings at 75° and 60° to core axis. 423'0"-423'5" - fragmented and shattered core.

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Footage	Interval	Description
423'5" - 424'2½"	0'9½"	<u>Sandstone</u> , shaly; light-grey, variably finer and coarser grained; dark shale bands with plant remains locally; carbonaceous and with coal traces locally; no regular banding, but some at 60° and 75° to core axis.
424'2½" - 429'2"	4'11½"	<u>Shale</u> , dark-grey, fine-grained, massive; gypsum crystals; fine fractures at 76°-78° to core axis; banding locally. 425'3½" - thin band at 68° to core axis. 425'7" - thin band at 73° to core axis. 426'0" - carbonaceous fracture at 73° with pyrite scale; minor coal bands nearby. 426'10"-427'5" - silty bands at 63° to core axis and irregular patches. 427'0" - rounded structures of light-colored shale. 428'6" - preferred parting, curved. 428'10"-429'2" - contact zone of irregular light-grey silty bands at 60° to core axis interbedded with dark-grey shale.
429'2" - 432'4"	3'2"	<u>Siltstone</u> , light or dark depending on shale content; shiny blue-black carbonaceous or thin shale partings, with gypsum-like crystals; more shaly near bottom contact; banding at 68° to core axis, variable. 430'4" - weak fracture at 38° to core axis, across banding at 68° to core axis. 430'10½" - dark scale, plant remains. 431'11½" - plant tissue structures. From 432' - more shaly downhole.
432'4" - 435'0"	2'8"	<u>Shale</u> , dark-grey, fine-grained, with gypsum crystals; and minor lighter colored siltier lenses and bands at 67°-68° to core axis.

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Footage	Interval	Description
		434'0"-435'0" - black shale, almost massive, with preferred parting at 70° to core axis. 434'0" - fracture at 23° to core axis, across banding. 435'0" - contact at 70° to core axis.
435'0" - 436'9½"	1'9½"	<u>Sandstone and siltstone</u> , with some shaly material. 435'0"-436'0" - sandstone, dark-grey, fine-grained, impure; faint banding at 70° to core axis; locally carbonaceous. 436'0"-436'9½" - siltstone, well banded at 70° to core axis; carbonaceous partings; coal and plant remains locally. 436'3" - thin lens of coal; plant remains. 436'6" - carbonaceous scale in preferred parting.
436'9½" - 439'3½"	2'6"	<u>Shale</u> , dark-brown, (light-brown streak), fine-grained, homogeneous; fine partings at 70°, 74°, 76° to core axis; gypsum crystals; coal traces locally. 438'9½" - fracture changing angle from 30° to 50° to core axis, with pyrite scale. 439'0" - parting at 77° to core axis.
439'3½" - 439'4"	0'0½"	<u>Coal</u> , band at 72° to core axis, mainly glossy-bright conchoidal; minor dull coal with plant tissue structures.
439'4" - 439'11"	0'7"	<u>Coal</u> , cannel, conchoidal fracture, matte surface, light weight; minor bands of better grade coal at 70° to core axis; hairline silt layers locally. 439'5" - wavy fracture at 15°-30° to core axis. 439'9¾"-439'11" - more coaly cannel, banded at 75° to core axis.
439'11" - 440'0½"	0'1½"	<u>Coaly black shale</u> ; coal bands and lenses at 75°-80° to core axis.

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Footage	Interval	Description
440'0 $\frac{1}{2}$ " - 440'1"	0'0 $\frac{1}{2}$ "	<u>Coal</u> , fragments; steely-bright, finely banded at 70° to core axis.
440'1" - 441'2"	1'1"	<u>Lost core</u> ; gamma ray neutron log indicates coal.
441'2" - 441'6 $\frac{1}{2}$ "	0'4 $\frac{1}{2}$ "	<u>Contact zone</u> ; dark shale above; fine-grained sandstones below, fractured at 78° to core axis; fractures not always continuous into shale.
441'6 $\frac{1}{2}$ " - 448'1 $\frac{1}{2}$ "	6'7"	<u>Sandstone series</u> - variable; grains irregular, partly indistinct; numerous black grains as essential constituent even in clean lighter colored material; mica-like crystals locally. 441'6 $\frac{1}{2}$ "-443'10" - mainly finer grained, darker, due both to thin shale bands at mainly 70°, locally distorted, and to greater proportion of shale in sandstone beds; minor coal locally, especially in or near shale. 443'10"-445'5" - medium-grained; banding, due to variable argillaceous content, regular at 75° - 80° to core axis, but locally distorted; local thin shaly partings; minor coal locally. 445'5"-448'1 $\frac{1}{2}$ " - massive sandstone; traces of banding, locally more definite. 446'8"-447'1" - banded section, more shaly; shale band at 447'0 $\frac{1}{2}$ ".
448'1 $\frac{1}{2}$ " - 448'5"	0'3 $\frac{1}{2}$ "	<u>Shale</u> , dark-grey, (brown streak), calcareous; with minor siltstone bands at 70° to core axis.
448'5" - 450'11 $\frac{1}{2}$ "	2'6 $\frac{1}{2}$ "	<u>Sandstone series</u> , much as before. 448'5"-450'1" - massive, but faintly banded at 67° to core axis, locally carbonaceous. 448'7" - plant remains. 450'1"-450'11 $\frac{1}{2}$ " - banding variable, at 60°, 65°, 70° to core axis, and locally distorted.

