BRITISH COLUMBIA HYDRO AND POWER AUTHORITY

A PRELIMINARY ASSESSMENT OF THE COAL RESOURCES OF THE CARIBOO COALFIELD, QUESNEL, BRITISH COLUMBIA

SYSTEM ENGINEERING DIVISION

Report No. SE 8018

July 1980

Copy for A. Matheson

14 October 1980

Mr. C. B. Guelke
Manager
Generation Planning Department
B.C. Hydro and Power Authority
Box 12121
555 West Hastings St.
Vancouver, B.C.
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Dear Mr. Guelke:

Thank you for the copy of the Cariboo Coalfield Study by Dr. P. T. McCullough. The report will be filed with Mr. A. Matheson in Coal Inventory. We would like to thank you for it.

Yours very truly,

A. Sutherland Brown, Ph.D., P. Eng.
Chief Geologist, Geological Div.
Mineral Resources Branch

ASB:nhc

BRITISH COLUMBIA HYDRO AND POWER AUTHORITY

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6 October 1980

File: 804D-

Mr. E.R. MacGregor
Assistant Deputy Minister
Ministry of Energy, Mines and Petroleum Resources
Parliament Buildings
Victoria, B.C.
V8V 1X4

Dear Mr. MacGregor:

Cariboo Coalfield Study

Attached for your information is a copy of the geological report on the Cariboo Coalfield prepared by Dr. P.T. McCullough. The coalfield was examined as a source of alternate fuel for a proposed hog fuel-fired thermal plant at Quesnel. The report describes earlier work on the deposit and also includes a reinterpretation based on a literature study and field work conducted by B.C. Hydro.

We do not have definite plans for future work on this deposit at the present time because of the current status of the overall Quesnel Hog Fuel study.

We would be pleased to receive any comments you may have on the report. Note that some of the drill logs of the site near Quesnel were supplied by the Ministry of Transportation and Highways and they should be consulted prior to placing the report on open file.

Yours truly,

C.B. Guelke
Manager,
Generation Planning Department

Enclosure

CB Quesnel 80(1)A

BRITISH COLUMBIA HYDRO AND POWER AUTHORITY

OPEN FILE

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SUMMARY

The main showings of the Cariboo coalfield are 28 km south of Quesnel, along the banks of the Fraser River and Australian Creek. A coal land reserve was established over these showings and the surrounding region on 13 December 1979 under B.C. Order in Council 3050. The reserve will remain in effect until 1 January 1982.

Outcrops are scarce in the area, particularly in parts underlain by the coal-bearing Fraser River Formation of Tertiary age. In order to assist in assessing the areas devoid of outcrops, drilling results, assessment reports, government geological reports and air-borne magnetometer maps were examined. From the air-borne magnetometer maps it was evident that a large area around the coal land reserve is underlain by sedimentary rocks with a low magnetic response. The study area was enlarged to include Ahbau in the north and Hargreaves in the south on the basis of these magnetic maps. The coal land reserve and part of the enlarged area were examined during a trip to the field between 27 March and 1 April 1980.

Two sets of geologic maps were prepared for this report; one set is based on the geology as outlined in earlier reports, whereas the second set is based on an interpretation of the air-borne magnetometer maps, assessment reports and the field trip. The two sets of maps are significantly different, but the area underlain by the coal-bearing Fraser River Formation is not appreciably enlarged as a result of the new interpretation.

On the basis of these investigations it is evident that the Australian Creek portion of the Cariboo coalfield, which is within the coal land reserve, has the best potential for providing sufficient coal for supplementary fuel to a 60 MW (gross) hog fuel fired thermal plant. A drill hole completed in 1930 penetrated a 24.1 m coal zone, which is

the thickest that has been encountered, although an 18.2 m zone was penetrated by a nearby drill hole completed in 1978. Twenty-five drill holes have been completed in this area. These drill holes have indicated a comparatively small area on both sides of the Fraser River that is underlain by a coal zone with gradational boundaries and generally containing between 6.6 m and 9.0 m of coal. Geological resources in the zone to a depth of 80 m are approximately 29.5 Mt for the portion near the Fraser River and approximately 74.2 Mt for the area including the Fraser River and Australian Creek portions. If the coal is presumed to be isolated in the main seams the resources to a depth of 80 m are estimated at approximately 21.0 Mt and 50.0 Mt respectively. The coal is subbituminous B to C in rank and it is expected to have a heating value of approximately 19 400 kJ/kg on a dry basis.

It is estimated that only 10.2 Mt would be required to supply all of the fuel for a 60 MW (gross) thermal plant at Quesnel. Sufficient strippable coal may be available to provide supplementary fuel for the proposed hog fuel plant at Quesnel; insufficient information is available to assess the stripping ratio and other mining characteristics of the deposits. Therefore no information is available on mining costs, although the cost per tonne is expected to be high because of the small scale of the proposed mining operation. The 30 km haul of low quality coal from the coal deposit to Quesnel would also add significantly to the cost per tonne, however no estimates of cost were made because this report is meant to provide only background information on the deposits. More information on the mining characteristics and coal quality would be required to make such a cost assessment. The collection of this information would require a substantial drilling program and it should not be undertaken unless the use of coal at a Quesnel hog fuel plant is considered very seriously.

SECTION 1.0 - INTRODUCTION

The Quesnel study area lies in the Interior Plateau of British Columbia, 28 km south of Quesnel and 385 km northeast of Vancouver. The Interior Plateau in this region consists of the Fraser Basin, which is made up of the Fraser River valley and the valleys of its major tributaries, and the Fraser Plateau, which comprises the adjacent upland. The bottom of the Fraser Valley is at 425 m elevation at the south end of the map area and at 515 m in the north. The Quesnel River valley rises to 610 m within the map area and joins the Fraser Valley at Quesnel. The ridge extending through Dragon and Granite mountains contains the highest parts of the Fraser Plateau within the study area; the ridge rises to 1465 m in elevation.

The Quesnel area is readily accessible by plane, train or car. There are airports at Williams Lake and Quesnel which are served from Vancouver by Pacific Western Airlines and have regularly scheduled flights twelve times per week to Williams Lake and five times per week to Quesnel. The B.C. Railway has a service three times per week, both north and south. Passengers may board or disembark at numerous communities along the route. Highways 97 and 26, together with numerous tributary roads, serve most of the area. Much of the land is privately held or under grazing lease; therefore permission is required before entering these lands either by vehicle or on foot.

The purpose of investigating the coal resources of the Cariboo coalfield is to examine alternate fuels for a proposed hog fuel plant at Quesnel should the hog fuel be insufficient for the plant. The previously explored portion of the Cariboo coalfield is 35 km south of Quesnel and some coal is known to underlie Quesnel itself. Approximately 290 000 t/a would be required for a 60 MW (gross) thermal plant if the plant was forced to rely totally on coal.

SECTION 2.0 - LAND STATUS

A coal land reserve was established over part of the Cariboo coalfield on behalf of B.C. Hydro and Power Authority on 14 December 1979 (Appendix A) under Order in Council 3050. The study area lies in the Cariboo Mining Division. Much of the land in the area is privately owned or under grazing lease which restricts access to outcrops.

It seemed advisable at this preliminary stage to maintain a low profile, so only areas that were accessible by public road or along the tracks of the B.C. Railway were examined. Mineral claim maps and related assessment reports together with exploration reports on expired coal licences provided much of the information on the geology and geophysics of the region.

SECTION 3.0 - HISTORY

The coal deposits near Quesnel were first described by Mr. G.M. Dawson in 1871 and several years later he described additional deposits 50 to 65 km northwest of Quesnel.[1,2] Mr. D.B. Dowling reported on coal showings and associated stratigraphy near Quesnel in 1915.[3] In 1920 Mr. L. Reinecke[4] in describing mineral deposits between Lillooet and Prince George noted the clay, diatomaceous earth and coal of the Quesnel region; he also described the regional geology. An anonymous author described various coal showings between Alexandria Ferry and 2 km north of Quesnel in 1924;[5] he believed that the showings lay in a number of small basins. In 1929 Mr. W.S. Bacon described the geology of a number of showings along the Fraser River near the mouth of Australian Creek[6] and Mr. C.J. de Souza listed some analyses and gasification data for Cariboo coals.[7] In 1930 both Mr. B.W. Dunn[8] and Mr. S.J. Schofield et al.[9,10] reported on oil possibilities in the area. Additional geologic interpretations were provided by Mr. S.J. Schofield[11] and lithologic logs for 3 drill holes near Australian Creek were summarized by Mr. A. Lakes[12] in 1930. In 1932 Mr. W.E. Cockfield described the general geology of the sedimentary deposits and assessed oil and gas possibilities in the Fraser basin.[13] Mr. D. Lay produced a comprehensive study of the Tertiary drainage history in 1940 and 1941; in his report he also described the locations and nature of Tertiary outcrops.[14,15] In 1941 two analyses of Cariboo coal were reported by Mr. J. Dickson in his summary of analyses of B.C. coals. In 1951 a hole was drilled for oil exploration by the Kersley Oil and Gas Company Limited to a depth of 3552 feet (1083 m); two coal seams were noted at 110 feet (34 m) and 860 feet (262 m) and the lower seam was analyzed;[17] no geologic information was recorded from a subsequent hole drilled in 1952 and abandoned at 648 feet (198 m),[18] well above its proposed depth of 3370 feet (1027 m). Three additional holes named Australian No. 1, Beaver Valley No. 1 and Beaver Valley No. 2 were drilled for oil on lot 6726, lot 719 and near Harper's camp;[19] there is no additional

information on these holes because they were drilled before reporting to the Petroleum Branch was organized. In 1951 Mr. J.S. Irwin reported on the geology of the Soda Creek area.[20] A geological survey of the Quesnel area was conducted by Messrs. R.H. Laurence and J.C. Sproule in 1953.[21] The Jig claims, southwest of Quesnel, were examined by Mr. I Bain for clay and diatomite in 1958.[22] In 1959 Messrs J.S. Scott and D.W. Smellie supervised a fixed wing air-borne magnetometer survey over the Quesnel River area.[23] In 1959 through 1960 Dr. H.W. Tipper completed bedrock[24,25] and surficial[26] geologic mapping of the Quesnel and Prince George map areas which included the coal-bearing region examined in this current investigation. In 1961 an air-borne magnetometer survey was completed over most of the study area (5 maps)[27] for the Geological Survey of Canada and the B.C. Department of Mines and Petroleum Resources.

Beginning in 1968 exploration activity in the area increased. Numerous assessment reports were completed based on geophysical, geochemical and geological investigations of mineral properties within the southern part of the map area.[28,35,36,37,38,39,40,41,44,45,46] Oil and gas exploration was conducted in 1969 and 1970.[29,30,31,32,33,34,42] As part of these investigations Mr. K.M. Piel examined the palynology of Oligocene sediments and presents a good summary of the previous work on geology and paleo-environment.[42] Renewed gas exploration throughout much of the Fraser Basin and Nechako Plain began again in 1979. Coal exploration and investigation resulted in summaries of drilling programs[43,47] and coal geology[43,48] being prepared by Masters Exploration and the Geological Survey of Canada (21 drill holes and 3 drill holes respectively). The drilling by Masters Exploration was restricted primarily to the west bank of the Fraser River near the mouth of Australian Creek. Dolmage, Campbell and Associates Ltd. summarized the coal geology of the Cariboo coalfield in their investigation of coal resources of British Columbia.[49] R.M. Hardy and Associates Ltd. examined the potential for sliding at Quesnel in 1978 for the Ministry of Highways after drilling 14 diamond drill holes and 10 rotary holes.[50]

SECTION 4.0 - METHODOLOGY

In order to evaluate the potential of the Cariboo coalfield a literature search and site visit were completed.

A field examination of the Cariboo coalfield was conducted between 27 March and 1 April 1980. This examination consisted both of investigating previously known outcrop locations and coal showings provided by Mr. P.S.W. Graham of the Geological Survey of Canada or described in other reports and of searching for new outcrops. Only outcrops near roads or accessible without crossing privately held land were examined and mapped. In addition an appreciation of the topography and its possible effect on mining was obtained.

A number of important considerations became evident as a result of the site visit. Outcrops are scarce, particularly in areas underlain by Tertiary sedimentary rocks. Outcrops are found over only a few percent of the area of the sedimentary basin. Major creek gully walls, river valley walls, roadcuts and railway cuts provide most of these bedrock exposures. There was appreciable valley in-filling by sand and gravel deposits during the waning stages of glaciation; subsequently the rivers and large creeks cut through these deposits and even now the rivers and creeks are rarely directly on bedrock. Most of the Fraser Basin consists of a flat bench underlain by these thick sand and gravel deposits. The Dragon Mountain Range, which consists of metasedimentary rocks comprises an upland plateau with few outcrops. There are other plateaus and rounded mountains which are composed of volcanic and plutonic rocks. These factors necessitate a strong reliance on geophysics (i.e. air-borne magnetometer) for mapping the bedrock.

