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PR-NOMAN CREEK 69(1)B

NOMAN CREEK
PINE PASS COAL PROJECT

FENCO LTD.

DEC. 18th/1969

GEOLOGICAL BRANCH
ASSESSMENT REPORT

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PR - NOMAN CREEK 690)B

Noman Creek

Pine Pass Coal Project
CHETWYND B.C.

BRAMEDA RESOURCES LIMITED

FENCO

Foundation of Canada Engineering Corporation Limited

PR- NOMAN CREEK 69(1)B

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BRAMEDA RESOURCES LIMITED

Report on

The Assessment of Application of Mining Methods

for

The Noman Creek Area

of

The Pine Pass Coal Project

near

Chetwynd, British Columbia

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BRAMEDA RESOURCES LIMITED

ASSIGNMENT

Brameda Resources Limited ("Brameda") have requested Foundation of Canada Engineering Corporation Limited ("FENCO") to undertake an assessment of the coal-bearing property known as the Pine Pass Coal Project, Noman Creek Property, using the information which exists at the present time and with particular reference to the feasibility of an underground mining operation.

If the findings indicate that the property warrants the development of an underground operation, then FENCO is to recommend what additional information and expenditure may be required to confirm this opinion.

ASSIGNED FENCO PERSONNEL

W. R. Holden - Manager, Mining and Metallurgy Division
H. S. Haslam - Coal Mining Engineering Consultant to FENCO

EXISTING INFORMATION

This was provided to FENCO by Brameda as follows:

1. A publication by the British Columbia Department of Mines, dated 1955, entitled "Coal Reserves of the Hasler Creek - Pine River Area of British Columbia", by N. D. McKechnie (herein referred to as the McKechnie Report).

2. Various publications of the British Columbia Department of Mines and Petroleum Resources and of the Geological Survey of Canada, which relate to the surrounding areas of the Noman Creek Area, were examined and are listed as follows:

   (a) Geological Survey of Canada - Paper 60-1

   "The Subsurface Gething and Bluesky Formations of north-eastern British Columbia" - D. C. Pugh.

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EXISTING INFORMATION (continued)

(b) Geological Survey of Canada - Paper 60-16

"Cretaceous Rocks between Smokey and Pine Rivers, Rocky Mountain Foothills, Alberta and British Columbia" - D. F. Stott

(c) Geological Survey of Canada - Paper 61-10

"Dawson Creek Map-Area British Columbia" - D. F. Stott

(d) Geological Survey of Canada - Paper 61-11

"Type Sections of Some Formations of the Lower Cretaceous Fort St. John Group near Pine River, British Columbia" - D. F. Stott

(e) British Columbia Department of Mines & Petroleum Resources - Bulletin No. 51-1964

"Jurassic and Cretaceous Strata of the Bullhead Succession in the Peace and Pine River Foothills" - J. E. Hughes

(f) British Columbia Department of Mines & Petroleum Resources - Bulletin No. 52-1967

"Geology of the Pine Valley, Mount Wabi to Solitude Mountain Northeastern British Columbia" - J. E. Hughes

3. Brameda Resources Limited's graphical interpretation of results of the diamond core-drilling programme carried out by Messrs. Connors Drilling Ltd. of Calgary and Vancouver, on behalf of Brameda Resources Limited with the additional information from the McKechnie Report.

4. Information supplied to FENCO by the officials of Brameda Resources Limited during conferences and site inspection visit.

5. Brameda Resources Limited extended the necessary facilities to inspect the property, and FENCO representatives visited the majority of the locations of the diamond drill holes, also an adit driven into one of the seams. Property inspection was made November 20 to 22, 1969.

LOCATION AND ACCESS TO NOMAN CREEK AREA

The area is located north of the Pacific Great Eastern Railway, 640 miles from Vancouver, and 150 miles northeast of Prince George. It is also 100 miles west of Dawson Creek, from where there is connection with the Northern Alberta Railway. The Canadian National Railway connects between Prince George and Prince Rupert.

The property is also served by the John Hart Highway, and both the railway and the highway pass within a few hundred feet of the southern outcrops of the seams in the valley of the Pine River, which can provide sufficient water for process and other uses. The railway and the road allow year-round operation. The proximity of a major transmission line readily affords electric power to the site. The coalfield, which lies on the north side of the Pine River valley between Fisher Creek and Cleveland Creek, extends roughly one-and-one-half miles northwestward from the highway.

Figure 1 is a map which locates the Pine Pass Coal Project Area.

By Order in Council No. 2270, approved on July 15, 1959, the reservation to the Crown of coal was rescinded effective August 18, 1969, in the following described area:

> "Bounded on the south by 55 degrees and 25 minutes of north latitude,
> on the north by 55 degrees 40 minutes of north latitude,
> on the east by 121 degrees 50 minutes of west longitude and
> on the west by 122 degrees 30 minutes of west longitude."

The Pine Pass Coal Company Limited was granted prior right to select and apply for coal licences in this area as illustrated in Figure 2.

The Noman Creek section of the Pine Pass Coal Company Limited's property forms a portion of the above area, lying in its northwest corner, and consisting of ten Coal Licences and one Industrial Licence as illustrated generally in Figure 3. The Noman Creek area is one of three recognized coal bearing areas within the rectangle illustrated in Figure 2 - the other two being known locally as the Hasler Creek coalfield and the Willow Creek coalfield.

This assignment is concerned only within the Noman Creek area.

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BRIEF DESCRIPTION OF THE NOMAN CREEK AREA

McKechnie Report page 5 outlines:

> "The topography is that of the Foothills belt of the Rocky Mountains. The north-easterly trending, mile-wide Pine River valley, at 2000 ft. elevation, cuts across the northwest - southeast trending ridges which rise to 4700 ft. above sea level, and are capped by hard sandstones and conglomerates. The ridges are separated by valleys of creeks which are tributary to the Pine River, and are underlain by the softer sandstones, siltstones and shales."
>
> "Overburden consists of glacial till, which appears to have filled pre-existing valleys, and glacial lake clays, silts, and gravels. . . . . Later erosion cut down through the lake deposits and glacial till to form the present drainage pattern. Poorly drained flat areas underlain by muskegs are common, and constitute something of a hazard to the moving of heavy equipment. The depth of the overburden is commonly between 10 and 20 feet and in places depths are of the order of 75 feet. A few depths of the order of 200 feet were found."

The general terrain may be described as very rough, and it is thickly wooded. The timberline is about 4500 ft. elevation. The explored coal-bearing area extends some 8500 ft. north-westerly from the Pine River.

GENERAL GEOLOGY

From a study of the McKechnie Report and from various publications of the Geological Survey of Canada, it was learned that the Noman Creek strata form part of the Gething formation of the Lower Cretaceous system. McKechnie's description of the Gething formation is quoted below, as it gives a clear indication of the nature of the strata which may be encountered in an underground mining operation.

GENERAL GEOLOGY (continued)

> "The Gething formation (page 7 of Report), to which the Coal Measures are confined, consists of about 3000 ft. of shales, siltstones, sandstones and coal seams. The shales tend to be silty. The sandstones are fine grained, brownish in colour, show very poor porosity and in general are cross-bedded. They are lenticular, range in thickness from a few inches to tens of feet, and can seldom be traced more than a few hundred feet....."
>
> "The Gething formation is exposed in three northwest - southeast trending anticlinal structures. The Pine River anticline, which is the principal one, is on the northeast, and the Noman Creek anticline and the Boulder Creek anticline lie to the southwest of it ....."
>
> "..... The Pine River anticline is cut by three sets of reverse faults, possibly of the same age, and by one normal fault, which is probably younger. The Noman Creek anticline is cut by two reverse faults ....."
>
> "..... The lack of marker beds within the Gething and the fact that fracture zones in soft shales may be inconspicuous suggests that in such closely folded rocks undetected minor faults may exist."

Figure 4 is a reproduction of Figure 12 of the McKechnie Report, and shows the contours of the area, with indications of the outcrops of the seams.

Figure 5 is a reproduction of Figure 13 of the Report, and shows geological sections of the area.

Such a description of an area in which coal is to be mined by modern underground methods forebodes of difficulties in operation so grave as to preclude the existence of a viable mine producing a high daily tonnage. From the sections of the coalfield in Figure 13 of the McKechnie Report (reproduced herein as Figure 5) showing the anticline, plus the adjacent synclinal fold of the strata to the southwest of it, it is found that the width of the ground which contains both these

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GENERAL GEOLOGY (continued)

structures is only 2400 ft. However attractive the respective coals may be from the point of view of their commercially useful qualities, it is apparent that the strata and intervening coal seams are highly folded and faulted, and contain short lengths (in sectional view) of steeply dipping coal seams.

EXPLORATION WORK - McKECHNIE REPORT

In the Noman Creek Area, McKechnie indicates that diamond core drilling southwest of the Noman Fault consisted of six holes, totalling 3961 ft.; and to the northeast of the Noman Fault, ten holes totalling 6045 ft. were drilled. Figure 5 (Figure 13 of the Report) shows six southwest - northeast sections of the strata in this field, and whilst we do not doubt that the named observer (F. K. North) did in fact record the outcrops as found - (in spite of the very rough and thickly wooded terrain), it is not clear that the evidence of outcrop positions for the seams shown, together with the evidence of only six drillholes in a length of field of some 4500 ft. is sufficient to be able to determine with certainty the precise folding pattern and configuration of the strata and the coal seams.

The same argument applies equally well to the area to the northeast of the Noman Fault, particularly when what is described as 'very thick overburden' is noted.