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Footage	Interval	Description
450'11½" - 456'9"	5'9½"	<p><u>Shale</u></p> <p>450'11½"-454'5½" - dark shales, lesser siltstones; banded at 70°, then 67°, then 70°, to core axis.</p> <p>450'11½"-451'4½" - silty shale, dark-brown, with lighter colored, more silty bands.</p> <p>452'5½"-452'10" - more silty material.</p> <p>454'5½"-456'9" - shale, more massive, with partings at 70°; minor, more silty bands at 65°-70° to core axis.</p> <p>456'6" - fracture at 60° to core axis with thin calcite veinlet.</p>
456'9" - 457'6"	0'9"	<p><u>Coaly black shale; variable, generally thin bands or lenses of coal, often glossy-bright conchoidal.</u></p> <p>456'9"-456'9½" - interbedded medium-bright coal with rectangular fracture and thin shale layers, at 70° to core axis.</p> <p>456'9½"-456'10½" - coaly shale; lenses of glossy-bright conchoidal coal with partings of dull coal.</p> <p>456'10½"-456'11½" - mainly dull coal; some bright and glossy-bright.</p> <p>456'11½"-457'0½" - black shale, carbonaceous; little coal.</p> <p>457'2"-457'2½" - coal band at 80° to core axis, partly bright, with rectangular fracture.</p> <p>457'2½"-457'3¼" - shale remnant.</p> <p>457'3¼"-457'4" - ¾" band of coal, fragments.</p> <p>457'4"-457'4½" - coaly shale.</p> <p>457'4½"-457'6" - coal, mainly medium bright, with lesser glossy-bright conchoidal; fracture system at 30° to core axis; banding at 75°-77° to core axis.</p>

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Footage	Interval	Description
457'6" - 457'11½"	0'5½"	<p><u>Coaly shale</u>, brown, silty; glossy-bright conchoidal and bright coal lenses and bands at 65° to core axis; considerable pyrite locally.</p> <p>457'6½"-457'8" - pyrite in breccia-like rock.</p> <p>457'10" - pyrite.</p> <p>457'10"-457'11½" - medium-bright coal, some shale, banded at 70° to core axis; faint fractures at 30° to core axis.</p>
457'11½" - 458'6½"	0'7"	<u>Lost core</u> ; neutron log indicates coal.
458'6½" - 458'8½"	0'2"	<u>Coal</u> , alternating dull and bright with lesser glossy-bright coal; finely banded at 70° to core axis; minor silty shale with fine coal lenses; mainly fragments, some intact core.
458'8½" - 459'5"	0'8½"	<p><u>Shale</u>, silty, dark-brown, fine-grained, coaly uphole.</p> <p>458'8½"-459'1" - main section with narrow coal lenses and bands at 67° to core axis.</p> <p>459'2½" - carbonaceous plant remains.</p>
459'5" - 472'7½"	13'2½"	<p><u>Siltstone</u>, light-colored with fine shaly partings; initially darker, and locally darker depending on content of shale; weakly banded at 70° to core axis, with local distortion; little interstitial argillaceous material, and dark and light bands differ only slightly from each other in composition; locally carbonaceous; traces of coal.</p> <p>459'5"-461'7" - initial darker section, gradational from shale section above.</p> <p>468'0"-470'3" - darker, more shaly; stronger shale banding.</p> <p>470'8"-470'10" - unusual tear in rock.</p>