In examining the government air-borne magnetic maps[27] it was evident that a large area near the reserve had low magnetic relief

characteristic of an area of sedimentary rocks and similar to the magnetic response of the upper Hat Creek Valley. Three sedimentary rock units, which could provide this magnetic response, were mapped in the area by Tipper (1959, 1960).[24,25] These are the Permian or earlier Cache Creek Group consisting of chert, argillite, limestone, greenstone and minor greywacke and conglomerate, the Upper Triassic and Lower Jurassic strata consisting of argillite, greywacke, andesite and basalt tuffs, breccias and flows, with minor conglomerate and limestone and the equivalent of the Kamloops Group consisting of conglomerate, sandstone, greywacke, claystone, shale, lignite, volcanic breccia, tuff and basalt. The determination that vast areas around Quesnel are underlain by sedimentary rocks and that these rocks could belong to the coal-bearing formation, required that the scope of the study be enlarged from including only the coal reserve to incorporating a belt 36 km wide and 108 km long.

During the visit snow conditions ranged from patchy and a few inches deep on the benches of the Fraser and Quesnel rivers, through snow that was 30.0 cm deep in major creek gulleys where shaded, to snow that was more than 40.0 cm deep along the ridge of Dragon Mountain. The snow only provided a minor hinderance to locating outcrop in the Fraser Valley where most of the field investigation was conducted.

There is coal in the vicinity of Quesnel itself. If an economic deposit was found, it would be difficult to mine because housing and commercial subdivisions with large lot sizes are widespread around the city of Quesnel. The presence of residences limited access to some areas during the site visit.

Drill logs, mineral inventory maps,[51] assessment report maps[52] and assessment reports were used to provide geologic information for interpreting the air-borne magnetometer results. From this information a revised geologic map was constructed.

SECTION 5.0 - GEOLOGY

5.1 REGIONAL GEOLOGY

Although bedrock is exposed over only a few percent of the area, glacial drift is thin on the plateaus and on the sides of the steeper hills. Bedrock age in the area ranges from Permian to Recent (Table 5-1).

The Cache Creek Group comprises the oldest rock unit that outcrops in the area (Fig. 5-1 a,b). Much of the Dragon Mountain ridge as well as the areas around McLeese and Bouchie lakes are underlain by rocks of the Cache Creek Group. The unit consists of argillite, slate, greenstone, guartzite, tuff and shale. An exposure of this unit was examined along the road between Dragon Lake and Hydraulic Lake, which follows the Quesnel River valley. Near Dragon Lake the bedrock consisted of several rock types. The fine-grained chloritic sandstone trends 128° and dip 63° southwest. Chloritized micaceous quartzite is white with dark green blebs; clasts are angular and approximately 2.5 mm in diameter; the foliation is moderately well developed. White fine-grained tuff, which weathers yellow brown to dark brown and contains voids partially filled with quartz, is exposed at the same location. A dark grey sandstone with grey, white, black and light brown well rounded clasts, approximately 0.5 mm in diameter, with moderate sphericity, was found in the same outcrop area; the rock is composed of approximately 50 percent clasts with calcium carbonate cement and it is cut by a few calcite veinlets. A well bedded, dark grey, calcareous shale, with a few flecks of pyrite, is associated with this rock unit. Near the south end of the outcrop area there is interbedded dark grey slate and white and grey, mottled sandstone. The beds are of variable thickness with well developed slaty cleavage at approximately 70° to the bedding. Minor open folds are common and plunge 116° at 21°; the axial plane strikes 084° and dips 43° southeast. Crenulations at the same outcrop trend 138° at 29°. There are a

TABLE 5-1

TABLE OF FORMATIONS

CENOZOIC

Quaternary

Pleistocene and Recent

Till, gravel, sand, clay, and silt

Tertiary

Miocene and (?) Pliocene or Pleistocene

Basalt, andesite, related tuff and breccia; minor conglomerate, greywacke, shale and diatomite

Middle-Upper Miocene

Upper Fraser River Formation conglomerate, sandstone, siltstone, claystone; minor clay, coal, diatomite and tuff

Lower Oligocene

Lower Fraser River Formation claystone with lesser sandstone, conglomerate and coal

Eocene

Basalt, andesite, related tuff and breccia; minor conglomerate, sandstone, and shale

MESOZOIC

Lower Jurassic and (?) Later

Granodiorite, quartz diorite, diorite, biotite granite, quartz monzonite, monzonite, granite and minor gabbro

Upper Triassic (?) and Lower Jurassic (?)

Argillite, greywacke, green, grey, black, purple andesite and basalt and related tuffs and breccias; minor conglomerate and limestone

PALAEOZOIC

Permian and (?) Earlier

Cache Creek Group black to dark grey ribbon chert, black argillite green to black basic volcanic rocks, grey limestone; minor argillite and chert; mainly grey limestone, greywacke

few small veinlets of quartz as much as 1.0 mm wide. An area of angular float consisting of olive green phyllite with abundant chlorite and epidote, together with grey, massive quartzite, was found adjacent to the Hydraulic Lake road, southeast of Dragon Mountain. Another outcrop of well bedded, green tuff was found in a small rock quarry west of Dragon Mountain; the bedding strikes 017° and dips 11° southeast.

Upper Triassic (?) and Lower Jurassic (?) marine, sedimentary and volcanic rocks comprise a discontinuous northwest trending belt and numerous isolated pods in the northern part of the map area.[24,25] Towards the south this unit projects under part of the unmapped region. The sequence consists of argillite and greywacke, plus andesite and basalt flows, tuffs and breccias, minor conglomerate and limestone. The attitude of bedding in this unit is variable (Fig. 5-1 a,b).

The older units are intruded by granodiorite, quartz diorite, diorite, biotite granite, quartz monzonite, monzonite, granite and rarely gabbro plutons.[24,25] These intrusions crop out northwest of Bouchie Lake, along the Cottonwood River, along Ahbau Creek, on Granite Mountain and east of McLeese Lake; they undoubtedly underlie some of the drift and fluvial deposits as well as some of the previously unmapped portions of the study area. The granitic rocks are commonly coarse-grained and deeply weathered; some are foliated.

The base of the Cenozoic is composed mainly of Middle Escene basalt and andesite comtemporaneous with the volcanic rocks of the Kamloops Group to the south. The volcanic rocks are exposed in a north northwest trending belt near the Fraser River. Three radiometric dates have indicated an age of 42 million years for the lavas.[42] This unit is believed to be a valley fill sequence[15] more than 600 m thick.[48] Some of the flows dip at high angles. Two samples were collected from this unit. The first sample was collected west of the Fraser River and north of Narcosli Creek and consists of green-brown andesite with chalcedony amygdules surrounded by a chloritic rim. The second sample

is from the banks of Narcosli Creek and consists of black, vesicular basalt with ellipsoidal vesicles that are lined with light green chlorite.

The lower Fraser River Formation is of early Oligocene age and consists of more than 360 m of claystone[48] with lesser quantities of sandstone, conglomerate, coal and ironstone. The sequence is commonly thin-bedded and gently folded with dips usually between 20° and 30°. The sandstones are light green, fine to medium grained. Clasts are rarely as much as 2.0 mm in diameter. The sandstones contain a moderate to high percentage of clay and sorting is moderate to good. The lower part of the coal-bearing sequence was examined on Australian Creek, where an exposure approximately 0.8 m thick consists of black, friable, dull, thin-bedded coal (Fig. 5-2). There are numerous other thin exposures of dirty coal along Australian Creek and along the tracks of the B.C. Railway. The latter exposures are in the upper part of the lower Fraser River Formation and they are associated with poorly consolidated sandstone and claystone (Fig. 5-3). Coal is also evident from a zone of baked claystone on the south bank of the Quesnel River at its junction with the Fraser River (Fig. 5-4). The lower Fraser River Formation crops out south of Quesnel and underlies some of the fluvial and drift deposits adjacent to the Fraser River and as far south as McLeese Lake.

The upper Fraser River Formation is of Middle to Late Miocene age and it is exposed north and east of Australian Creek as far north as Dragon Mountain and also north of Quesnel. This member consists of more than 200 m of massive conglomerate and sandstone (Fig. 5-5) which grades upward into siltstone, claystone and minor clay, coal and diatomite. The beds are poorly indurated and the associated coal seams are thin, dirty and discontinuous.

Olivine plateau basalt and andesite, which are of Early Pliocene to Late Miocene age, are exposed near Bouchie Lake and on both

Fig. 5-2 - Coal outcrop along Australian Creek

Fig. 5-3 - Dirty, oxidized coal outcrop along the B.C. Railway tracks south of Quesnel

Fig. 5-4 - Red clay in a burned zone in the lower Fraser River Formation, south side of the Quesnel River.

Fig. 5-5 - Sandstone of the upper Fraser River Formation on the east bank of the Fraser River north of Quesnel.

5.1 REGIONAL GEOLOGY - (Cont'd)

sides of the Fraser River south of Kersley. The sequence contains breccia and tuff as well as flows and it could be as much as 300 m thick.[25] The plateau-building flow rocks are relatively undeformed and lie unconformably on the Fraser River Formation.

The area was covered by glaciers resulting in the deposition of Pleistocene to Recent till, gravel, sand, clay and silt. Along the Fraser River there are as many as three till sheets and deposits are locally as much as 215 m thick, although they are commonly only 8 m to 15 m thick.

5.2 SURFICIAL GEOLOGY

In the Quesnel area glacial movement was in a northerly direction. South and east of Quesnel movement was north westerly changing to northeasterly north of Quesnel. South and west of Quesnel movement was northeasterly changing to due north near Quesnel.

Most of the upland areas are covered with a thin veneer of till. Lacustrine sediments are extensive in the upper parts of the Fraser Valley north of Marguerite.[24] These deposits were cut to form terraces along the Fraser, Quesnel and Cottonwood rivers and along some major creeks. The remaining parts of the Fraser and Quesnel valleys contain fluvial sediments.

5.3 AIR-BORNE MAGNETOMETER SURVEY

(a) Magnetic Theory

The two kinds of magnetism that contribute to the total field magnetic intensity are termed remanent magnetism and induced magnetism. Remanent magnetism results from the tendency of some rocks to form natural magnets with a field orientation related to the earth's magnetic field at the time the rock cooled below the Curie point (585°C for magnetite). Like the remanent magnetic

field, the strength of the induced magnetic field is related to the amount of magnetic minerals, particularly magnetite, in the rock. However, the induced magnetic field is produced in susceptible substances (eg. magnetite) by induction from the earth's present magnetic field. For simplicity of interpretation induced magnetism is assumed to be the total source of the magnetic effects. Under most circumstances this assumption closely approximates the existing situation.

The flux lines of the earth's magnetic field at Quesnel are inclined at approximately 75° and are at a declination of about 25° east. These flux lines are related to the orientation of the induced magnetic field.

The response of the magnetometer varies with the inverse square or cube of the distance from the source depending on the slope and orientation of the source (rock unit) relative to the earth's magnetic field. Each magnetic source is in fact a dipole, although a monopole response may be given by a geologic source depending on the orientation of the earth's magnetic field and the orientation of the source relative to that field. Unfortunately responses are often due to a number of sources; therefore there may be several geologic interpretations for any geophysical perturbation.

Mafic igneous or metamorphic rocks usually contain more magnetite and therefore they have a more pronounced magnetic response than felsic rocks. Sedimentary rocks usually give a response which is still lower. The magnetic relief together with the anomaly signature may enable an investigator to forecast the rock type and orientation of the strata.

5.3 AIR-BORNE MAGNETOMETER SURVEY - (Cont'd)

(b) Quesnel Survey

The air-borne magnetometer survey by the Geological Survey of Canada and the B.C. Department of Mines and Petroleum Resources (now Energy, Mines and Petroleum Resources) provided considerable information for assessing the nature of the underlying bedrock. A revised geological map was constructed which was based on this survey and it is described in Section 5.4. The survey was flown at a mean terrain clearance of 1000 feet (305 m) along flight lines approximately one half mile (0.8 km) apart.

The low magnetic relief and low topographic relief over much of the map area is characteristic of areas underlain by sedimentary rocks which tend to have appreciably lower magnetic susceptibilities and therefore magnetic intensities than most volcanic or plutonic rocks. The study area was enlarged from the area of the coal reserve to include the area illustrated in Fig. 5-6 a,b because of this widespread area of low magnetic relief.