In each area, from the McKechnie Report, the evidence is not sufficiently accurate for the purpose of making recommendations regarding the planning and forecasting of an underground mine.

With these circumstances in mind the Brameda staff decided to carry out a drilling programme to prove, more conclusively and more exactly, the strata and coal seams to the southwest of the Noman Fault.

NOTES FROM McKECHNIE REPORT - RELATING TO THE NOMAN CREEK AREA

Much useful information is gained from McKechnie's description of the geology in the Noman Creek area, and this is partially quoted

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NOTES FROM McKECHNIE REPORT - RELATING TO THE NOMAN CREEK AREA (continued)

below from Pages 15 and 16 of this Report.

"The structure consists of a sharp anticline trending northwest parallel to the Pine River anticline, but with the axial plane dipping to the northeast at about 65 degrees. The fold plunges at 5 to 8 degrees southeastward. ..... the dips on both limbs are variable, and range from nearly flat to more than 60 degrees. The structure is cut by two principal faults termed the Noman Fault and the Eastern Fault. The Noman Fault strikes north 40 degrees west and dips 75 degrees southwestward..... It is a reverse fault with a dip-slip of about 550 ft; the total displacement is not known. The Eastern Fault outcrops North East of the anticlinal axis and is a reverse fault moving the northeast limb some 450 ft. up the dip..... The Noman Fault and the Eastern Fault must either join or cross on surface just northwest of the sharp westward bend of Noman Creek. Their effect has been to form a structural rift valley in the centre of the anticline ....."

"Two major coal seams were disclosed..... Seam 76 ..... and Seam 78. Seam 39, Seam 60 and some negligible seams ..... (were also found) ..... Seam 76 the most important seam in the three areas, has a maximum known thickness of 22 ft. and an average thickness in its main bench of 16 ft. ..... (Near the Noman Fault) ..... the seam consists of three distinct benches separated by partings and totalling as much as 20 ft. thick..... Seam 78 is 75 ft. to 100 ft. stratigraphically above Seam 76. West of the Noman Fault, it has been traced in outcrops on both limbs of the minor syncline, where it appears to be almost as thick and persistent as Seam 76. East of the Fault however, it is nowhere of commercial thickness or grade ....."

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NOTES FROM McKECHNIE REPORT - RELATING TO THE NOMAN CREEK AREA (continued)

On Page 18, we find the following statement:

> "The evidence is not conclusive, but the coal appears to have been formed in local basins, and continuity even of the thickest seams cannot be assumed safely for great distances."

McKECHNIE REPORT - MINING NOTES (PAGE 18 OF REPORT)

McKechnie comments as follows, and the quoted extracts refer to underground mining operations.

> "The mining of coal in this region would be essentially by underground operations ..... The coal is deeply weathered....."

> "The steep dips and prevalent faulting preclude use of many of the mechanized methods and mining systems that lower the per ton costs in flat-seam mines. On the other hand, there may be some advantages in coal handling on steep slopes."

> "The roof conditions are not good. Most of the roof would be soft shale, which could not be expected to stand unsupported over even narrow widths. Fortunately the coal is strong, and the leaving of a strip of coal as roof would go far toward solving this difficulty."

> "No caving or appreciable spalling of the coal in the back of the Hasler Mine entries occurred even after five years."

> "It would be necessary to allow for higher costs than would be expected in flat-seam mines....."

EXPLORATION WORK - BRAMEDA RESOURCES LIMITED

Brameda Resources Limited confined their attention, in the main, to the area to the southwest of the Noman Fault. Seven coalfield section lines were set out each parallel and trending (as did those in the McKechnie Report), in a northeast - southwest direction. These section lines were 1,600 ft., 1,480 ft., 1,950 ft., 2,050 ft., 1,575 ft., and 1,760 ft. apart respectively, whilst McKechnie's sections, six in number, were taken between Brameda's Sections 1 and 4. Figure 6 is reproduced from Brameda Resources Limited Drilling Plan - Pine Pass Coal Project Noman Creek Area Series 93 0/9, Drawing No. 112.

Brameda drilled twenty-two diamond core holes, size NQ, totalling 14,984 ft. in length, at angles varying from vertical to 45 degrees. The majority of these holes were located in the area to the southwest of the Noman Fault, which is assumed to follow roughly the line of the Noman Creek, or further to the east of the Creek. We thus have to rely on the McKechnie Report for knowledge of the stratigraphy to the northeast of the Fault.

Brameda made roads through the area by bulldozer, in order to gain access to the drillhole locations, and in so doing, they were able to expose outcrops of coal seams which assisted in the general interpretation of the geology of the area, and in the drawing of their geological sections.

NOTES ON THE EXPLORATION WORK DONE BY BRAMEDA RESOURCES LIMITED

The evidence provided by the Brameda drilling programme together with the findings recorded in the McKechnie Report permits a reasonable concept of the way in which the coal seams lie. See Figure 1 to 12.

Southwest of the Noman Fault, and southwest of Noman Creek, the seams in sectional view, form a synclinal 'U' shape, the rough dimensions of which are 500 ft. to 800 ft. wide (that is from southwest to northeast), and some 450 ft. to 800 ft. in depth.

From an examination of the six strata sections drawn by the Brameda staff (Figures 7 to 12), it is clear that the easterly limb of the 'U' cannot be accurately defined - due to the very disturbed ground, the presence of faults, the variation of the dip of the strata within comparatively short distances, and the wide variation in the thickness of both the coal seams themselves and the intervening beds, as evidenced

NOTES ON THE EXPLORATION WORK DONE BY
BRAMEDA RESOURCES LIMITED (continued)

by a seam of some 20 ft. thickness which disappears in a few hundred feet. We are thus left to draw the conclusion that the only portion of this complex synclinal fold where the strata have any semblance of consistency of dip and strike is the westerly limb of the 'U', although it will be seen from the following notes that the two major coal seams, Nos. 76 and 78, are anything but consistent in thickness and quality owing to the appearance of intercalated dirt and shale bands. Such observations lead us to concur with McKechnie as to the formation of the coal seams in local basins.

In many cases, correlation of the seams in adjacent drillholes is most difficult and ..... "no marker horizons have been recognized ....." as McKechnie observes (Page 7).

Let us now examine each of the sections of strata as drawn by the Brameda staff.

Section 1 Figure 7 (Brameda Series 93 0/9 Drawing E-103)

The sections revealed by DDH B-1 and DDH B-5, in the westerly limb of the 'U' show a continuity of Seams 76 and 78 over a dip distance of 500 ft. from the outcrop, and the seams show at the surface. Another seam of 7'5" to 8'3" thick (marked 'A') shows in these drillholes. These three seams are dipping at approximately 60 degrees to the horizontal. DDH B-5 and DDH B-2 reveal that lying between them there is either a fault or a synclinal fold. Seam 76 is 11'5" thick in DDH B-5 and is interpreted as the same seam at 13'9" thick in DDH B-2. This is assumed to be the same seam as one 12'0" thick in DDH B-3. Seam 78 (14'7" in DDH B-5) is down to 3'4" thick in DDH B-2. Two other seams in DDH B-5 of 11'0" and 8'1" respectively are not present in DDH B-2, where only one seam of 3'2" is found.

Seam 'A' in DDH B-5 (8'3" thick) could well be the 7'5" seam found in DDH B-2, in which case the measures between Seam 76 and Seam 'A' have thickened in DDH B-2.

There is a similarity between the seams found in DDH B-2 and DDH B-3 only if we assume Seam 76 (DDH B-2 at 13'9") to be the 12'0" seam found in DDH B-3. The seams above Seam 76 in each of these drillholes have altered considerably - all within a distance of 200 ft. and less. Yet P. R. 10 (McKechnie Report) indicates that Seams 76 and 78 - at 8'0" and 16'0" thick respectively, have been encountered.

NOTES ON THE EXPLORATION WORK DONE BY BRAMEDA RESOURCES LIMITED (continued)

This would indicate indefinable mining conditions. Evidence of surface outcrops of seams in this area is difficult owing to glacial overburden - measured as 85 ft. thick in DDH B-2, DDH B-3 and DDH B-5.

All four Brameda drillholes were wet, and DDH B-1 made more water than the other three.

Section 2 Figure 8 (Brameda Series 93 0/9 Drawing E-104)

The three drillholes of this section could indicate the 'U' shape of the syncline, but the seams vary in thickness. Seam 76 is 19'0", 14'0" and 10'0" respectively in the three holes, and the sections of this seam are only 900 ft. apart. Seam 78 shows thickness of 4'0", 8'4" and 10'0" within a distance of 650 ft.

Section 3 Figure 9 (Brameda Series 93 0/9 Drawing E-105)

Seam 78 was not struck in DDH B-6, but DDH B-21 met a 14'0" seam at a corresponding position above Seam 76, as shown in DDH B-8. Seam 76 would appear to be thickening from 12'0" in the west of this section to 21'5" in the centre hole, and to 24'0" in the easterly hole.

But it is a matter of conjecture as to whether one is entitled to assume the correctness of the dotted lines as shown on this sectional diagram.

It should be noted that whilst the draughtsman has indicated the dips of the beds as found from the drill cores, the orientation of these dips may be inaccurate, or should be related to the complementary angle of dip. This is evident from the fact that the dips shown for DDH B-10 conflict with those recorded for DDH B-21. In any event, the nature of the beds, their thickness and their relative positions are revealed by the cores.