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Footage	Interval	Description
472'7½" - 478'5½"	5'10"	<u>Siltstone and shale</u> , interbedded; siltstone predominant; strongly banded at 70° to core axis, some irregular, and shale partly lens-like; carbon patches locally; trace plant tissue structures. 476'11½"-478'5½" - stronger, closer, darker, shaly bands.
478'5½" - 481'10"	3'4½"	<u>Shale</u> , silty, dark-brown, many partly irregular, siltier lenses, streaks and bands at about 70°-75° to core axis, variable. 480'9½"-481'1" - lighter more silty band.
481'10" - 483'4½"	1'6½"	<u>Shale</u> , dark-brown, light-brown streak; darker downhole, nearly black at lower contact; more homogeneous than above, with a few silty bands at 70° to core axis; blue-black partings at 65°-70° to core axis.
483'4½" - 483'5"	0'0½"	<u>Coaly shale</u> , glossy-bright conchoidal bands, one at lower contact.
483'5" - 485'0"	1'7"	<u>Lost core</u> ; gamma ray neutron log indicates coal.
485'0" - 486'3½"	1'3½"	<u>Coal</u> . 485'0"-485'3" - broken core, mixed glossy-bright and steely-bright; mainly faintly banded at 65° to core axis; fragments elongated rectangular, with plane and conchoidal faces; minor coaly shale. 485'3"-486'1" - coal, mainly steely-bright, with bands at 74°-76° to core axis of glossy-bright conchoidal and lesser dull coal; core fractures parallel to banding; two other fracture systems at 8° and 20° to core axis, normal to each other, but not seen together; intact core. 485'3"-485'9" - fracture system at 8° to core axis. 485'3½"-485'4" - ½" band of coaly shale. 485'9"-486'1" - fracture system at 20° to core axis.

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Footage	Interval	Description
		486'1"-486'2" - broken core, including banded coal, with glossy-bright conchoidal; mixed steely-bright and dull, dark-brown coaly shale.
		486'2"-486'3" - steely-bright banded coal; intact core.
		486'3"-486'3½" - shaly coal; alternating bands of glossy-bright conchoidal coal and fine-grained, dull, shale and coal mixed.
		<u>Sample 610</u> 485'0" - 486'3½" 1'3½"
486'3½" - 486'5"	0'1½"	<u>Coaly shale</u> , brown; upper contact a coal band at 73° to core axis; lower contact a carbonaceous parting at 63° to core axis.
486'5" - 487'9"	1'4"	<u>Siltstone</u> , darker and more shaly near downhole contact; irregular shale partings at 65°-70° to core axis; minor coal lenses and patches locally.
487'9" - 488'5½"	0'8½"	<u>Shale</u> , silty, gradational from siltstone above; darker towards downhole contact. 488'5½" - narrow coal lenses.
		<u>Sample 611</u> 486'3½" - 488'5½" 2'2"
488'5½" - 489'0½"	0'7"	<u>Coal</u> . 488'5½"-488'6½" - broken core, mainly bright coal with glossy-bright conchoidal and dull coal bands at 72°. 488'6½" - ¼" parting of siltstone and coal at 70° to core axis; pyrite. 488'6½"-488'7" - band of steely-bright rectangular coal with some glossy-bright conchoidal at 70° to core axis; fine shale partings. 488'7"-489'0½" - banded glossy-bright conchoidal, bright and dull coals, fracturing at 17° to core axis, and across banding at 72° to core axis. 488'10" - thin partings.
		<u>Sample 612</u> 488'5½" - 489'0½" 0'7"