A number of geophysical features are evident from the air-borne magnetic map (Fig. 5-6 a,b). Two large plutons are situated in the map area; one is near Greening, in the northeast corner of the map area, and the other is at Granite Mountain. The latter pluton appears to be larger, consisting of more felsic material and may be in part sill like. Both plutons appear to be larger than indicated by surface outcrops. A northwest trending belt of alternating magnetic ridges and troughs extends along the eastern margin of the map area. These belts consist of volcanic horizons with the western part dipping westerly. The magnetics of the central part of this volcanic sequence is very complex and this complexity may result from a much lower dip angle to these strata. Two similar, discontinuous belts extend along the eastern side of the study area. These belts are associated with both steeply dipping Eocene and flat lying Miocene volcanic sequences

5.3 AIR-BORNE MAGNETOMETER SURVEY - (Cont'd)

which together produce a very complex magnetic response. Despite this complexity the flat lying nature of the Miocene volcanic is evident from the magnetic signature and overall low relief between Macalister and Cuisson Lake. Most of the broad areas of low relief are under lain by Early Cambrian or later, Pennsylvanian (?) and Permian, Late Triassic and Early Jurassic (?), Early Oligocene or Middle to Late Miocene sedimentary rocks. The distinction between these units is based on observations at a few outcrops. The air-borne magnetometer maps have been used to extrapolate to covered areas. The locations of narrow belts of Oligocene and Miocene sedimentary members of the Fraser River Formation have been taken from earlier publications; however, some of those lying in major river valleys may be unconsolidated, Recent, glaciofluvial or fluvial material. The Miocene unlithified sediments are particularly difficult to distinguish from Recent sediments. West of the Fraser River and north of the Cottonwood River the Fraser River Formation is thin and the underlying volcanic rocks are evident from the high magnetic relief.

A number of faults have been identified on the basis of the air-borne magentometer survey. These faults trend principally northwesterly and some of them offset units as recent as Miocene in age. These faults are principally normal faults with some possibly having a strike-slip component.

5.4 REVISED REGIONAL GEOLOGY

Much of the bedrock geology of the study area remained unmapped after the investigation by Tipper (1959, 1960)[24,25] because of the lack of outcrops. The air-borne magnetic maps, assessment reports, recent geological mapping and site visit were used to reinterpret the nature of the underlying bedrock (Fig. 5-7 a,b) within the study area.

5.4 REVISED REGIONAL GEOLOGY - (Cont'd)

The Cache Creek Group of Permian and possibly earlier age, comprise the oldest rocks in the map area. This unit is in a northwest trending belt and the strata have a variable strike, which is commonly northwesterly, and a variable dip.

The next oldest rocks lie in the northeast corner of the map area and comprise an Upper Triassic (?) and Lower Jurassic (?) sequence. The strike of the rocks is variable and the dip ranges from moderate to steep.

Lower Jurassic and possibly later intrusions outcrop near Granite Mountain and near Greening. The Granite Mountain stock may be partly sill like, intrudes the Cache Creek Group and contains several copper showings. The stock near Greening plunges vertically.

Eocene volcanic rocks equivalent to the Kamloops Group lie unconformably over the older rocks and comprise two belts along the Fraser and Quesnel rivers as well as other isolated areas. The eastern belt is in faulted contact with the Cache Creek Group. The thickness has been estimated by Lay (1941)[15] at more than 600 feet (180 m). The volcanic rocks are mainly flows of andesite, basalt and quartz latite with some beds of tuff, pumice and sandstone.

The volcanic sequence is overlain unconformably by Lower Oligocene sedimentary rocks that are along the Fraser River south of Quesnel and possibly includes some isolated outcrops south of Castle Rock. These latter areas were not visited in preparing this report and may be exposures of glaciofluvial sediments. Dips are less than 35° and commonly less than 20°. An anticlinal structure is evident along Australian Creek; the structure possibly plunges southwesterly at a low angle. At Dodd's Ranch, on the west side of the Fraser River and near the mouth of Australian Creek the dominant structure is a southwest plunging syncline.

5.4 REVISED REGIONAL GEOLOGY - (Cont'd)

The Middle to Upper Miocene sedimentary rocks overlie the earliest Olgiocene strata and appear to extend beyond the confines of the basin mapped earlier. This unit comprises the subcrop east of the Fraser River and north of Australian Creek and north of Quesnel. The beds commonly dip more gently than the underlying Oligocene strata.

These sedimentary units are overlain by gently dipping, plateau-type, volcanic rocks. These volcanic rocks lie in two discontinuous belts on either side of the Fraser River and south of the junction of the Quesnel River and Beaver Creek.

5.5 COAL GEOLOGY

The principal coal-bearing member in the Cariboo coalfield is the lower Fraser River Formation of Lower Oligocene age. This member is more than 360 m thick and consists of claystone with lesser amounts of sandstone, conglomerate, coal and diatomite.[48] The principal coal seams are contained in the lower part of the member and they have been noted in drill holes, outcrops or underground workings on Australian Creek, Doyles Ranch, Quesnel, Howard's Ranch and Alexandria Ferry.

The initial drilling in the area was conducted on Australian Creek and consisted of three drill holes between the Fraser River and the upper reaches of the creek (Table 5-2 and Fig. 5-7 a,b). The maximum thickness of a coal zone was 24.1 m, encountered in DDH 30-3 (Appendix B).

A more detailed description of the statigraphic column for this area was given by Graham (1978)[48] and it is summarized in Fig. 5-8. The principal coaly interval is approximately 18.7 m in apparent thickness; the true thickness is 16.5 m. This zone is approximately 52 percent coal. A second coal zone is 70 m lower in the section and it is 4.0 m thick. The interval between the coal zones

TABLE 5-2

RESULTS OF DRILLING IN THE CARIBOO COALFIELD

Drill Hole No.	Collar Elevation (in m)	Hole Depth (in m)	Depth to Coal (in m)	Apparent Thickness of Coal (in m)	Apparent Thickness of Partings (in m)	Ratio of Coal to Waste in Zone
30-1	N.D.[1]	191.4	30.5	4.4[2]/35.8[3]/0.6[+]	N.D.	N.D.
30-2	N.D.	194.8	-[4]	-	-	-
30-3	N.D.	189.0	1.5	4.3/141.7/24.1	N.D.	N.D.
71-1	454	44.2	7.9	13.2	8.6	1.53
71-2	451	68.6	10.1	10.6/28.9[3]/2.9	3.1/28.9/2.7	3.39/1.10
71-3	482	89.9	72.4	3.4	0.1	27.50
71-4	479	83.8	17.1	7.1/45.2/1.1	4.5/45.2/3.8	16.37/0.28
71-5	485	138.7	72.1	4.8/15.2/0.6	2.7/15.2/0.4	1.79/1.46
72-6	506	68.6	13.4	0[5]	-	-
72-7	469	77.7	39.9	9.2	3.0	3.11
72.8	451	62.5	41.7	5.8	1.0	5.95
72.9	472	77.7	9.4	0.6	0.4	1.50
72-10	479	65.5	-	-	-	-
72-11	442	74.7	-	-	-	-
72.12	500	77.7	-	-	-	-
72.13	472	77.7	-	-	-	-
72.14	454	77.7	-	-	-	-
72.15	463	59.4	-	-	-	-
72.16	448	59.4	-	-	-	-

TABLE 5-2 - (Cont'd)

Drill Hole No.	Collar Elevation (in m)	Hole Depth (in m)	Depth to Coal (in m)	Apparent Thickness of Coal (in m)	Apparent Thickness of Partings (in m)	Ratio of coal to waste in zone
72.17	436	29.0	-	-	-	-
72.18	576	80.8	60.2	2.0	3.2	0.62
72.19	524	32.0	11.0	0.2/14.2/0.3	0/14.2/2.9	0/0.12
72-20	530	77.7	26.5	1.5/8.5/2.7	2.2/8.5/9.3	0.67/0.29
72-21	442	47.2	-	-	-	-
78-Q-1	N.D.	215.8	60.5	9.4/77.5/4.0	8.8/77.5/3.4	1.05/1.18
78-Q-2	N.D.	160.0	-	-	-	-
78-Q-3	N.D.	230.7	32.5	2.6/20.4/2.3	10.5/20.4/21.2	0.25/0.11
78-RMH-1	474	23.5	8.5	3.1	2.8	1.10

[1] N.D. is an abbreviation for not determined.

[2] Considerable clay is included in the interval. Where three numbers are given under thickness, the thicknesses of coal or partings in the zones are noted together with the thickness of the intervening waste.

[3] The interval contains several thin seams each less than 0.6 m thick.

[4] A dash (-) indicates that no coal was found.

[5] Although there was no coal, a burn zone possibly 0.6 m thick was encountered immediately under the surficial deposits and at a depth of 1.34 m.

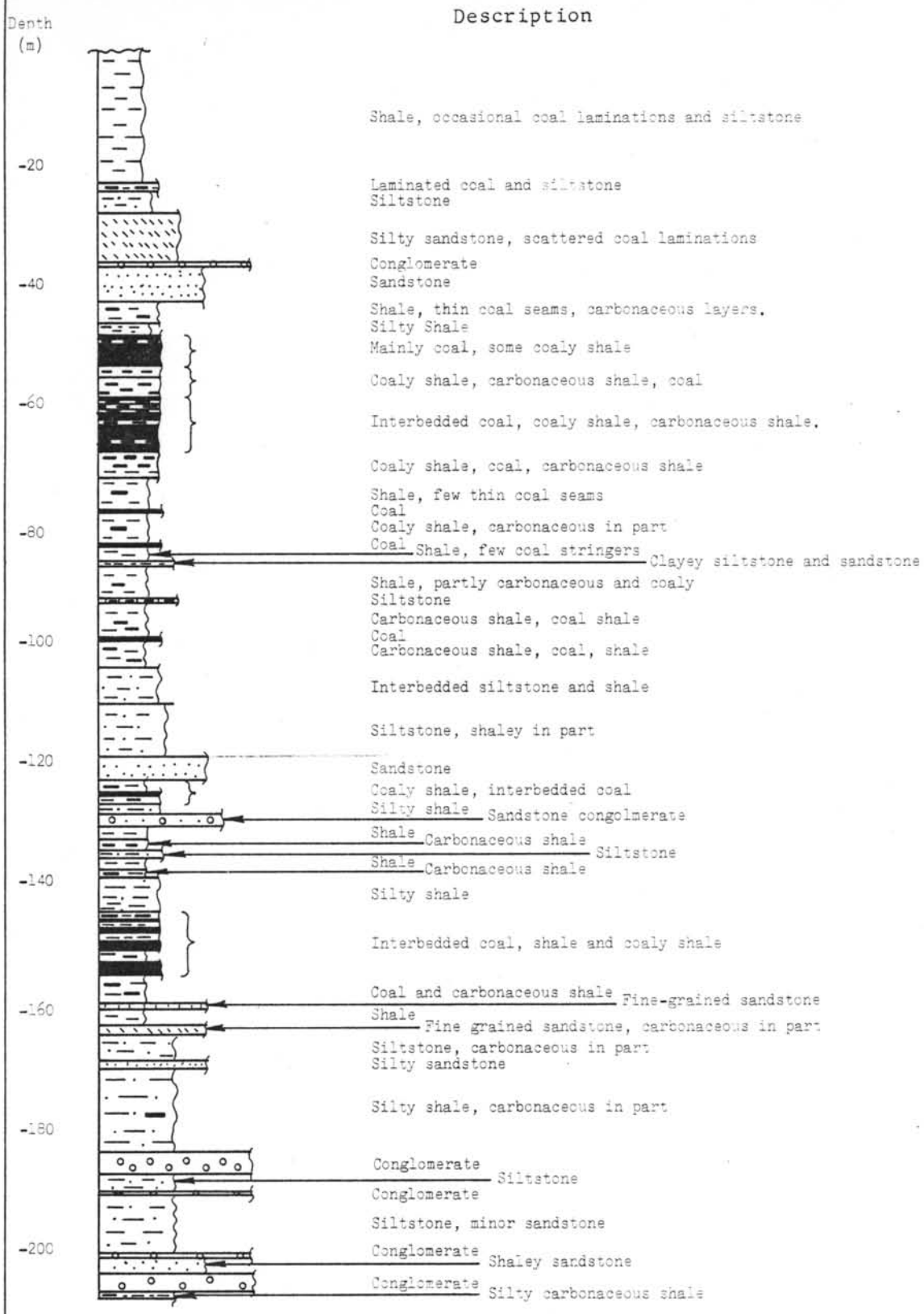


FIGURE 5-8 Partial Stratigraphic Column Through the Coal-Bearing Interval Lower Fraser River Formation at Australian Creek (Apparent Thickness)

consists principally of carbonaceous shale and siltstone. The strata below the lower seam contain appreciably more coarse clastic rocks.