Section 4 Figure 10 (Brameda Series 93 0/9 Drawing E-106)

The same remarks apply to DDH B-11 as were noted for DDH B-10. This means that if the strata dips shown for DDH B-11 were rotated 180° to indicate a dip of 80 degrees rather than a dip of 10 degrees as shown, the shape of the syncline would more nearly conform to that suggested in Sections 1 and 2.

NOTES ON THE EXPLORATION WORK DONE BY BRAMEDA RESOURCES LIMITED (continued)

DDH B-16 passed through several fault indications, and whilst DDH B-20 passed through small coal seams in its first 200 ft., it was barren of coal seams below that horizon. Faulting and intense folding of the measures can then safely be assumed to have taken place.

It is disturbing to note that DDH B-7 struck the major seams of the area, Seams 76 and 78, at thicknesses of not more than 4'6", and that DDH B-9 exposed these seams as split by shale bands. Three other seams appeared in DDH B-9 - one of 10'0", one of 13'4" and one of 15'5", but in tracing these to adjacent drillholes, they are found severely thinned or split.

Section 5 Figure 11 (Brameda Series 93 0/9 Drawing E-107)

Matching up the seams from the results of the drill cores in the three drillholes of this section again is a difficult exercise, and shales and sandstones between the seams form no recognizable pattern of correlation. Seam 76 has thinned in the westerly hole to 9'0", and it thickens in DDH B-14 to 11'9", whilst Seam 78 has split into two beds presumably with some 15 ft. of shale in between. Another seam not previously met in the holes so far drilled, lies below Seam 76. It is 17'0" thick, and is 23'0" thick some 500 ft. further down the dip. Alternatively, one may argue that this is Seam 76, but we have no evidence to guide us either way.

Section 6 Figure 12 (Brameda Series 93 0/9 Drawing E-108)

The seams have all thinned considerably in this section, although their correlation may be simpler. The measures also lie at flatter dips, and are shallower-lying than in the preceding sections. DDH B-19 was very wet down to 372 ft. in depth, and the water was under considerable pressure.

Section 7

Owing to the nature of the results of the drillholes of the previous sections, the drilling programme was stopped pending an assessment of the preceding information. No holes were drilled for Section 7.

GENERAL COMMENT ON BRAMEDA GEOLOGICAL SECTIONS

It was noted in examining the various sections that if the DDH B-2 in Section 1, DDH B-4 in Section 2, DDH B-8 in Section 3, DDH B-11 in Section 4, and DDH B-15 in Section 5 were rotated through 180 degrees, the overall pattern of the syncline would more readily resemble those indicated in the proposed sections of the McKechnie Report, Figure 13, which is Figure 5 of this report.

SUMMARY OF GEOLOGICAL EVIDENCE

In our examination of the various sources of information concerning this property, we have been constantly reminded of the following facts:

(a) The steep dips of the strata and coal seams vary from level (for very short distances) to vertical and over-vertical.

(b) The irregularity of the occurrence and thickness of the coal seams and the intervening beds, as revealed by adjacent drillholes, make correlation between drillholes, although relatively near together, difficult and problematical.

(c) The prevalence of either excessively sharp local folding of the strata, or of normal or reverse faults, to some extent would assist in the stratigraphical explanation of problem areas.

(d) The lenticular nature of the coal seams, also their associated sandstones and shales, and the frequent splitting of coal seams by intervening dirt bands.

(e) The presence of water in some of the holes drilled, with some indication of water under high pressure within the coal basin.

(f) The deep weathering of the coal seams.

(g) Due to the highly folded, stressed and disturbed nature of the area, one expects to find coal seams which have suffered from the effects of strata compression and tension, causing slickensiding of both coal seams and shales. To this must be added the normal cleating of the coals, thus rendering them more friable and less competent. This could mean that control of coal getting operations may be jeopardized, but the only way to prove such conditions is to realise them in practice.

SUMMARY OF GEOLOGICAL EVIDENCE (continued)

(h) The soft shaley nature of the roofs of the coal seams, in spite of coal being left against the roof, can and often does cause difficult mining conditions. Again, one can only determine the answer to such a question under actual working conditions. In any event the presence of water in the soft shaley roofs can cause difficult conditions.

(i) Due to the presence of reverse faults, it is expected that areas of coal may have to be left unworked owing to the possible danger of working in friable and disturbed strata. The prospect of working the double thickness of coal around a reverse fault is remote under such conditions.

The nearest working of underground coal to the Noman Creek Area was the small underground mine at Hasler Creek, some 16 miles to the southeast of Noman Creek. (See Figure 2). Experience gained at such a distance away has little if any relevance in guiding the operator at Noman Creek. Thus the Noman Creek Area must be regarded as 'unknown' for underground mining operational purposes.

The factors which are cause for concern in an unknown and previously unworked area are many, and some of the more important ones are as follows:

(i) Spontaneous combustion of the coal in the ground.

(ii) Spontaneous combustion of the coal in storage or shipment.

(iii) Occurrence of 'bumps' or rock/coal 'bursts'.

(iv) Quantity of methane emitted per ton of coal mined.

These difficulties are encountered in the Rocky Mountain coal areas, and if encountered would require special working methods to be adopted to counteract them.

QUALITY OF THE COAL SEAMS

It was reported that test results from samples of coal taken from the property indicate a good grade of coking coal in terms of requirements for the Japanese market. It is also noted that the detailed results of analysis and test of samples shipped to Japan had not been received as of November 24, 1969. Whatever arrangement is finalized between Brameda and their customers, the maintenance of a consistent quality of coal is of paramount importance.

QUALITY OF THE COAL SEAMS (continued)

It is extremely difficult to visualize that this area could yield coal, as mined, ready for the market, thus a coal preparation plant would be necessary. Having regard for the conditions of underground mining which the above evidence indicates, it is apparent that no degree of selective mining could be practised. Hence the coal preparation plant would be subject to a widely fluctuating percentage of dirt and refuse in the run-of-mine coal, and this would severely tax the ability of the plant designers and the mine personnel to ensure a standard and consistent quality of product. The alternative would be an over-capacity plant, geared for the removal of high quantities of refuse, but cost consideration could rule this out. Also there would be the difficulty of determining the rate of refuse extraction from the raw coal.

WORKABLE COAL RESERVES

Referring to Page 17 of the McKechnie Report, it is estimated that the area to the southwest of the Noman Fault contains a coal reserve of 5,000,000 short tons. This is the only portion of the areas he describes which is of interest to Brameda. The seams to the northeast of the Noman Fault are excessively faulted, and are too steep, too deep, and too variable in thickness to permit a viable underground operation. This was also indicated by McKechnie. McKechnie (Page 9) estimates that 50% of the coal reserves he quotes are recoverable, which leaves 2,500,000 short tons available for working. Actually this figure would be much less. Based on McKechnie's figures, we submit that for the least capital expenditures which are unavoidably involved in commencing to mine this area on the required scale for market requirements, there is insufficient coal available.

Initially, one must start from the premise that there is sufficient coal in recoverable quantities to warrant the installation of a railway spur line and sidings, a coal preparation plant, shops, offices, electric power facilities, underground and surface machinery and possibly a townsite. Such facilities call for a mining operation whose life is of the order of twenty years, or more, with sufficient annual output of salable coal to justify the scheme.

Such a justification cannot be related to 2.5 million tons of coal of workable reserves. Having regard for all relevant conditions, coal reserve tonnage should be very much higher.

APPLICATION OF UNDERGROUND MINING METHODS

We believe that the Noman Creek Coalfield is unique in its structure, degree of disturbance and limited dimensions, and we have no knowledge of any working coalfield with similar natural conditions.

We do not rule out the possibility of a small operation with a daily output of 100 or 200 tons served by highway trucks, if such a market exists, but only while the more easily accessible coals are available. Such an operation would not satisfy Brameda's objectives.

For such an operation, the method of working could be a modified overhand stoping system, or the methods used on the continent of Europe in the steep seams in the days of hand-got mining - namely "Gradins Renversés" and "Tailles Chassantes". Such methods are not applicable with current labour rates.

Mechanized Room and Pillar

This is the method of working in coal mines most widely used in the United States, but such a method has no place at Noman Creek. Essential for its success is a flat or gently dipping seam, with a roof sufficiently competent to allow wide rooms to be driven with mechanical devices between pillars of coal for the support of the superincumbent strata.

Mechanized Longwall Mining

This method was originally developed in the United Kingdom. It cannot be applied successfully at Noman Creek. In this method a coal shearing machine travels on the side structure of an armoured face conveyor, with the roof carried by hydraulically-operated roof supports. Design of the roof supports permits the advance of the conveyor after the passage of the shearer, then being in position for the next 'cut' from the coal face.

The following factors are essential to the success of the system:

1. The maximum gradient of the face, along which lies the armoured face conveyor, is 30 to 35 degrees. This gradient is also critical with regard to the point of overbalance of the powered roof supports.

APPLICATION OF UNDERGROUND MINING METHODS (continued)

2. Two access levels are required (at least) for each longwall face equipped with this system. The topmost level is for an escape route for the personnel, for power supply, and for return ventilation. The bottom level is the one to which the coal is delivered by the armoured face conveyor. It serves as an intake airway, for power supply, and as the route to the coal face for the transport of men and supplies. Owing to the non-productive work which is necessary to keep these levels advanced at a speed compatible with that of the extraction of coal from the coal face, it is of advantage to place these levels as far apart as all the relevant factors permit. Longwall faces vary from 300 ft. to 900 ft. in length in present practice, with 500 ft. to 600 ft. as a reasonable average length.

3. The system will permit a maximum height of coal of approximately 10'0" to be worked in one 'lift', and the equipment can negotiate a minimum height of 6'0".