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Footage	Interval	Description
489'0 $\frac{1}{2}$ " - 490'0"	0'11 $\frac{1}{2}$ "	<u>Lost core</u> ; gamma ray neutron log indicates coal.
490'0" - 490'1"	0'1"	<u>Coaly shale</u> , dark-grey shale; thin bands and lenses of coal.
490'1" - 490'4"	0'3"	<u>Shale</u> , dark, gradational from above; minor coal.
490'4" - 490'7"	0'3"	<u>Coal</u> , mainly bright rectangular with glossy conchoidal bands; duller coal locally, especially near uphole and downhole contacts; fracture system at 23 $^{\circ}$ to core axis; core partly broken.
490'7" - 490'8 $\frac{1}{2}$ "	0'1 $\frac{1}{2}$ "	<u>Shale</u> , dark; several coal lenses, one at 80 $^{\circ}$ to core axis.
490'8 $\frac{1}{2}$ " - 497'4"	6'7 $\frac{1}{2}$ "	<u>Sandstone</u> , light-colored; mainly felsic, some black granules; many darker layers and fine shaly partings at 70 $^{\circ}$ to core axis. 490'11 $\frac{1}{2}$ "-491'2" - darker, more shaly. 496'8"-496'11 $\frac{1}{2}$ " - brown shale and siltstone, curved bands about 70 $^{\circ}$ to core axis.
497'4" - 500'8"	3'4"	<u>Sandstone-siltstone-shale series</u> ; interbedded partly cross-bedded sandstones, siltstones and more regular shale bands at 70 $^{\circ}$ to core axis; some variation between 65 $^{\circ}$ - 75 $^{\circ}$ to core axis. 499'10 $\frac{1}{2}$ "-500'8" - radiating white lines, not fractures but drilling scratches. 500'6 $\frac{1}{2}$ "-500'8" - sandstone, fine-grained; with pyrite blebs in band at 80 $^{\circ}$ to core axis; fracture at 15 $^{\circ}$ to core axis, pyrite.
500'8" - 501'11"	1'3"	<u>Coal</u> , intact core; one main fracture at 5 $^{\circ}$ to core axis through whole section. 500'8" - thin coaly shale. 500'8"-500'8 $\frac{1}{2}$ " - broken core; coaly shale and cannel coal.

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Footage	Interval	Description
		500'8½"-500'10½" - cannel coal and dull coal, mixed, with bands of bright and glossy-bright conchoidal coal.
		500'8½" - narrow band of bright coal, rectangular fracture.
		500'9½" - band of glossy-bright conchoidal coal, irregular shape.
		500'10½"-501'9" - mainly medium-bright with bands of dull coal; several bands of glossy-bright conchoidal at 75° to core axis.
		501'9"-501'11" - good bright rectangularly-fracturing coal, thin bands of glossy-bright conchoidal.
		501'11" - finely banded bright and dull coal.
		<u>Sample 614</u> 500'8" - 501'11" 1'3"
501'11" - 503'8½"	1'9½"	<u>Black shale</u> , coaly at top; plant remains; partings at 70° to core axis; friable.
503'8½" - 503'9½"	0'1"	<u>"Mud Seam"</u> , fracture with light-grey clay with irregular platy shale fragments.
503'9½" - 505'3"	1'5½"	<u>Shale</u> , dark-brown, locally silty; plant remains locally; local coal traces. 503'9½" - parting with smooth carbonaceous scale. 504'3" - plant remains in break at 65° to core axis. 504'6" - thin band of glossy-bright conchoidal coal at 75° to core axis with remnants of another just downhole.
505'3" - 505'7"	0'4"	<u>Siltstone</u> , shaly, dark-brown, fine-grained; traces of coal; tough.
505'7"		<u>End of Hole.</u>

Note:

Water level at 12 feet.

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	<u>Lost Core</u>		<u>From drill run</u>
294' 0" - 294' 11"	0' 11"	Lost core	294' 0" - 300' 0"
305' 0" - 306' 0"	1' 0"	" "	300' 0" - 306' 0"
306' 11" - 307' 0"	0' 1"	" "	306' 0" - 307' 0"
315' 4" - 316' 0"	0' 8"	" "	307' 0" - 316' 0"
321' 4" - 322' 0"	0' 8"	" "	316' 0" - 322' 0"
322' 0" - 322' 2"	0' 2"	" "	322' 0" - 326' 0"
360' 11" - 362' 0"	1' 1"	" "	355' 1" - 362' 0"
369' 7" - 371' 0"	1' 5"	" "	362' 0" - 371' 0"
372' 4" - 372' 7½"	0' 3½"	" "	371' 0" - 376' 0"
405' 7" - 406' 0"	0' 5"	" "	396' 0" - 406' 0"
413' 10" - 415' 8"	1' 10"	" "	406' 0" - 416' 0"
418' 4½" - 422' 0"	3' 7½" (total)	" "	416' 0" - 426' 0"
440' 1" - 441' 2"	1' 1"	" "	436' 0" - 446' 0"
457' 11½" - 458' 6½"	0' 7"	" "	456' 0" - 466' 0"
483' 5" - 485' 0"	1' 7"	" "	476' 0" - 485' 0"
489' 0½" - 490' 0"	0' 11½"	" "	485' 0" - 490' 0"
	<u>16' 4½"</u>		

Core Recovery = 92%