Australian Creek was explored some time ago with adits, inclines and surface mapping. Coal analyses are summarized in Table 5-3 and indicate that the coal rank is subbituminous B to C.

Drilling in 1971/72 by Masters Exploration was concentrated near the mouth of Australian Creek. Only holes DDH's 71-1, 71-2, 71-3, 71-4, 71-5, 72-7 and 72-8 encountered significant coal (Table 5-2). The apparent thicknesses are 13.2 m, 10.6 m, 3.4 m, 7.1 m, 4.8 m, 9.2 m and 5.8 m respectively for the main coal zone in these drill holes. The ratio of the coal seams to total partings are 1.53, 3.39, 27.50, 16.37, 1.79, 3.11 and 5.95 to 1.0 respectively for the drill holes. These ratios compare favorably to the 1.05 to 1.0 ratio determined for the main coal zone in DDH-78-Q-1; however the quality of the logs for the 1971/72 holes and the lack of detailed coal analyses for the holes makes a further assessment impossible.

Outcrops of coal have been reported north of Diamond Island (on the east bank of the Fraser River), where two drill holes apparently failed to penetrate the surficial deposits; additional outcrops of coal were reported south of Menzinger Creek on the east bank of the Fraser River, near the mouth of Dog Prairie Creek, along the railway tracks south of Quesnel and in the city of Quesnel. In addition thin zones of coal 2.6 m and 2.3 m thick, containing numerous partings, were reported on DDH-78-Q-3 at Quesnel (Table 5-2 and Fig. 5-7a). A burned zone consisting of baked claystone forms a red and orange bluff at the mouth of the Quesnel River and DDH-72-6 penetrated 0.6 m of similar baked claystone immediately below the surficial deposits near the mouth of Australian Creek. These burned zones indicate the presence of near surface coal in addition to that previously located.

TABLE 5-3

COAL SEAM DATA, QUESNEL, B.C.

Location	Source of Data	Coal Thickness (m)	Interval Between Seams (m)	Moisture (%)	Volume Matter (%)	Fixed Carbon (%)	Ash (%)	Sulphur (%)	H.V. (kJ/kg)	Reference
Alexandria Ferry	outcrop	1.07 1.22 1.22	0.6 0.46	6.9[1] 5.1 1.4	39.7 38.2 38.8	39.7 38.5 36.8	13.7 18.2 21.0			BC MMAR, 1924
Doyles Ranch	outcrop	minium 2.4		13.9	23.4	27.2	15.5	0.6	13816	Can. Dept. Mines Tech. Surv. Rept. Analyses, 1940
	outcrop	minimum 2.4		21.0 0.0[2]	25.5 42.8	31.8 57.2	21.7 0.0			BC MMAR, 1931
	7 rotary[4] & 1 dd hole	1.2 to 13.2 net coal		45.8 0.0[3]	19.3 49.3	18.5 51.7	16.4 30.2	0.23		Yoon, 1972 Lakes, 1930
Australian Creek	adit	1.13		11.5 0.0[3]	30.6 49.8	28.4 50.2	29.4 0.0			Reinecke, 1920
	incline	1.2 1.2		5.6 8.7	36.8 35.4	37.0 37.1	20.6 18.8			BC MMAR, 1924
	dd holes	2.3 2.3 2.4 to 3.7		18.8 17.2 14.8	30.0 30.5 32.4	31.6 45.3 52.2	19.6 7.1 0.6	1.6 1.0	15630 18468 29215[3]	Lakes, 1930
	ddh 3	4.2 to 21.9	141.7							
Near Australian Creek	outcrop(?)			27.9	28.6	34.5	9.0			Dickson, 1941
Kersley	drill hole			0.0[3]	40.0	50.2	9.8	1.5	26098	B.C. Min Energy Mines Pet. Res. O.F.
Howard's Ranch	outcrop	1.3		3.6 0.0[2]	40.2 52.0	35.6 48.0	20.6 0.0			BC MMAR, 1924
Quesnel	outcrop(?)			14.6	37.3	43.4	4.7			Dickson, 1941
North of Quesnel	outcrop(?)			2.8	36.8	25.4	35.0			BC MMAR, 1924
Quesnel	3 rotary holes	2.0 to 6.0								B.C. Dept. Highways Unpublished Rept., 1958
Red Cliff	15 auger holes	18 net or 30 gross								B.C. Dept. Highways Unpublished Rept., 1978

[1] Analysis on an "as Received" basis

[2] Dry ash free analysis calculated using the Parr Formula

[3] Analysis on a "Dry" basis

[4] Analysis averaged from 8 samples

5.5 COAL GEOLOGY - (Cont'd)

Substantial coal quality information is available; however this information was taken on various analytical bases, with unknown sampling techniques and unknown states of oxidation. The information is summarized in Table 5-3, but it is not reliable. The samples appear to have a high inherent ash and the coal is probably comparable to Hat Creek both in rank and quality.

SECTION 6.0 - DISCUSSION

In examining the potential for coal from the Cariboo coalfield the study area was initially broadened significantly from the coal reserve at Australian Creek to include an area bounded by Hargreaves on the south, Ahbau on the north, Castle Rock on the west and Fifteen Mile Lake on the east. The larger scope was necessary based on a preliminary examination of government air-borne magnetometer and topographic maps.

These maps illustrated that magnetic properties similar to those of the Hat Creek Valley extended over much of the revised study area. Subsequent investigation comparing field observation with the magnetometer maps indicated that the magnetic response was due principally to sedimentary rocks as expected, but in most areas these rocks do not comprise the coal-bearing formation.

From the topographic maps it was determined that the area consisted of broad, flat valleys with steep to moderately sloping sides which rise to flat-topped ridges. Fig. 6-1 is a photograph looking northeast from the plateau which is composed of Eocene volcanic rocks, across the Fraser River valley, which is underlain by Fraser River Formation sedimentary rocks, and toward the ridge of Dragon Mountain in the background, which is composed of Permian (?) or earlier Cache Creek Group sedimentary rocks. Fig. 6-2 is a photograph looking northwest across the Quesnel River, which is underlain by Eocene volcanic rocks with high magnetic relief, toward Dragon Mountain, which is underlain by Cache Creek Group rocks with low magnetic relief.

Four areas near Quesnel were described by Graham (1978)[48] as being of interest for potential coal development although additional information was required to make a satisfactory assessment. The first area is Red Cliff, south of Quesnel, where the red clay from the burned

coal seam is exposed on the cliff. Drilling by the B.C. Department of Highways 560 m southwest of the cliff penetrated a possible 30 m coal zone which contains approximately 60 percent coal by volume. A coal zone 18 m thick was found in a water well 800 m east of the Department of Highways drill holes. Subsequent drilling by the Geological Survey of Canada (DDH's 78-Q-2 and 78-Q-3 in Appendix B) failed to detect significant coal.

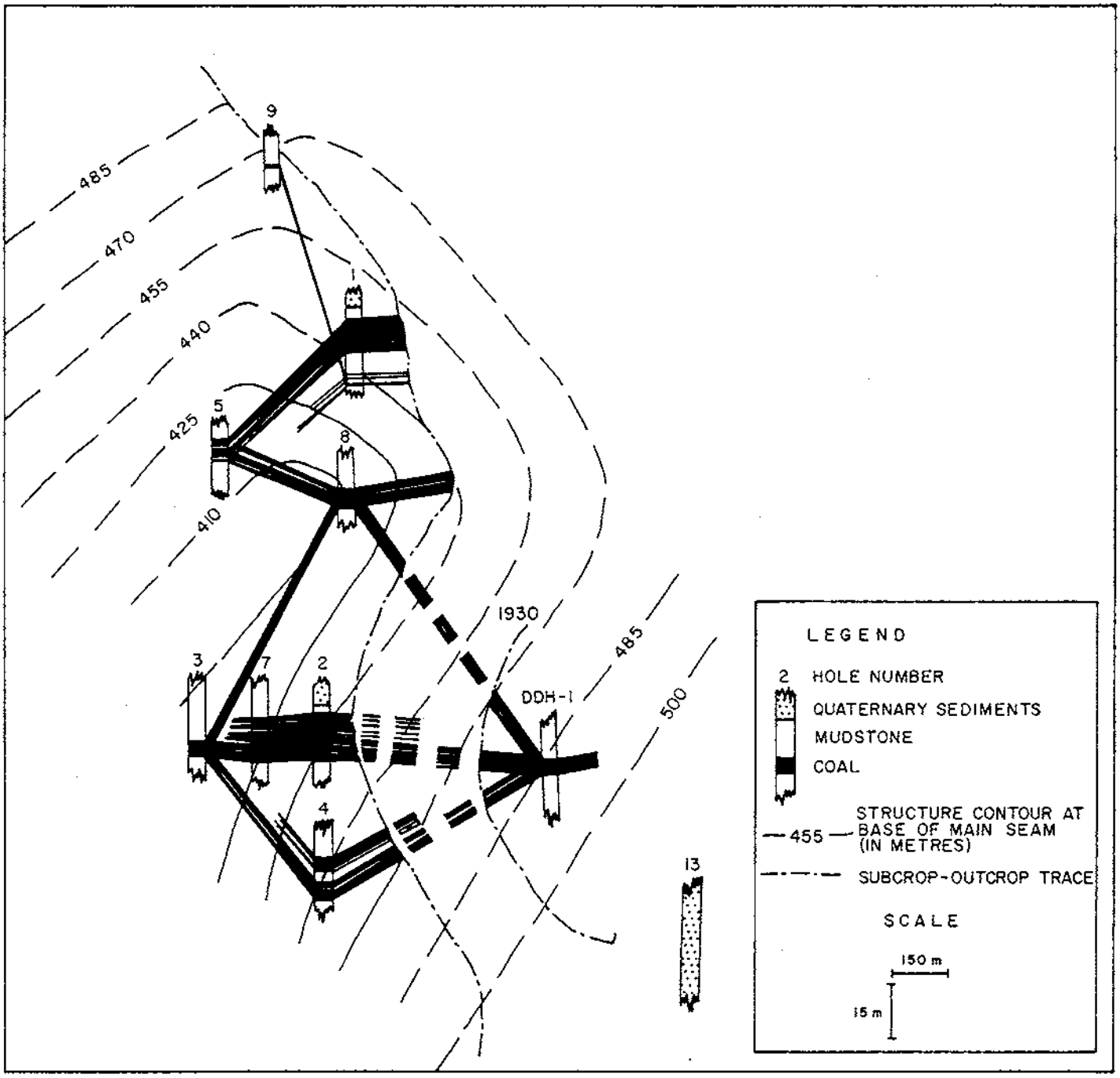
An outcrop south of the old Alexandria Ferry (Fig. 5-7b) contains a coal zone 4.7 m thick containing 3.5 m of coal. The beds dip 15° south. A large washout is believed to have eliminated much of the potential of the area; however a small area east and south of Alexandria Ferry may be underalin by a major coal seam.

The other two areas are upper and lower Australian Creek which have the most potential in the Cariboo coalfield for developing significant coal reserves based on geophysics, geological mapping and drilling. A structure contour map, based on the drilling by Masters Exploration was prepared by Graham (1978).[48] Although this map (Fig. 6-3) differs in detail from one prepared by B.C. Hydro in that the fold in Fig. 6-3 is somewhat more closed, the map from Graham (1978) is adequate to illustrate the essential features of the structure. The coal measures at the mouth of Australian Creek are folded into an open syncline plunging southwest and with the limbs dipping at approximately 10°. A fault zone may extend along the Fraser River valley. It results in a break in structural continuity across the valley. Bedrock exposures on Australian Creek indicate an anticlinal structure with the limbs dipping between 25° and 45°.

In order to determine the ability of the Cariboo coalfield to support a 60 MW coal-fired thermal plant or supplementary fuel for a hog fuel plant, the coal resources were assessed. The estimates of coal resources in the Cariboo coalfield are based on the following assumptions:

Fig. 6-1 - View looking northeast along the Narcosli Creek valley toward the Fraser River.

Fig. 6-2 - View looking northwest toward Dragon Mountain with the Quesnel River in the foreground.



FENCE DIAGRAM AND STRUCTURE CONTOUR MAP OF MAIN SEAM

FIGURE 6-3

1. The areas underlain by coal are as indicated in Fig. 6-4.

2. The structural geology is not well defined on the east side of the Fraser River, so the seams are conservatively assumed to be flat lying and confined to a narrow area adjacent to the drill holes.