4. It is necessary to ensure that it is possible to advance a longwall for such a continuous distance, that the amount of coal won from it justifies the cost of placing the equipment on the longwall, and recovering it at the end of the life of the longwall. It follows then that, within certain limits, the longer the advance 'run' of a longwall, the better from this point of view and from the standpoint of the overall profitability of the operation.

It will be appreciated that the Noman Creek field has serious limitations for equipment of this nature.

Hydraulic Mining of Coal

Various attempts have been made over the past few years in the United Kingdom, Germany, Russia, Japan and Canada (Alberta) to perfect a system of mining using high pressure water jets for underground coal getting purposes.

Until these are proved successful and reliable, and until proven equipment is readily available, we would not recommend adoption of the system, and particularly not at Noman Creek in view of its remoteness and its geological problems.

STRIP MINING

Though the subject of strip mining was not included in the terms of reference, it is worth observing that the extreme depth of the main seams, Nos. 76 and 78, and the resulting steep walls of the syncline would create considerable dilution problems, owing to the way in which the seams lie in the syncline.

The problems caused by the excessive folding and faulting of the seams, and their inconsistent thicknesses, their splitting into thin benches, their disappearance in many cases and their unpredictable stratigraphical locations would practically preclude selective mining and result in excessive coal cleaning problems.

Due to the water conditions, where clay bedding may be encountered, we would anticipate uncontrollable problems for the support of crawler mounted equipment.

In view of the synclinal trough conditions, the disposal of overburden presents excessive transportation and handling costs, which would be aggravated by the unknown stability of such refuse piles.

RECOMMENDATION ON FURTHER EXPLORATION

The Assignment included the authority to recommend further exploration expenditures if the indications so warranted.

Sufficient data is outlined above, to draw definite conclusions as to the prospect of a successful underground mining operation in the Noman Creek Area of this coalfield. The diamond drillholes on approximately 400 ft. intervals prove the seams to be unworkable by recognized mining methods.

In view of the foregoing conditions it is not reasonable to expend further monies for additional exploration of Noman Creek Area at this time.

CONCLUSION

The Noman Creek Coalfield is found to have suffered so severely from the effects of earth movements, that apart from considerations of

CONCLUSION (continued)

quality or market possibilities, the folding and faulting are such that for the yearly tonnages required, it is not an economic or practical proposition.

SUGGESTION

Since expenditures to date on the property are apparently sufficient to retain title for an appreciable period, it is suggested that progress of the development of hydraulic mining be followed with consideration as to its potential application to this property.

The foregoing was investigated and prepared by Mr. W. R. Holden with Mr. H. S. Haslam as the consultant in Coal Mining Engineering.

Presented December 18, 1969

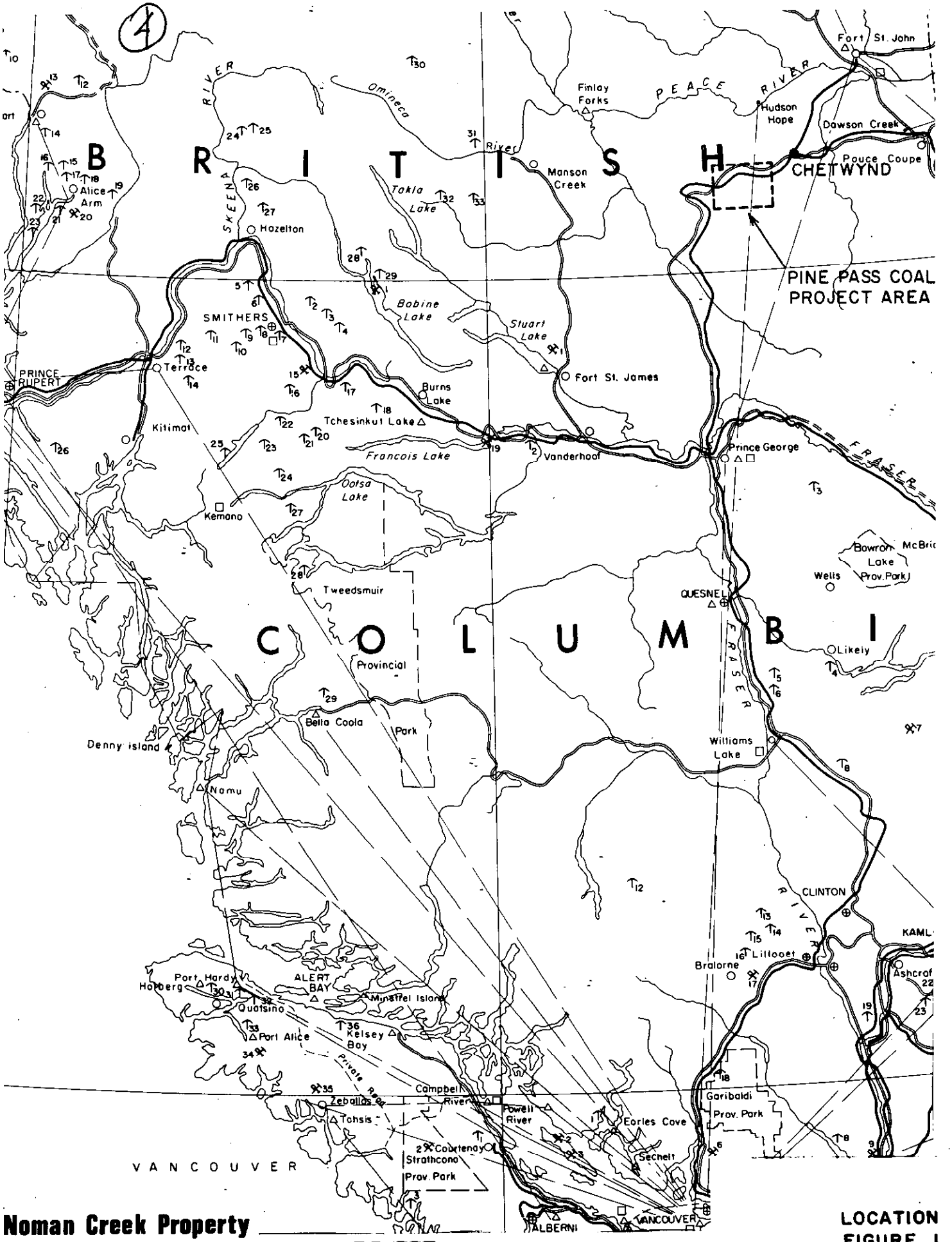
W. R. Holden, P. Eng.
Manager, Mining & Metallurgy Division

Non-resident Licence for the Association of Professional Engineers of British Columbia pending.

H. S. Haslam, P. Eng.
Consultant in Coal Mining Engineering

Non-resident Licence for the Association of Professional Engineers of British Columbia pending.

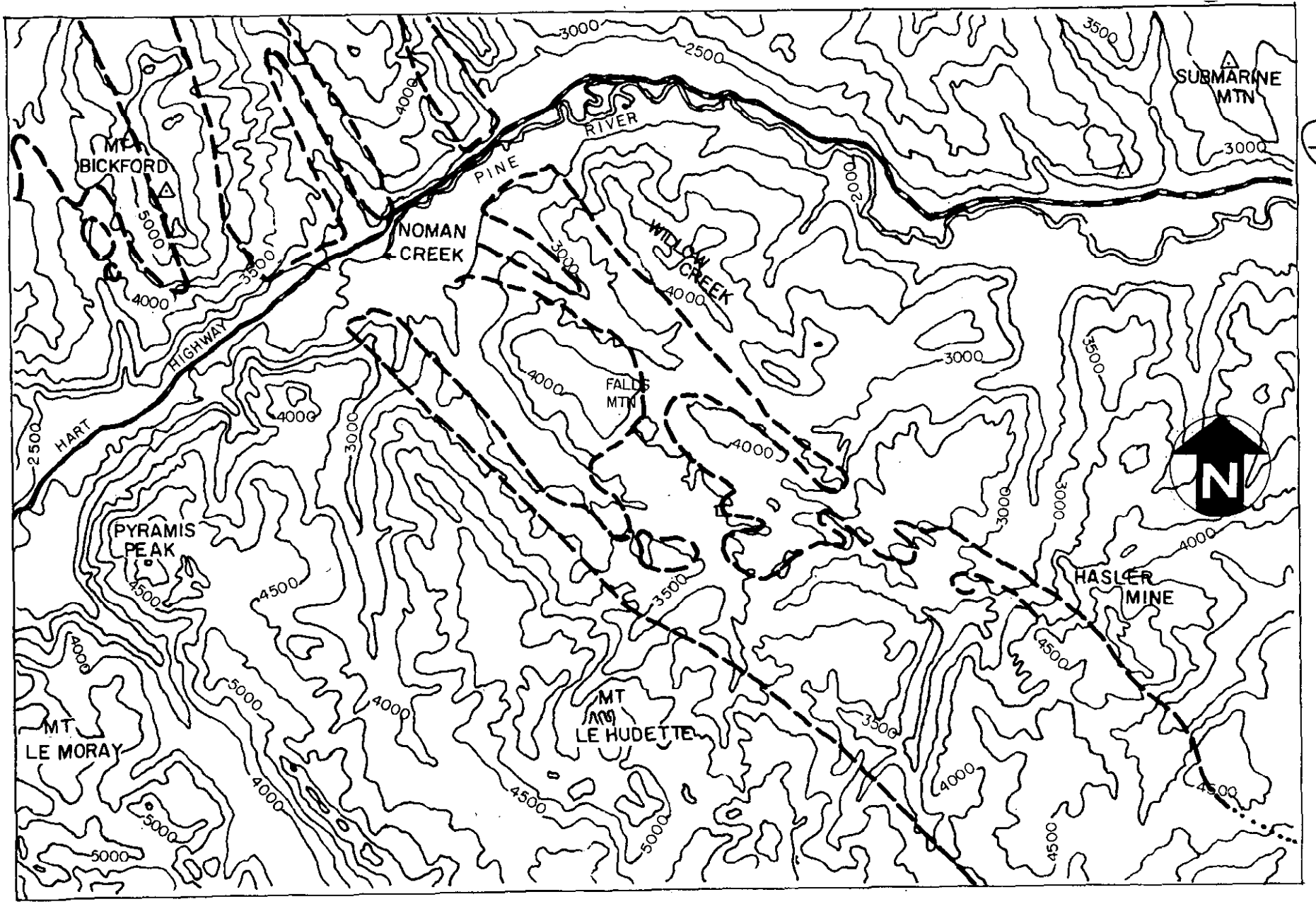
Corporation of Engineers of Quebec Licence No. 14337.