3. The ratio of partings to coal in the 1930 drill holes is assumed to be 1.05:1.00 as in hole DDH-78-Q-1 (Table 5-2).

4. The coal contains 25 percent ash* and the partings contain 50 percent ash on a moist basis; therefore the overall ash content is 45 percent on a dry basis (34 percent ash on a moist basis).

5. The moisture content is 25 percent.

6. The relationship of ash to specific gravity is as determined for Hat Creek i.e. Specific Gravity = 1.1704 + .009577 (percent ash on a dry basis);[53] therefore the overall specific gravity is 1.6.

Resources for the coal zones to a depth of 80 m are estimated as follows:

Area A: Zone thickness: 6.6 m
Area: 3 990 000 m^2
Volume: (3 990 000 m^2) (6.6 m) = 26 334 000 m^3
Volume Under Fraser River: (1 200 000 m^2) (6.6 m) = 7 920 000 m^3
Effective Volume: 26 334 000 m^3 - 7 920 000 m^3 = 18 414 000 m^3
Density: 1.6 t/m^3
Tonnage: (18 414 000 m^3) (1.6 t/m^3) = 29 462 400 t

---

* This ash value agrees with the estimate of inherent ash being between 20 and 30 percent.[48]

Area B: Zone Thickness: 9.0 m

Area: 3 990 000 m^2 + 1 660 000 m^2 + 380 000 m^2 = 6 030 000 m^2

Volume: (6 030 000 m^2) (9.0 m) = 54 270 000 m^3

Volume Under Fraser River: 7 920 000 m^3

Effective Volume: 54 270 000 m^3 - 7 920 000 m^3 = 46 350 000 m^3

Density: 1.6 t/m^3

Tonnage: (46 350 000 m^3) (1.6 t/m^2) = 74 160 000 t

Although these potential resources are very high the incombustibles are also very high, possibly totalling 70 percent for the coal zone. It is difficult to assess individual seams because of the lack of detailed lithologic logs or geophysical logs for the pre-1978 drilling. By taking the main seam in each drill hole, resources were calculated based on the following assumptions:

1. The areas underlain by coal are as indicated in Fig. 6-4.

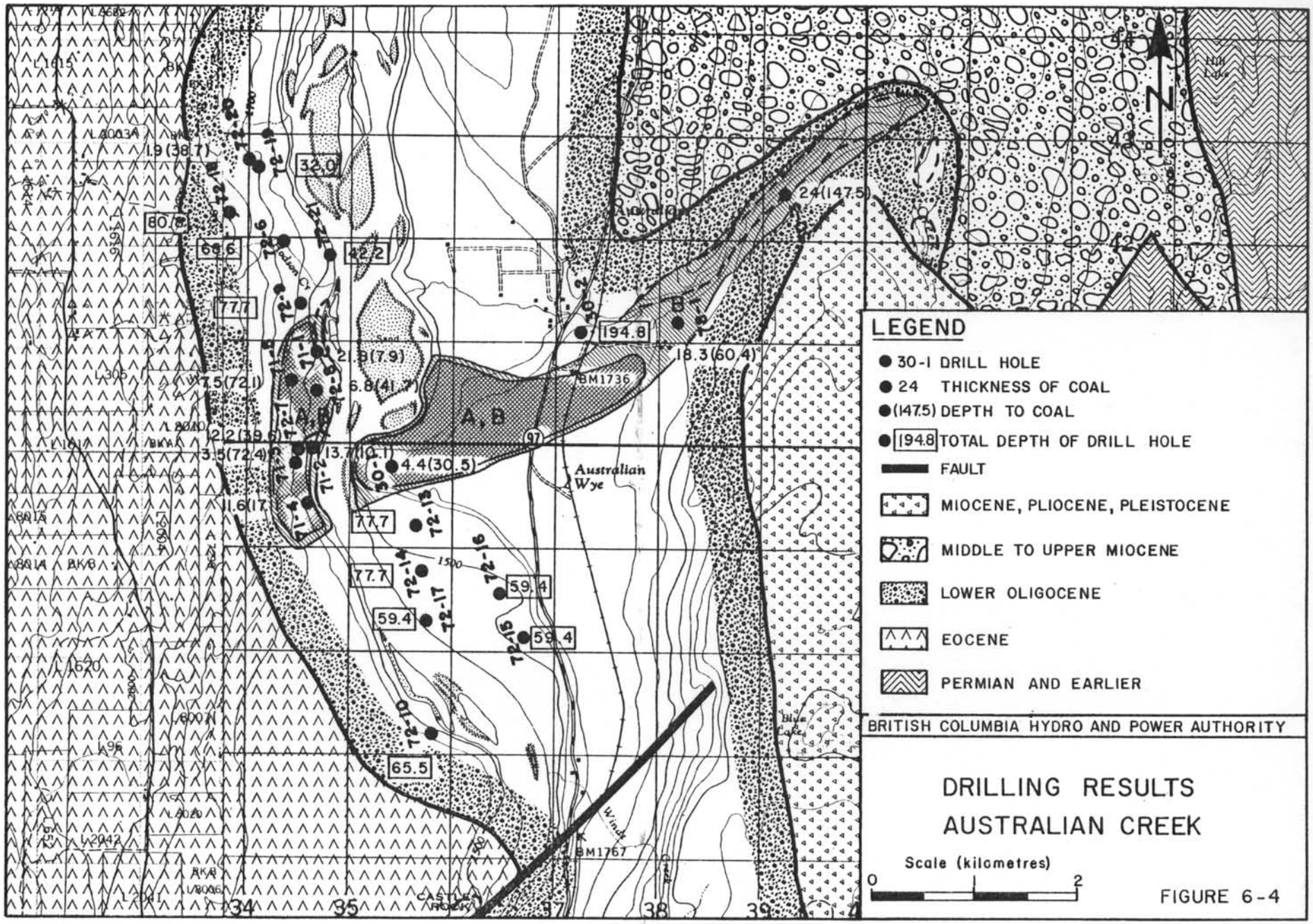
2. The seams are flat lying.

3. The amount of partings in the 1930 drill holes are the same as in DDH-78-Q-1.

4. The coal contains 25 percent ash and the partings contain 50 percent ash on a moist basis; therefore the overall ash content is 29 percent on a moist basis or 39 percent on a dry basis.

5. The relationship of ash to specific gravity is as determined for Hat Creek i.e. Specific Gravity = 1.1704 + .009577 (percent ash on a dry basis); therefore the overall specific gravity is 1.54.

Resources based on the main seams to a depth of 80 m are estimated as follows:


LEGEND
30-1 DRILL HOLE
24 THICKNESS OF COAL
(147.5) DEPTH TO COAL
194.8 TOTAL DEPTH OF DRILL HOLE
FAULT
MIOCENE, PLIOCENE, PLEISTOCENE
MIDDLE TO UPPER MIOCENE
LOWER OLIGOCENE
EOCENE
PERMIAN AND EARLIER
BRITISH COLUMBIA HYDRO AND POWER AUTHORITY
DRILLING RESULTS
AUSTRALIAN CREEK
Scale (kilometres)
0
2
FIGURE 6-4
Australian Wye
A, B
BM1736
BM1767
CASTLE ROCK
Blue Lake
Hill Lake
Windy
194.8
18.3(60.4)
24(147.5)
4.4(30.5)
59.4
65.5
77.7
32.0
42.2
80.8
69.6
1.9(38.7)
2.3(7.9)
6.8(41.7)
7.5(72.1)
2.2(39.6)
3.5(72.4)
13.7(10.1)
11.6(17)
34
35
37
38
39

Area A: Seam Thickness: 5.4 m
Area: 3 990 000 m^2
Effective Volume: 13 626 000 m^3
Density: 1.54 t/m^3
Tonnage: (13 626 000 m^3) (1.54 t/m^3) = 20 984 040 t

Area B: Seam Thickness: 6.7 m
Area: 6 030 000 m^2
Effective Volume: 32 481 000 m^3
Density: 1.54 t/m^3
Tonnage: (32 481 000 m^3) (1.54 t/m^3) = 50 020 740 t

It is estimated that a Quesnel hog fuel plant if it unrealistically was forced to operate using only coal would require 10.2 Mt. This estimate is based on a heating value of 19 380 kJ/kg (dry basis) and a 60 MW (gross) thermal plant with similar operating characteristics to Hat Creek; therefore the Hat Creek figures were simply proportioned to arrive at an approximation for coal required by a Quesnel hog fuel plant.

Although no work was conducted during this investigation that was designed specifically to assess mining problems, it is evident from lithologic logs, electric logs (caliper) and field investigation that the footwall and hanging wall rocks tend to be almost unconsolidated and therefore weak. This factor would affect the cost of surface mining and the extent and cost of underground mining.

SECTION 7.0 - CONCLUSION

There is sufficient fuel in the Cariboo coalfield for the Quesnel hog fuel plant; however inadequate information is available to assess the stripping ratio and subsequent mining costs. It is probable that sufficient strippable coal is available for a small scale mining operation to provide supplementary fuel for the proposed plant.

The mining activity would disturb a number of small farming operations. In addition the use of the coal would involve a 30 km truck haul to Quesnel. Alternate transportation could be provided by rail transport or even barge transport on the Fraser River. Each of these would involve additional handling which would be expected to increase costs. In addition the Fraser River may be flowing too quickly for barge transport to be feasible; this was not investigated.

The collection of further information on coal characteristics and reserves would require a substantial drilling program and other investigations which should not be undertaken unless the use of coal at a Quesnel hog fuel plant is considered very seriously.

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APPENDIX A

ORDER IN COUNCIL ESTABLISHING THE COAL LAND RESERVE

BRITISH COLUMBIA

3050

APPROVED AND ORDERED DEC. 14.1979

Lieutenant-Governor

EXECUTIVE COUNCIL CHAMBERS, VICTORIA DEC. 13.1979

On the recommendation of the undersigned, the Lieutenant-Governor, by and with the advice and consent of the Executive Council, orders that the area of coal land described in the attached schedule be designated as a coal land reserve until January 1, 1982.

Minister of Energy, Mines and Petroleum Resources

Presiding Member of the Executive Council

(This part is for administrative purposes and is not part of the Order.)

Authority under which Order is made:

Act and section: Coal Act, Section 30

Order (specify):

Section authority checked by C.S. WATT

(Signature and typed or printed name of Legal Officer)