Noman Creek Property

PINE PASS COAL COMPANY LTD. PROJECT

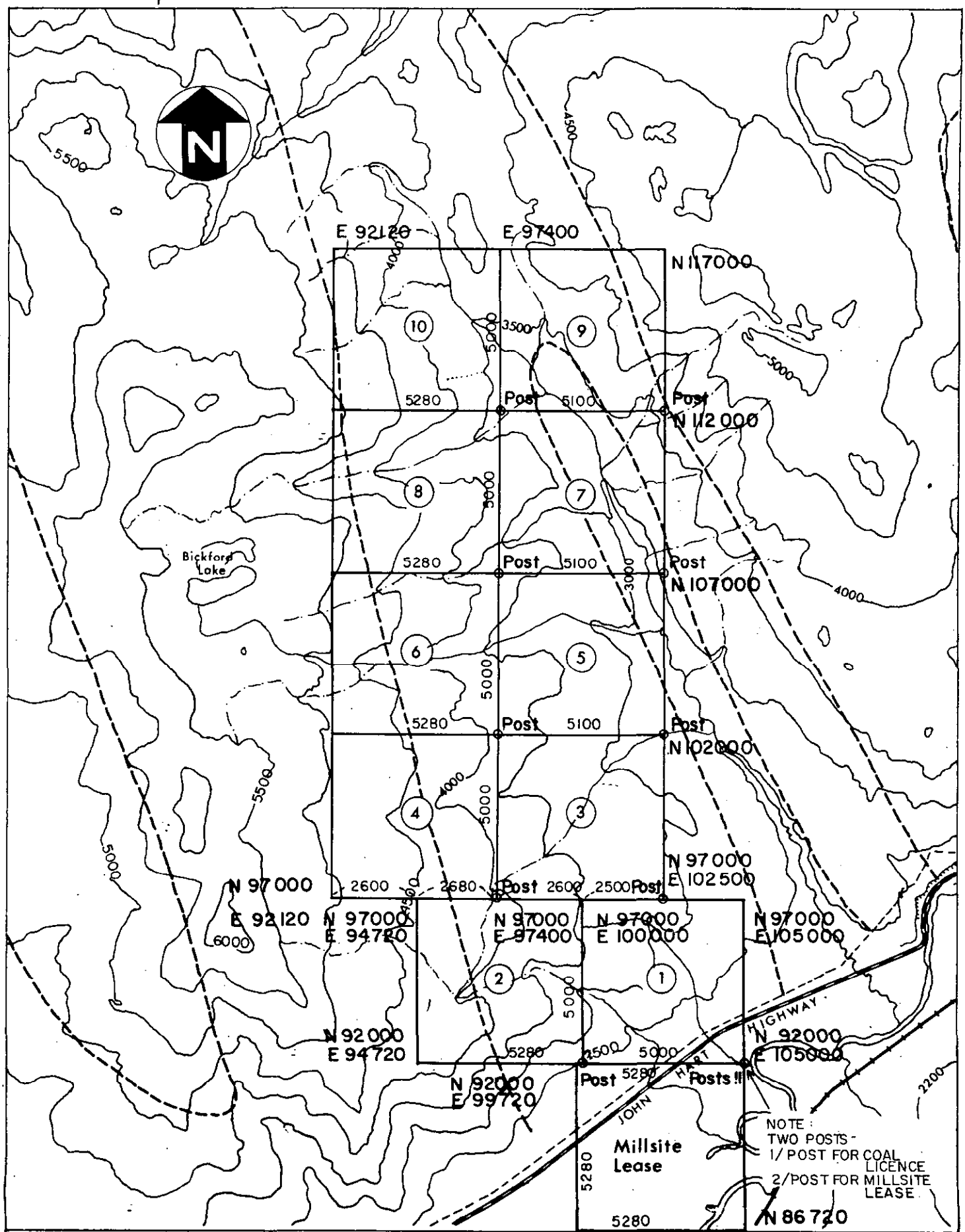
LOCATION
FIGURE 1



Noman Creek Property

PINE PASS COAL COMPANY LTD. PROJECT

FIGURE 2

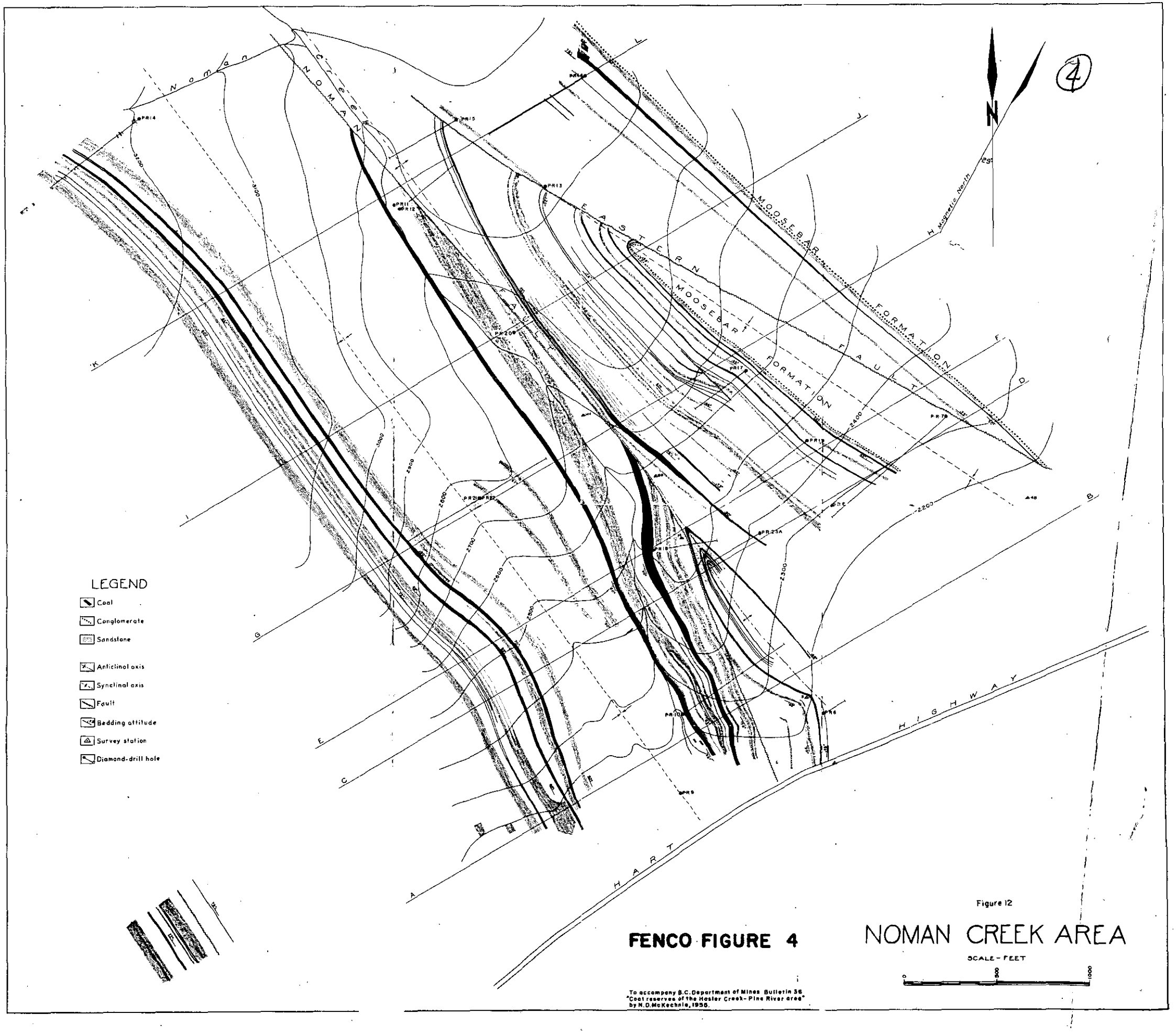


Noman Creek Property

PINE PASS COAL COMPANY LTD. PROJECT

LOCATION OF LICENCES

FIGURE 3



LEGEND

- Coal
- Conglomerate
- Sandstone
- Anticlinal axis
- Synclinal axis
- Fault
- Bedding attitude
- Survey station
- Diamond-drill hole

FENCO FIGURE 4

Figure 12

NOMAN CREEK AREA

SCALE - FEET

0 500 1000

To accompany B.C. Department of Mines Bulletin 35
"Coal reserves of the Hasler Creek - Pine River area"
by N.D. McKechnie, 1956.

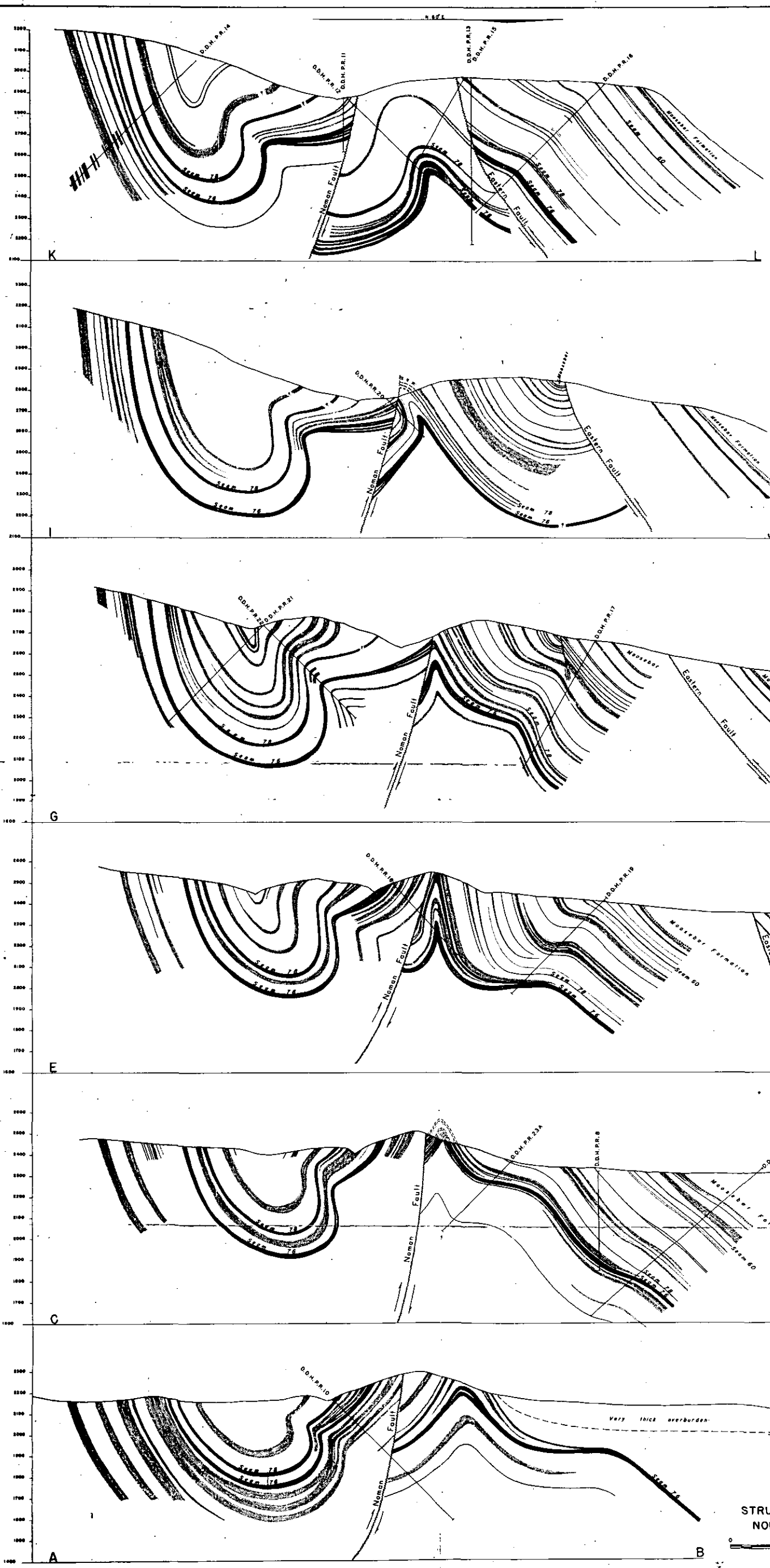


Figure 13

STRUCTURAL SECTIONS
NOMAN CREEK AREA

0 400 800
Scale—Feet

FENCO FIGURE 5

To accompany B.C. Department of Mines Bulletin 36, "Coal reserves of the Hasler Creek-Pine River area" by N.D. McKechnie, 1955

(4)

COAL SEAM
DIAMOND DRILL HOLE - 1969
DIAMOND DRILL HOLE - 1948
ROAD OR TRENCH
SURVEY CONTROL POINT
STREAM
TREE LINE
BOUNDARY LINE

"SECTION 1"
"SECTION 6"
"SECTION 5"
"SECTION 4"
"SECTION KL"
"SECTION 3"
"SECTION IJ"
"SECTION GH"
"SECTION EF"
"SECTION CD"
"SECTION AB"
"SECTION 1"

B-19 (-60°)
B-22 (-70°)
B-17 (-90°)
B-13 (-45°)
B-15 (-60°)
B-14 (-90°)
B-16 (-75°)
B-18 (-90°)
B-20 (-90°)
B-11 (-45°)
B-9 (-90°)
B-10 (-50°)
B-6 (-45°)
B-8 (-45°)
B-21 (-76°)
B-23 (-90°)
B-5 (-90°)
B-41 (-90°)
B-3 (-45°)
B-4 (-90°)
B-2 (-90°)

0+7,080'
0+5,030'
0+3,080'
0+1,600'
0

1760' 536.8m
1578' 480.5m
2050' 625.2m
1950' 594.1m
1480' 451.4m
1400' 426.7m

78 ASSURED
76 ASSURED
COAL SEAMS
INCL.
BASELINE (FENCE)
SIMULATED 6' FENCE FOR TONNAGE ESTIMATE
ADDITIONAL SEAM (COULD BE 76 OR 78)
76 - COULD BE 78
78 IN DOUBT
LIGHT OVERBURDEN TO THE WEST OF ACCESS ROAD
DEEP OVERBURDEN ON THIS SLOPE INTO NOMAN CREEK 100'-120' AT LEAST
COAL SEAM 78
COAL SEAM 76
SLOPES STOCKED FOR OPEN PIT
SLOPES SECTION I PROJECTED FROM FACE AT ENTRY ROAD

(COAL LICENCE Nº 2)
(COAL LICENCE Nº 4)
(COAL LICENCE Nº 3)
(COAL LICENCE Nº 1)

PR-1 PR-2 PR-3 PR-4 PR-5 PR-6 PR-7 PR-8 PR-9 PR-10 PR-11 PR-12 PR-13 PR-14 PR-15 PR-16 PR-20 PR-22 PR-23A

100,000 N
98,000 N
96,000 N
94,000 N
92,200 N
92,000 E
96,000 E
98,000 E
100,000 E
102,000 E
104,000 E
106,000 E
108,000 E

NOTE:
SECTIONS "AB" TO "KL" FROM FIG. 12 Mc. KECHNIE REPORT

FENCO FIGURE 6

REV	DETAILS OF REVISION	DATE	BY
A	Added DDH's B-22 & 23, new location of coal seam, etc	NOV 27/69	L.B.

BRAMEDA RESOURCES LTD.

— DRILLING PLAN —

PINE PASS COAL PROJECT
NOMAN CREEK AREA
LIARD MINING DIV., B.C.

DATE	SCALE	N.T.S.
NOV, 1969	1" = 400'	93 O/9
DRAWN BY	MAPPED BY	JOB Nº / DRWG. Nº
L.B.	H.M.J.	K-112

4

2600'

BASELINE FENCO

2400'

225'

ADIT POSITION
IN SEAM 76

D.D.H. B-1
(-47°)

D.D.H. B-4
(-56°)

D.D.H. B-5
(-56°)

D.D.H. B-2
(-90°)

NOMAN CREEK

D.D.H. PR 10

Coal Seam (16.0')

Coal Seam (8.0')

2200'

2150'

85' OVERBURDEN
CLACIAL - TILE

Coal Seam (12.2')

Coal Seam (11.5')

Coal Seam (8.1')

Coal Seam (11.0')

Coal Seam (2.8')

COAL SEAM #78

Coal Seam (3.2')

Coal Seam (3.2')

Coal Seam (1.5')

Coal Seam (5.9')

Coal Seam (3.8')

Coal Seam (3.4')

2000'

Coal Seam (12.0')

Coal Seam (14.7')

Coal Seam (13.9')

NOMAN
FAULT - ASSUMED POSITION

Coal Seam (7.5')
SEAM "A"

T.D. 511'

Coal Seam (11.5')

Coal Seam (0.5')

Coal Seam (1.5')

COAL SEAM #76

Coal Seam (4.0')

1800'

Coal Seam (4.0')

T.D. 751'

SEAM "A"
Coal Seam (8.3')

Coal Seam (3.0')

T.D. 772'

APPROXIMATELY
60°

1600'

Coal Seam (7.5')

T.D. 752'

NOTE:
ALL 4 HOLES HAD WATER
B.I. HAD MOST WATER

SECTION LOOKING N 40° W

NOTE:
DD Holes B-2, B-3, B-5 are projected
80' SE from the section.

LEGEND

COAL SEAM — SHALE

CLAYSTONE — SILTSTONE

SANDSTONE — c ~ Carbonaceous Rocks

FENCO FIGURE 7

BRAMEDA RESOURCES LTD.

— SECTION Nº 1 —

PINE PASS COAL PROJECT

NOMAN CREEK AREA

LIARD MINING DIV, B.C.