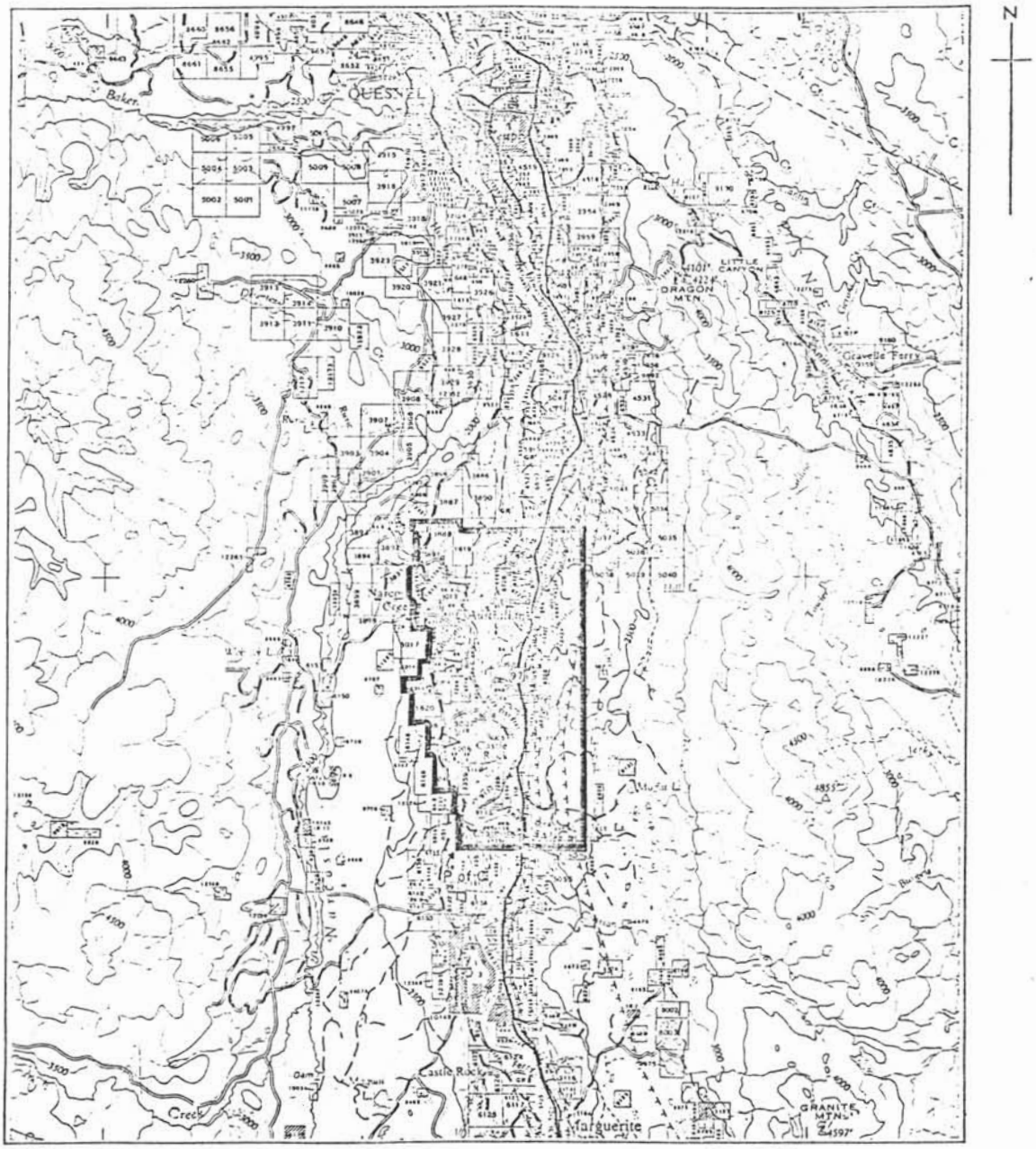
SCHEDULE

Cariboo Land District

Commencing at the most southerly southwest corner of Lot 6145; thence due east 6 500 m, more or less, to a point due south of the southwest corner of Lot 5038; thence 12 600 m, more or less, due north to the southwest corner of Lot 5038; thence northerly on the west boundaries of Lot 5038 and Lot 5037 to the northwest corner of Lot 5037; thence due west 5 900 m, more or less, to the east boundary of Lot 3888; thence northerly and westerly on the east and north boundaries of Lot 3888 to northwest corner of it; thence westerly on the south boundary of Lot 12321 to the east boundary of Lot 3900; thence due south to the north boundary of Lot 3892; thence easterly, southerly and westerly on the north, east and south boundaries of Lot 3892 to the northwest corner of Lot 12194; thence southerly on the west boundaries of Lot 12194 and Lot 1615 to the southwest corner of Lot 1615; thence easterly on the south boundary of Lot 1615 to the northwest corner of Lot 1614; thence southerly and easterly on the west and south boundaries of Lot 1614 to the west boundary of Lot 1616; thence southerly to the north boundary of Lot 305; thence westerly and southerly on the north and west boundaries of Lot 305 to the north boundary of Lot 1617; thence westerly on the north boundary of Lot 1617 and southerly on the west boundary of Lot 1617 to the north boundary of Lot 8015; thence westerly on the north boundary of Lot 8015 to the northwest corner of it; thence southerly on the west boundaries of Lot 8015 and Lot 8014 to the southwest corner of Lot 8014; thence easterly on the south boundary of Lot 8014 to the northwest corner of Lot 1620; thence southerly and easterly on the west and south boundaries of Lot 1620 to the northwest corner of Lot 652; thence northerly, easterly and southerly on the west, north and east boundaries of Lot 652 to the southwest corner of Lot 2042; thence easterly on the south boundary of Lot 2042 to the west boundary of Lot 204; thence southerly on the west boundary of Lot 204 and the west boundary of Lot 304 to the southwest corner of it; thence easterly on the south boundary of Lot 304 and Lot 3359 to the northwest corner of Lot 6144; thence southerly and easterly on the west and south boundaries of Lot 6144 to the northwest corner of Lot 6145; thence southerly on the west boundary of Lot 6145 to the most southerly southwest corner of it, being the point of commencement.

FILE 113(504)

Province of British Columbia
Ministry of Energy, Mines and Petroleum Resources
MINERAL RESOURCES BRANCH-TITLES DIVISION



SCALE- 1:250 000

CONTOUR INTERVAL- 500 FEET

MINING DIVISION CARIBOO	SKETCH PREPARED BY K. BALLANTYNE
LAND DISTRICT CARIBOO	MINERAL TITLES DRAUGHTING, VICTORIA B.C.
MAP NO. 93 B/9W, 10E, 15E, 16W	DATE 80·01·10

APPENDIX B

DRILL LOGS

"PRELIMINARY REPORT ON THE CARIBOO COAL AND CLAY CO. PROPERTY AT ALSTERLIAN", by A. LAKES, 1950

BOYLES BROS. LTD.

CARIBOO COAL & CLAY CO. LTD.

LOG OF DIAMOND DRILL HOLE NUMBER ONE

Footage	Description
- 13	Sandy clay
13 - 27	Interbedded gravel and sand
27 - 45	Fine sand
45 - 63	Gravel
63 - 80	Soft clay
80 - 100	Carbonaceous clay
100 - 114.5	Coal seam. 100 - 101 Poor coal 101 - 105 Sampled 105 - 114.5 Much clay but some hard coal Good core in whole seam sent in as testing material.
114.5- 162	Sandy clay. Much sand in places. A little carbonaceous.
162 - 164	Coal. A little tar. Seems to be a better coal than the seam above. Cracks but little on drying. Sampled.
164 - 177	Carbonaceous clay. 164 - 173 Much carbonaceous. 173 - 177 Very carbonaceous. A very poor coal.
177 - 205	Hard clay
205 - 207	Sandstone
207 - 208	Conglomerate
208 - 209	Sandstone
209 - 246	Soft clay. Very heavy
246 - 247	Carbonaceous clay
247 - 249	Coal. Perhaps larger seam than indicated. Sample sent in.
249 - 254	No core obtained.
254 - 258	Heavy clay
258 - 266	Light-coloured clay. Seems pure. Cores well. Shows minor faulting.
266 - 320	Brown Clay. Pure. Cores well.
320 - 628	Carbonaceous clay.

(signed) K. C. Watson.

BOYLES BROS. LTD.

CARIBOO COAL & CLAY CO. LTD.

DIAMOND DRILL HOLE NO. 2

Location. 1564 North of the S.E. Corner of Lot 4,
91 East of the S.E. Corner of Lot 4.

20	Glacial Clay
20 - 42	Clay
42 - 48	Sand
48 - 180	Glacial drift and clay
180 - 190	Interbedded gravel, sand and clay
190 - 212	Fine sand
212 - 220	Gravel and boulders
220 - 229	Fine sand and small boulders
229 - 235	Gravel and clay. Hole cemented from 213 - 235. Cement core shows a little flake gold.
235 - 284	Fine sand and gravel with a little clay
284 - 317	Gravel
317 - 353	Sand
353 - 362	Boulder
362 - 450	Glacial clay
450 - 565	Clay
565 - 639	Sandy clay

(signed) K. C. Watson

Foreman.

BOYLES BROS. LTD.

CARIBOO COAL & CLAY CO. LTD.

DIAMOND DRILL HOLE NO. 3

Location. North 1983 feet and East 2762 feet of the S.W. corner of Lot 4.
Elevation - Collar of hole is at 1785.

Footage	Description
5	Carbonaceous clay
5 - 12	Coal
12 - 19	Broken seam of coal
19 - 151	Brown clay
151 - 200	Brown clay, little carbonaceous material.
200 - 230	Pure brown clay
230 - 324	Clay, brown
325 - 344	Dark brown clay
344 - 475	Young sandstone
475 - 482	Carbonaceous clay
482 - 484	Carbonaceous clay
484 - 494	Poor coal.
494 - 509	Coal
509 - 535	Coal with clay partings
535 - 543	Coal
543 - 563	Coal
563 - 568	Carbonaceous clay
568 - 597	Clay with streaks of coal
597 - 620	Light sandy clay

(signed) K. C. Watson

Foreman

DRILL HOLE LOGS

Drill Hole No. QN-71-1

COMPANY: Master Explorations Ltd.

AREA: Quesnel, B.C.

DRILLER: W. Woods

LOCATION: S, W, NE Cor. Sec. , Twp. , R. , W M

ELEVATION: 1490'

DATE: 10-Dec-71

FROM	TO	DESCRIPTION
0	4'	Sand
4	14'	Gravel
14	26'	Shale
26	48.2'	Coal (sampled)
48.2	49.5'	Shale
49.5	59.5'	Coal (sampled)
59.5	74.3'	Clay
74.3	74.8'	Coal
74.8	76'	Clay
76	76.3'	Coal
76.3	80'	Clay
80	81'	Coal
81	81.5'	Shale (brown)
81.5	82.2'	Coal
82.2	83'	Shale (brown)
83	83.3'	Coal
83.3	85.3'	Brown shale
85.3	86'	Coal
86	87.4'	Brown shale
87.4	87.9'	Coal
87.9	91'	Brown shale
91	93.5'	Coal
93.5	94'	Brown shale
94	98.7'	Coal (sampled)
98.7	99'	Brown shale
99	145'	Light grey clay
		Total Depth = 145'

DRILL HOLE LOGS

Drill Hole No. QN-71-2

COMPANY: Master Explorations Ltd.

AREA: Quesnel, B.C.

DRILLER: W. Woods

LOCATION: S. W, NE Cor. Sec. , Twp. , R. , W M

ELEVATION: 1480'

DATE: 14-Dec-71

FROM	TO	DESCRIPTION
0	4'	Sandy clay
4	12'	Gravel
12	17'	Clay
17	22'	Shattered sandstone
22	27.5'	Sand
27.5	33.2'	Shale
33.2	36.5'	Coal
36.5	37.2'	Brown shale
37.2	41'	Coal (sampled)
41	41.3'	Brown shale
41.3	47.5'	Coal (sampled)
47.5	49'	Brown shale
49	52.3'	Coal
52.3	52.8'	Brown shale
52.8	53.1'	Coal
53.1	55'	Brown shale
55	61.2'	Coal (sampled)
61.2	61.8'	Light grey clay
61.8	63'	Coal
63	64.5'	Brown shale
64.5	65.3'	Coal (sampled)
65.3	65.8'	Brown shale
65.8	67.5'	Coal (sampled)
67.5	68.5'	Brown clay
68.5	70.1'	Coal
70.1	70.4'	Brown shale
70.4	71.6'	Coal
71.6	72'	Brown clay
72	72.8'	Coal

....2

DRILL HOLE LOGS

Drill Hole No. QN-71-2

COMPANY: Master Explorations Ltd.

AREA: Quesnel, B.C.

DRILLER: W. Woods

LOCATION: S, W, NE Cor. Sec. , Twp. , R. , W M

ELEVATION: 1480'

DATE: 14-Dec-71

FROM	TO	DESCRIPTION
72.8	73'	Brown clay
73	76.2'	Coal
76.2	76.5'	Brown clay
76.5	77.5'	Coal
77.5	79'	Brown clay
79	142'	Light grey clay
142	147'	Brown clay
147	171.5'	Light grey clay
171.5	172.3'	Brown shale
172.3	173.8'	Coal
173.8	174.2'	Brown shale
174.2	175.6'	Coal
175.6	176'	Brown shale
176	176.8'	Coal
176.8	180.2'	Brown shale
180.2	181'	Coal
181	183.2'	Light Grey Clay
183.2	185'	Coal
185	185.6'	Brown shale
185.6	187'	Coal
187	188.5'	Light Grey Clay
188.5	188.9'	Brown shale
188.9	190.2'	Coal
190.2	192.8'	Brown shale
192.8	193.4'	Coal
193.4	195'	Brown shale
195	225'	Light Grey Clay
		Total Depth = 225'

DRILL HOLE LOGS

Drill Hole No. QN-71-3

COMPANY: Master Explorations Ltd.

AREA: Quesnel, B.C.

DRILLER: W. Woods

LOCATION: S, W, NE Cor. Sec. , Twp. , R. , W M

ELEVATION: 1580'

DATE: 16-Dec-71

FROM	TO	DESCRIPTION
0	11'	Clay (sandy)
11	11.5'	Hard black sandstone (boulder)
11.5	32'	Sandy clay & rocks
32	36'	Brown clay
36	113'	Soft grey clay
113	116'	Brown shale
116	124'	Soft grey clay
124	129.5'	Brown shale
129.5	133'	Grey clay
133	179'	Brown shale
179	214'	Grey clay
214	237.5'	Brown shale
237.5	241.2'	Coal (sampled)
241.2	241.6'	Brown shale
241.6	249'	Coal (sampled)
249	251'	Brown shale
251	271'	Light grey clay
271	274'	Grey sandstone
274	295'	Light grey clay
		Total Depth = 295'

DRILL HOLE LOGS

Drill Hole No. QN-71-4

COMPANY: Master Explorations Ltd.

AREA: Quesnel, B.C.

DRILLER: W. Woods

LOCATION: S, W, NE Cor. Sec. , Twp. , R. , W M

ELEVATION: 1570'

DATE: 18-Dec-71

FROM	TO	DESCRIPTION
0	7'	Sand.
7	17'	Gravel
17	34'	Grey clay
34	56'	Brown shale
56	60.3'	Coal (sampled)
60.3	60.5'	Brown shale
60.5	61.7'	Coal (sampled)
61.7	62'	Brown shale
62	62.9'	Coal (sampled)
62.9	63.5'	Brown shale
63.5	67'	Coal (sampled)
67	68.5'	Brown shale
68.5	69'	Coal
69	70.1'	Brown shale
70.1	70.4'	Coal
70.4	78.8'	Brown shale
78.8	82.5'	Coal & carb. shale (sampled) 50% each
82.5	83.7'	Grey clay
83.7	86.5'	Coal & carb. shale (sampled) 50% each
86.5	88'	Brown shale
88	94'	Coal (sampled)
94	95.9'	Soft grey clay
95.9	96.5'	Brown shale
96.5	122'	Soft grey clay
122	127'	Sandstone
127	149'	Soft grey clay
149	158'	Brown shale
158	237'	Soft grey clay

DRILL HOLE LOGS

Drill Hole No. QN-71-4

COMPANY: Master Explorations Ltd.

AREA: Quesnel, B.C.

DRILLER: W. Woods

LOCATION: S. W. NE Cor. Sec. , Twp. , R. , W M

ELEVATION: 1570'

DATE: 18-Dec-71

FROM	TO	DESCRIPTION
237	242.2'	Brown shale & carb. shale
242.2	242.9'	Coal
242.9	244.1'	Brown shale
244.1	244.8'	Coal
244.8	246.6'	Brown shale & carb. shale
246.6	247.5'	Coal
247.5	250.2'	Brown shale
250.2	250.5'	Coal
250.5	253'	Brown shale
253	253.5'	Coal
253.5	257.8'	Brown shale
257.8	258.2'	Coal
258.2	259'	Brown shale
259	260'	Light grey clay
260	263'	Brown shale
263	275'	Light grey clay
		Total Depth = 275'

DRILL HOLE LOGS

Drill Hole No. QN-71-5

COMPANY: Master Explorations Ltd.

AREA: Quesnel, B.C.

DRILLER: W. Woods

LOCATION: S, W, NE Cor. Sec. , Twp. , R. , W M

ELEVATION: 1590'

DATE: 21-Dec-71

FROM	TO	DESCRIPTION
314.7	319'	Brown shale
319	389'	Light grey clay
389	394.6'	Carb. shale & brown shale
394.6	397.1'	Coal
397.1	397.5'	Brown & red shale
397.5	455'	Light grey shale
		Total Depth = 455'

DRILL HOLE LOGS

Drill Hole No. QN-72-6

COMPANY: Master Explorations Ltd.

AREA: Quesnel, B.C.

DRILLER: W. Woods

LOCATION: S, W, NE Cor. Sec. , Twp. , R. , W M

ELEVATION: 1660'

DATE: 7-Jan-72

FROM	TO	DESCRIPTION
0	13.5'	Sand & gravel
13.5	28'	Sandy clay
28	33'	Blue clay
33	44'	Clay & rocks
44	46'	Carb. shale & red shale (lost circ) — Brown
46	48'	Clay & rocks
48	78'	Sand & gravel
78	86'	Sandy clay
86	115'	Soft grey clay
115	121'	Blue clay
121	148'	Soft grey clay
148	153'	Blue clay
153	172'	Soft grey clay
172	207'	Clay & rocks
207	225'	Gravel (possibly cemented)
		Total Depth = 225'

DRILL HOLE LOGS

Drill Hole No. QN-72-7

COMPANY: Master Explorations Ltd.

AREA: Quesnel, B.C.

DRILLER: W. Woods

LOCATION: S. W, NE Cor. Sec. , Twp. , R. , W M

ELEVATION: 1540'

DATE: 9-Jan-72

FROM	TO	DESCRIPTION
0	22'	Sand
22	33'	Gravel
33	41'	Brown shale
41	48'	Soft grey clay
48	77'	Brown shale
77	101'	Soft grey clay
101	130.2'	Brown shale
130.2	131'	Black shale
131	132.5'	Coal
132.5	134'	Brown shale
134	135.6'	Coal
135.6	137'	Brown shale
137	138.5'	Coal
138.5	139'	Brown shale
139	139.7'	Coal
139.7	140.5'	Brown shale
140.5	141.6'	Coal
141.6	144'	Brown shale
144	147.2'	Coal
147.2	148'	Brown shale
148	152.5'	Coal
152.5	153.5'	Light grey clay
153.5	161.2'	Coal
161.2	162.5'	Brown shale
162.5	171'	Coal
171	255'	Light grey clay
		Total Depth = 255'

DRILL HOLE LOGS

Drill Hole No. QN-72-8

COMPANY: Master Explorations Ltd.

AREA: Quesnel, B.C.

DRILLER: W. Woods

LOCATION: S. W, NE Cor. Sec. , Twp. , R. , W M

ELEVATION: 1480'

DATE: 11-Jan-72

FROM	TO	DESCRIPTION
0	8.5'	Sand
8.5	26'	Gravel
26	36.5'	Grey clay
36.5	72'	Brown shale
72	119'	Light grey clay
119	128'	Brown shale
128	131'	Light grey clay
131	136.7'	Brown shale
136.7	140.6'	Coal & carb. shale
140.6	142'	Brown shale
142	146'	Coal & carb. shale
146	156.2'	Coal
156.2	158'	Brown shale
158	158.9'	Coal
158.9	161.5'	Brown shale
161.5	205'	Light grey clay
		Total Depth = 205'

DRILL HOLE LOGS

Drill Hole No. QN-72-9

COMPANY: Master Explorations Ltd.

AREA: Quesnel, B.C.

DRILLER: W. Woods

LOCATION: S, W, NE Cor. Sec. , Twp. , R. , W M

ELEVATION: 1550'

DATE: 14-Jan-72

FROM	TO	DESCRIPTION
0	6'	Sand
6	17'	Gravel
17	31'	Grey clay
31	31.8'	Coal
31.8	33.2'	Brown shale
33.2	34.5'	Coal
34.5	37'	Brown shale
37	41'	Light grey clay
41	42'	Brown shale
42	70.5'	Light grey clay
70.5	255'	Brown shale
		Total Depth = 255'

DRILL HOLE LOGS

Drill Hole No. QN-72-10

COMPANY: Master Explorations Ltd.

AREA: Quesnel, B.C.

DRILLER:

LOCATION: S, W, NE Cor. Sec. , Twp. , R. , W M

ELEVATION: 1570'

DATE: 15-Jan-72

FROM	TO	DESCRIPTION
0	12.5'	Sand
12.5	18'	Gravel
18	130'	Sand
130	156'	Sandy clay
156	167'	Sand
167	196'	Sandy clay
196	215'	Gravel
		Total Depth = 215'

DRILL HOLE LOGS

Drill Hole No. QN-72-1

COMPANY: Master Explorations Ltd.

AREA: Quesnel, B.C.

DRILLER:

LOCATION: S, W, NE Cor. Sec. , Twp. , R. , W M

ELEVATION: 1450'

DATE: 20-Jan-72

FROM	TO	DESCRIPTION
0	11'	Sand
11	21.5'	Gravel
21.5	87'	Grey clay & rocks
87	102'	Gravel
102	108'	Clay & rocks
108	119'	Gravel
119	138'	Clay & rocks
138	153'	Sand
153	189'	Sandy clay
189	245'	Gravel & sandy clay
		Total Depth = 245'

DRILL HOLE LOGS

Drill Hole No. QN-72-1

COMPANY: Master Explorations Ltd.

AREA: Quesnel, B.C.

DRILLER: W. Woods

LOCATION: S, W, NE Cor. Sec. , Twp. , R. , W M

ELEVATION: 1640'

DATE: 22-Jan-72

FROM	TO	DESCRIPTION
0	5'	Sand
5	38'	Gravel
38	123'	Sand
123	130'	Grey clay
130	142'	Clay & rocks
142	169'	Sand & gravel
169	203'	Cemented gravel
203	255'	Sandy clay & rocks
		Total Depth = 255'

DRILL HOLE LOGS

Drill Hole No. QN-72-13

COMPANY: Master Explorations Ltd.

AREA: Quesnel, B.C.

DRILLER: W. Woods

LOCATION: S, W, NE Cor. Sec. , Twp. , R. , W M

ELEVATION: 1550'

DATE: 3-Feb-72

FROM	TO	DESCRIPTION
0	4'	Sand
4	13'	Gravel
13	16'	Sand & gravel
16	31'	Gravel (blind)
31	78'	Sand
78	123'	Sandy clay
123	189'	Sand
189	255'	Sandy clay & rocks
		Total Depth = 255'

DRILL HOLE LOGS

Drill Hole No. QN-72-14

COMPANY: Master Explorations Ltd.

AREA: Quesnel, B.C.

DRILLER: W. Woods

LOCATION: S, W, NE Cor. Sec. , Twp. , R. , W M

ELEVATION: 1490'

DATE: 4-Feb-72

FROM	TO	DESCRIPTION
0	6'	Sand
6	14'	Gravel
14	36'	Sandy clay & gravel
36	39.5'	Sand
39.5	56'	Sandy clay
56	130'	Sandy clay & rocks
130	215'	Sand
215	255'	Sandy clay
		Total Depth = 255'

DRILL HOLE LOGS

Drill Hole No. QN-72-15

COMPANY: Master Explorations Ltd.

AREA: Quesnel, B.C.

DRILLER: W. Woods

LOCATION: S, W, NE Cor. Sec. , Twp. , R. , W M

ELEVATION: 1520'

DATE: 7-Feb-72

FROM	TO	DESCRIPTION
0	3'	Sand
3	11'	Gravel
11	29'	Sandy clay & gravel
29	40'	Cemented gravel
40	107'	Sandy clay
107	195'	Sandy clay & rocks
		Total Depth = 195'

DRILL HOLE LOGS

Drill Hole No. QN-72-16

COMPANY: Master Explorations Ltd.

AREA: Quesnel, B.C.

DRILLER: W. Woods

LOCATION: S, W, NE Cor. Sec. , Twp. , R. , W M

ELEVATION: 1470'

DATE: 6-Feb-72

FROM	TO	DESCRIPTION
0	9'	Sand
9	16'	Gravel
16	22'	Gravel & sandy clay
22	27'	Sand
27	120'	Sandy clay & rocks
120	139'	Sandy clay & gravel
139	146'	Gravel
146	163'	Sandy clay & rocks
163	195'	Cemented gravel
		Total Depth = 195'

DRILL HOLE LOGS

Drill Hole No. QN-72-17

COMPANY: Master Explorations Ltd.

AREA: Quesnel, B.C.

DRILLER: W. Woods

LOCATION: S, W, NE Cor. Sec. , Twp. , R. , W M

ELEVATION: 1430'

DATE: 7-Feb-72

FROM	TO	DESCRIPTION
0	4'	Sand
4	18'	Gravel
18	29'	Sandy clay & gravel
29	32'	Cemented gravel
32	95'	Sandy clay
		Total Depth = 95'

DRILL HOLE LOGS

Drill Hole No. QN-72-18

COMPANY: Master Explorations Ltd.

AREA: Quesnel B.C.

DRILLER: W. Woods

LOCATION: S, W, NE Cor. Sec. , Twp. , R. , W M

ELEVATION: 1890'

DATE: 10-Feb-72

FROM	TO	DESCRIPTION
0	11'	Brown clay
11	43'	Sandy clay & rocks
43	51'	Sand
51	92'	Clay & rocks
92	104'	Blue clay
104	120'	Brown clay
120	124'	Brown shale
124	138'	Blue clay
138	140'	Brown shale
140	142'	Light grey clay
142	144'	Brown shale
144	187'	Grey clay
187	193'	Brown clay
193	197.5'	Brown shale
197.5	198'	Coal
198	199.6'	Brown shale
199.6	200.2'	Coal
200.2	203.5'	Brown shale
203.5	204.2'	Coal
204.2	206.5'	Brown shale
206.5	208'	Coal
208	211.3'	Brown shale
211.3	213.5'	Coal
213.5	218'	Brown shale
218	265'	Grey clay
		Total Depth = 265'

DRILL HOLE LOGS

Drill Hole No. QN-72-18

COMPANY: Master Explorations Ltd.