DATE	SCALE	N.T.S.
OCT., 1969	1" = 50'	93 O/9
DRAWN BY	MAPPED BY	JOB Nº / DRW'G Nº
L.B. & O.C.	H.M.J.	/E-103

3000'

2800'

2600'

2400'

2200'

D.D.H. PR 22

D.D.H. PR 21

D.D.H. B-4 (-90°)

NOMAN CREEK

Coal Seam (10.0')

Coal Seam (10.0')

Coal Seam (10.0')

Coal Seam (0.8')

Coal Seam (8.4')

Coal Seam (0.8')

Coal Seam (40')

Coal Seam (19.0')

COAL SEAM #78

Coal Seam (14.0')

COAL SEAM #76

T.D. 789'

SECTION LOOKING N 30° W

FENCO FIGURE 8

LEGEND

COAL SEAM — SHALE

CLAYSTONE — SILTSTONE

SANDSTONE — c — Carbonaceous Rocks

BRAMEDA RESOURCES LTD.

— SECTION Nº 2 —

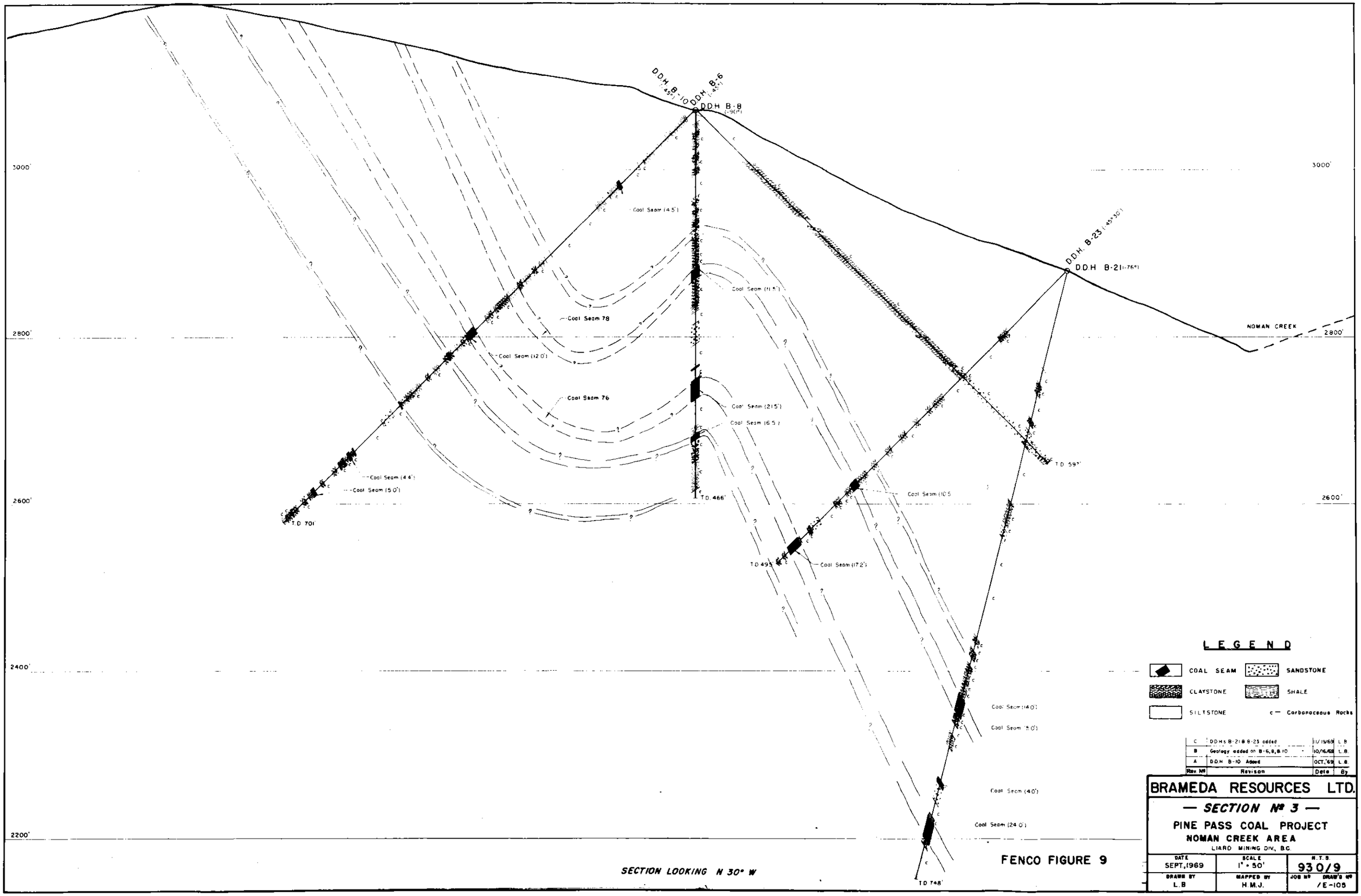
PINE PASS COAL PROJECT

NOMAN CREEK AREA

LIARD MINING DIV, B.C.

DATE	SCALE	N.T.S
SEPT, 1969	1" = 50'	93 O/9
DRAWN BY	MAPPED BY	JOB Nº / DRAWG Nº
L.B.	H.M.J.	/E-104

(4)



SECTION LOOKING N 30° W

FENCO FIGURE 9

LEGEND

COAL SEAM
SANDSTONE
CLAYSTONE
SHALE
SILTSTONE
c — Carbonaceous Rocks

Rev. No	Revison	Date	By
C	DDH's B-21 & B-23 added	11/19/69	L.B.
B	Geology added on B-6, 8, & 10	10/16/69	L.B.
A	DDH B-10 Added	OCT. '69	L.B.

BRAMEDA RESOURCES LTD.

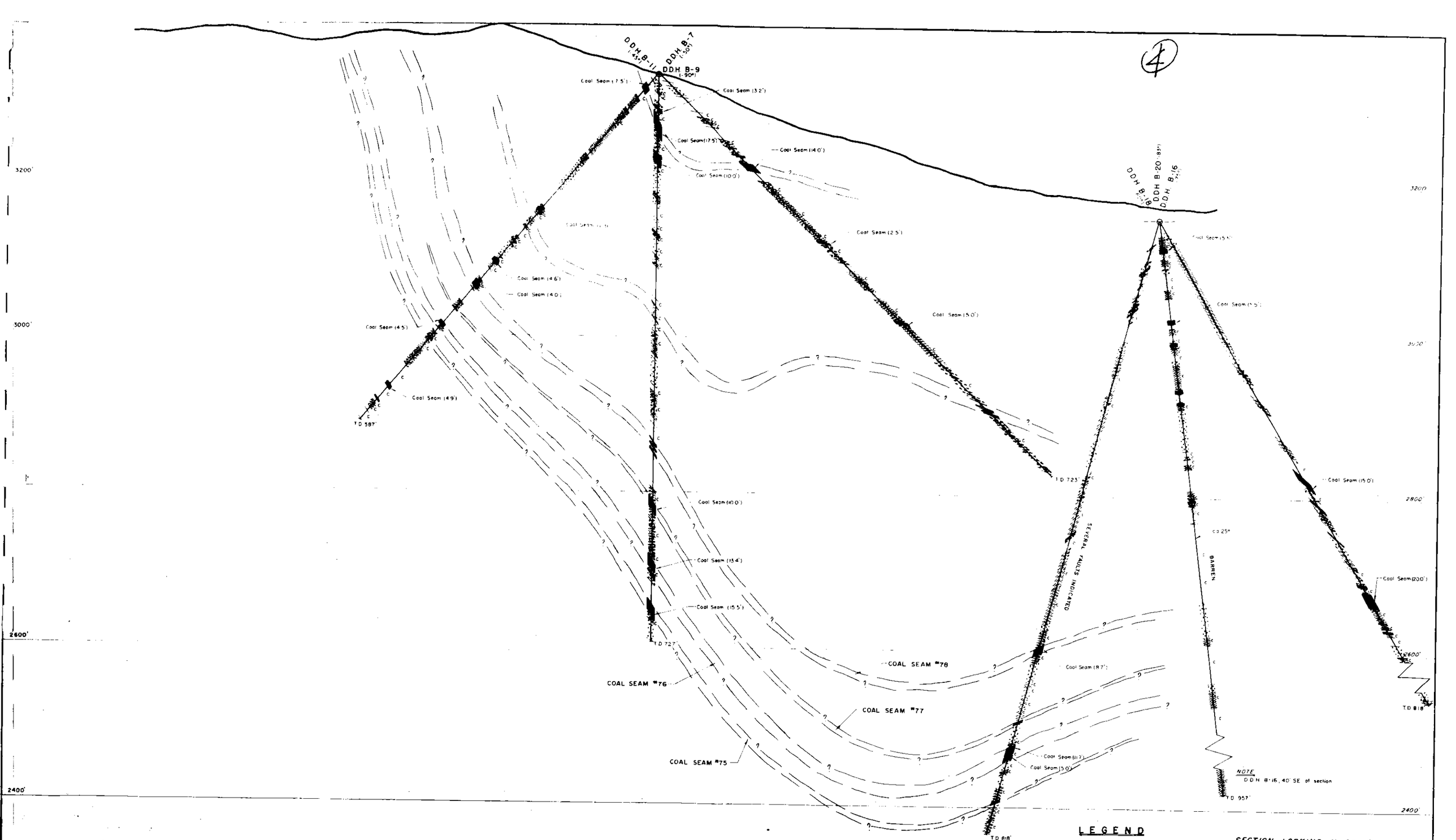
— SECTION No 3 —

PINE PASS COAL PROJECT

NOMAN CREEK AREA

LIARD MINING DIV., B.C.

DATE	SCALE	N.T.S.
SEPT, 1969	1" = 50'	93O/9
DRAWN BY	MAPPED BY	JOB No. / DRAW'G No.
L.B.	H.M.J.	/E-105



4

LEGEND

- COAL SEAM
- CLAYSTONE
- SANDSTONE
- SHALE
- SILTSTONE
- c — Carbonaceous Rocks

SECTION LOOKING N 30° W

FENCO FIGURE 10

C	Geology shown on DDH's B-16, 18 & B-20	11/21/69	L.B.
B	DDH B-18 Added	10/21/69	L.B.
A	DDH B-16 Added	10/15/69	L.B.

BRAMEDA RESOURCES LTD.

— SECTION No 4 —

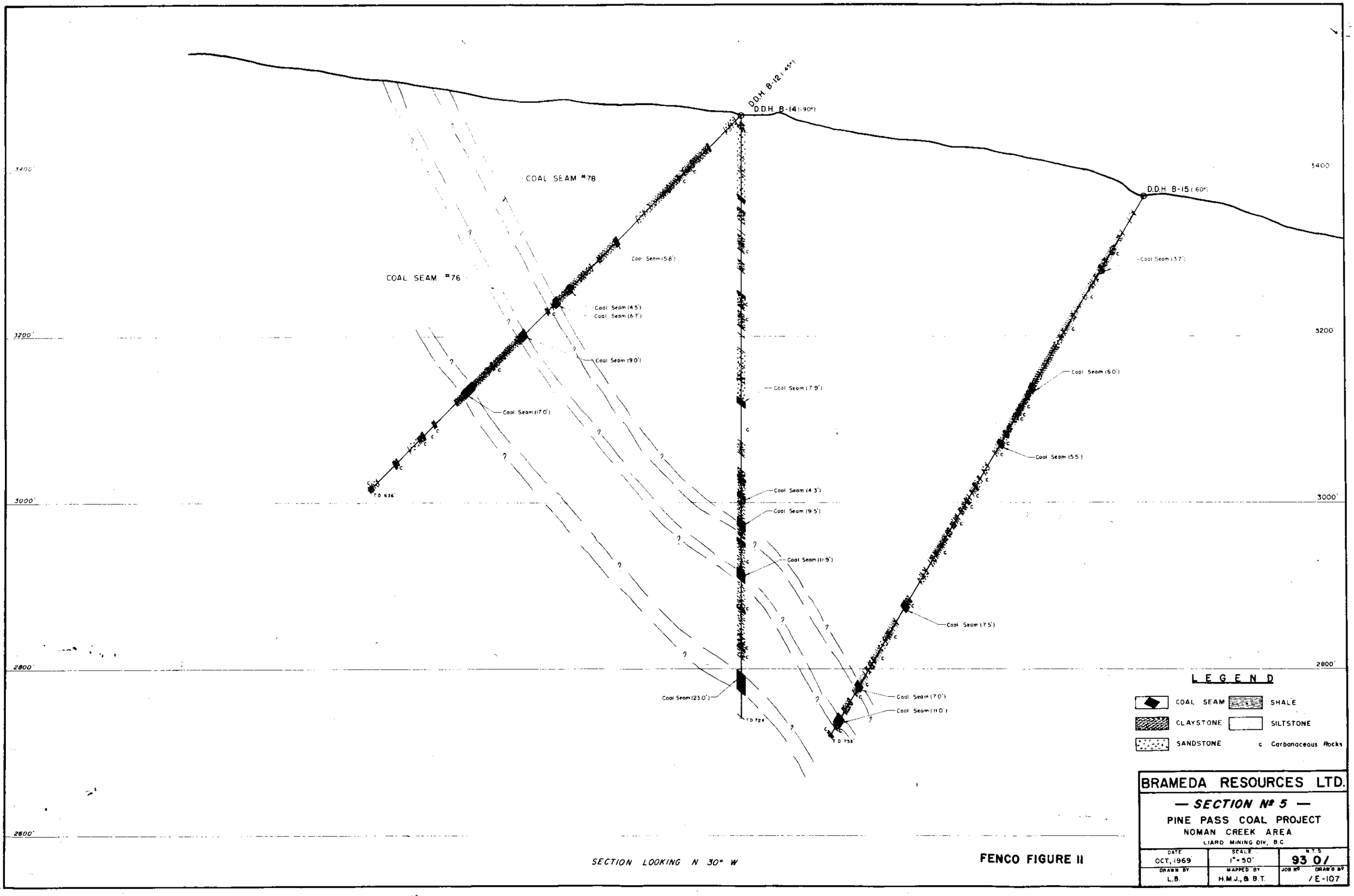
PINE PASS COAL PROJECT

NOMAN CREEK AREA

LIARD MINING DIV., B.C.

DATE	SCALE	N.T.S.
OCT., 1969	1" = 50'	93 O/9

(4)



SECTION LOOKING N 30° W

FENCO FIGURE II

LEGEND

COAL SEAM | SHALE
CLAYSTONE | SILTSTONE
SANDSTONE | c Carbonaceous Rocks

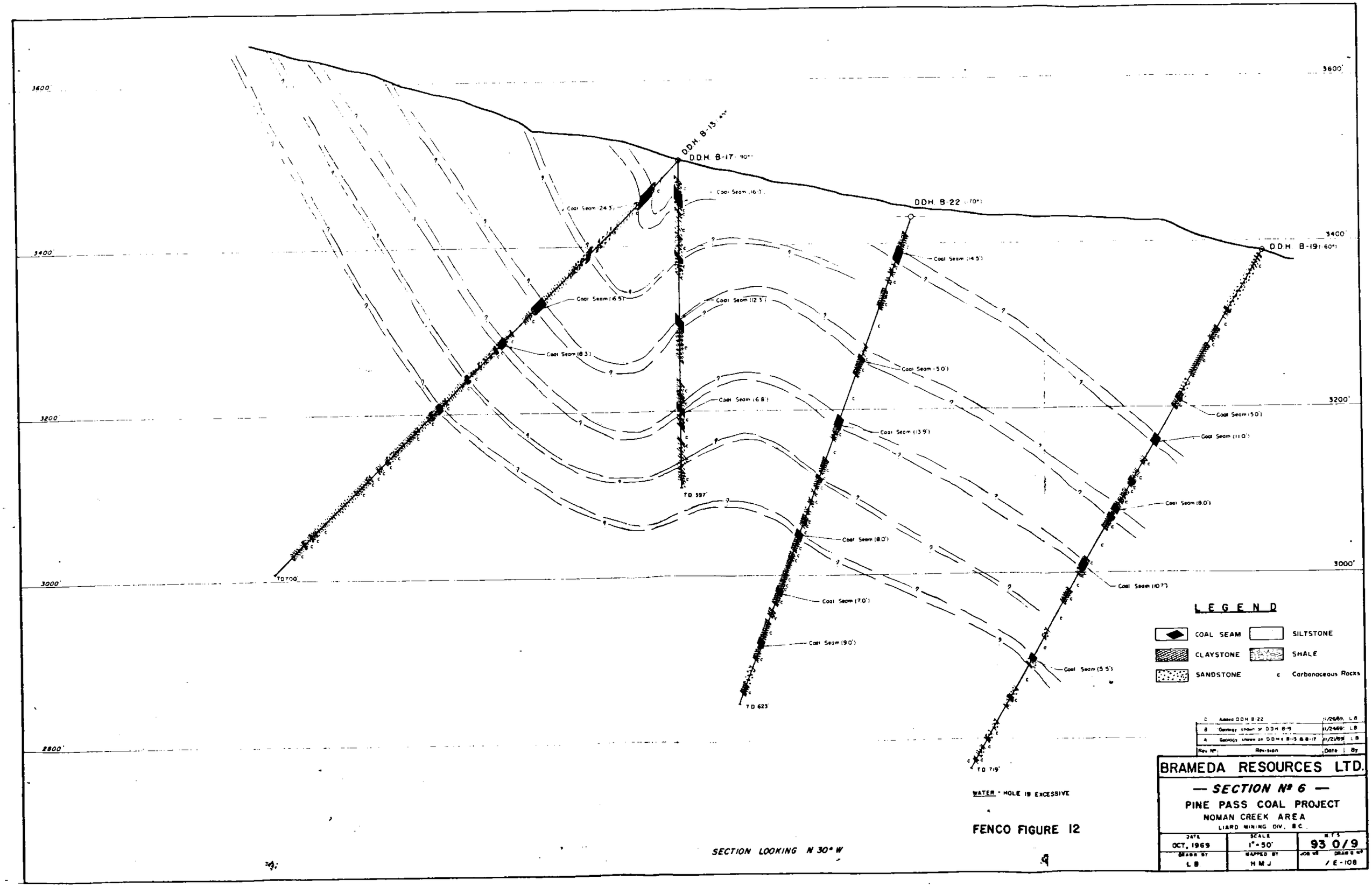
BRAMEDA RESOURCES LTD.

— SECTION Nº 5 —

PINE PASS COAL PROJECT
NOMAN CREEK AREA
LIARD MINING DIV., B.C.

DATE	SCALE	N.T.S.
OCT, 1969	1" = 50'	93 O/
DRAWN BY	MAPPED BY	JOB Nº / DRAW'G Nº
L.B.	H.M.J., & B.T.	/E-107

(4)



WATER - HOLE IB EXCESSIVE

FENCO FIGURE 12

SECTION LOOKING N 30° W