AREA: Quesnel, B.C.

DRILLER: W. Woods

LOCATION: S, W, NE Cor. Sec. , Twp. , R. , W M

ELEVATION: 1890'

DATE: 10-Feb-72

FROM	TO	DESCRIPTION
0	11'	Brown clay
11	43'	Sandy clay & rocks
43	51'	Sand
51	92'	Clay & rocks
92	104'	Blue clay
104	120'	Brown clay
120	124'	Brown shale
124	138'	Blue clay
138	140'	Brown shale
140	142'	Light grey clay
142	144'	Brown shale
144	187'	Grey clay
187	193'	Brown clay
193	197.5'	Brown shale
197.5	198'	Coal
198	199.6'	Brown shale
199.6	200.2'	Coal
200.2	203.5'	Brown shale
203.5	204.2'	Coal
204.2	206.5'	Brown shale
206.5	208'	Coal
208	211.3'	Brown shale
211.3	213.5'	Coal
213.5	218'	Brown shale
218	265'	Grey clay
		Total Depth = 265'

DRILL HOLE LOGS

Drill Hole No. QN-72-19

COMPANY: Master Explorations Ltd.

AREA: Quesnel, B.C.

DRILLER: W. Woods

LOCATION: S, W, NE Cor. Sec. , Twp. , R. , W M

ELEVATION: 1720'

DATE: 12-Feb-72

FROM	TO	DESCRIPTION
0	6'	Sand
6	19'	Sandy clay & rocks
19	23'	Coarse Sand (blind)
23	27'	Sandy clay
27	36'	Grey clay
36	36.5'	Coal
36.5	37'	Grey clay
37	41'	Blue clay
41	82.5'	Grey clay
82.5	83'	Brown shale
83	83.3'	Coal
83.3	88'	Brown shale
88	91'	Grey clay
91	92.7'	Brown shale
92.7	93.5'	Coal
93.5	105'	Brown shale (blind)
		Total Depth = 105'

DRILL HOLE LOGS

Drill Hole No. QN-72-21

COMPANY: Master Explorations Ltd.

AREA: Quesnel, B.C.

DRILLER: W. Woods

LOCATION: S, W, NE Cor. Sec. , Twp. , R. , W M

ELEVATION: 1740'

DATE: 13-Feb-72

FROM	TO	DESCRIPTION
0	28'	Sandy clay & rocks
28	41'	Grey clay
41	49'	Blue clay
49	84'	Light grey clay
84	87'	Brown shale
87	88.5'	Coal
88.5	89'	Brown shale
89	91'	Light grey clay
91	95.8'	Brown shale
95.8	99.2'	Coal
99.2	123'	Light grey clay
123	127'	Brown shale
127	133.2'	Coal (sampled)
133.2	160.7'	Light grey clay
160.7	161.5'	Coal
161.5	163'	Brown shale
163	163.5'	Coal
163.5	165'	Brown shale
165	166.2'	Coal
166.2	168'	Brown shale
168	187'	Light grey clay
187	190'	Brown shale
190	255'	Light grey clay
		Total Depth = 255'

DRILL HOLE LOGS

Drill Hole No. QN-72-21

COMPANY: Master Explorations Ltd.

AREA: Quesnel, B.C.

DRILLER: W. Woods

LOCATION: S. W, NE Cor. Sec. , Twp. , R. , W M

ELEVATION: 1450'

DATE: 13-Feb-72

FROM	TO	DESCRIPTION
0	8'	Sand
8	14'	Gravel & sandy clay
14	20'	Coarse sand
20	38'	Blue clay
38	41'	Coarse sand
41	71'	Grey clay & rocks
71	76'	Brown clay
76	87'	Sandy clay & rocks
87	155'	Grey clay
		Total Depth = 155'

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERING & PROFESSIONAL SERVICES

ROCK CORE LOG

PROJECT: Quesnel Slide Study
B.C. Department of Highways

HOLE LOCATION: Elevation 474 m. approx.

LOGGED BY: GL | CHECKED: GL | DATE OF INVESTIGATION: | JOB NUMBER: 01521 | HOLE: RHM#1

CORE RECOVERY ———
R.Q.D. — — — — — —
PERCENT 20 40 60 80 100

DEPTH	SOIL SYMBOL	CORE RUN	WEATHERING	STRENGTH	DESCRIPTION	REMARKS
1					Silt-sand mix. some gravel, trace organic, volcanic ash, gravel sub-rnded to subang, to 4cm dia.	
2					sand-some silt, loose, gy-brn	N=3
3					Shale-soft, lam w lig, slick, low plast, gy-grn	Water table at time of drilling N=12 N=17
4						
5					Shale-red soft	

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ROCK CORE LOG

PROJECT: Quesnel Slide Study
B.C. Department of Highways

HOLE LOCATION:

LOGGED BY: GL | CHECKED: GL | DATE OF INVESTIGATION: | JOB NUMBER: 01521 | HOLE: RMH#1

CORE RECOVERY ———
R.Q.D. — — — — — —
PERCENT: 20 40 60 80 100

DEPTH	SOIL SYMBOL	CORE RUN	WEATHERING	STRENGTH	DESCRIPTION	REMARKS
					Shale-soft,lam w lig, med plast,dk gy	Fractures 50°, 18°; bedding dipping 80° between fractures
						Bedding 20°
6						Fracture 50°
						Fracture 35°
						Fracture 70°
						Fracture 65°
						Bedding 30°
						Fracture 30°
					Lignite-soft	Fracture 60°, Bedding 10°
						Fracture 70°
7						
						Bedding 40°
8						
					Lignite-soft,lam,blk	Bedding 45°
					Some carb layers	Bedding 5°
					Lignite-soft,lam, brittle, blk	
9						Bedding 20°
						Fracture 70°
10					Slickensided	Slickensides Dip 20°

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ROCK CORE LOG

PROJECT: Quesnel Slide Study
B.C. Department of Highways

HOLE LOCATION

LOGGED BY: GL | CHECKED: GL | DATE OF INVESTIGATION | JOB NUMBER: 01521 | HOLE: RMH#1

CORE RECOVERY ——— R.Q.D. — — — — — — PERCENT 20 40 60 80 100

DEPTH (m): 11, 12, 13, 14, 15

SOIL SYMBOL | CORE RUN | WEATHERING | STRENGTH

DESCRIPTION	REMARKS
Shale-soft,lam w lig, mass & carb,sh lyrs, slick,lt brn & dk brn	
Lignite-soft,brittle, lam, blk	Bedding 35°
	Fracture 45°, Bedding 25°
Lignite-soft,brittle, lam, blk	
Shale-soft,lam,slick, high plast,lt gy	Slickenside 28°
Lignite-lam,dk brn	Bedding 0 - 2°
	Slickensides 10°
Shale-soft,lam w lig, med plast,dk brn	Fault 35° Fracture 28°,Bedding 22°
Some high plast. lam.	

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ROCK CORE LOG

PROJECT: Quesnel Site Study
B.C. Department of Highways

HOLE LOCATION:

LOGGED BY: G.L. | CHECKED: G.L. | DATE OF INVESTIGATION: | JOB NUMBER: 01521 | HOLE: RMH#1

CORE RECOVERY ——— R.Q.D. - - - - PERCENT 20 40 60 80 100

DEPTH	SOIL SYMBOL	CORE RUN	WEATHERING	STRENGTH	DESCRIPTION	REMARKS
					Shale-soft,lam w lig, med plast, some high plast lam	- Bedding 20° - Bedding 18°
					Lignite-shaly,soft,lam	
					Lignite-shaly,soft,lam	Dip 18°
17						
					Some sand,fine to med, sand grains, grn,dk gy	
					Shale-soft,mass,"sandy" sand grains are soft & fine to med,grn, inclus of organics	
18						
					Lam of brn shale, lig	
					Sandstone & lig, lam	
19					Shale-soft,lam w slst & Ss, brn	
					Sandstone	
20						
					End of Hole - Tiltmeter casing installed	

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ROCK CORE LOG

PROJECT: Quesnel Slide Study
B.C. Department of Highways

HOLE LOCATION: Surface Elevation 474 m. approx.

LOGGED BY: GL | CHECKED: GL | DATE OF INVESTIGATION: | JOB NUMBER: 01521 | HOLE: RMH#2

CORE RECOVERY ———
R.Q.D. — — — — — —
PERCENT: 20 40 60 80 100

DEPTH (m)	SOIL SYMBOL	CORE RUN	WEATHERING	STRENGTH	DESCRIPTION	REMARKS
					Sand-some silt,gravel, t boulders,loose,lyred, brn,damp	
					Sand-t silt,gravel, loose,lyred,brn	
1					Gravel-sandy,loose, lyred,brn,damp	
						Water table at time of drilling
2						N=8
					Clay-grvl,sand,tirm,brn	
					Shale-lignite interbed, soft,lam,med plast,brn & dk brn	Bedding 0 - 5° N=6
					Lignite-shaly,soft,lam	
3						
						N=11
4						
						PP= 240 kPa
5						PP= 210 KPa

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ROCK CORE LOG

PROJECT: Quesnel Slide Study
HOLE LOCATION: B.C. Department of Highways

LOGGED BY: GL | CHECKED: GL | DATE OF INVESTIGATION: | JOB NUMBER: 01521 | HOLE: RMH#2

CORE RECOVERY
Atterberg Limits ■
Water Content ●
PERCENT 20 40 60 80 100

DEPTH	SOIL SYMBOL	CORE RUN	WEATHERING	STRENGTH	DESCRIPTION	REMARKS
					Shale-lignite interbed	
					Lignite-soft,brittle, dk brn	
6						
7						
					Shale-soft,lam w lig, slick,brn	Bedding 0 - 5°
					Lignite-shaly,soft,lam	Bedding 33°
8					Shale-soft,lam,high plast,lt brn	Bedding 8°
					Shale-carb,soft,lam w lig,slick med,plast,brn	
9						
					High plast	Bedding 5°
10					High plast	
					High plast	Bedding 3°

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ROCK CORE LOG

PROJECT: Quesnel Slide Study
B.C. Department of Highways

HOLE LOCATION:

LOGGED BY: CL | CHECKED: CL | DATE OF INVESTIGATION: | JOB NUMBER: 01521 | HOLE: RMH#2

CORE RECOVERY: ———

Water Content ● PERCENT 20 40 60 80 100

DEPTH	SOIL SYMBOL	CORE RUN	WEATHERING	STRENGTH	DESCRIPTION	REMARKS
					Shale-carb,soft,lam w lig,slick,med plast,brn	Fracture 38°
11					High plast,lt grn	
					Lignite-shaly,soft,blk	
						Bedding 5°
						Fracture 52°
12					High plast,carb,slick	Fault 50°
					Lignite-shaly,soft,dk brn	Bedding 0 - 5°
						Fracture 20°
						Fracture 15°
						Fracture 32°
					High plast.	Fracture 32°
13						Fracture 48°
					Shale-carb,soft,lam w lig,med plast,brn & v dk brn	Fracture 45°,42°
					High plast	
14						
					High plast,slick,lt grn ish-brn	
					High plast,slick,lt brn	Fracture 52° Bedding within 5° to 55°
15						
						Fracture 31°
						Fracture 5°
						Fracture 28°
					Lignite-soft,lam,blk	Fracture 28
						Fracture 9°
16					High plast,slick,lt brn	

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ROCK CORE LOG

PROJECT: Quesnel Slide Study
B.C. Department of Highways

HOLE LOCATION:

LOGGED BY: CL | CHECKED: CL | DATE OF INVESTIGATION: | JOB NUMBER: 01521 | HOLE: BH#2

CORE RECOVERY
Atterberg Limits
Water Content
PERCENT 20 40 60 80 100

DEPTH	SOIL SYMBOL	CORE RUN	WEATHERING	STRENGTH	DESCRIPTION	REMARKS
					Shale-carb,soft,lam w lig,med plast,brn & v dk brn	Fracture 12°
17					Lignite-soft,lam, blk	
					Shale-soft,mass,high plast,lt bluish-gy, inclus. of organics	
18						
					Sandstone-med soft	Fracture 48°
19					Trace fine sand	Fracture 52° Fracture 62° Fracture 53° Fracture 22°
					Siltstone-soft,lam,some carb,lam,lt bluish-grn & brn	Oc=634.3 kPa Bedding 18°
20						
					Sandstone-med,soft,mass sand uniform fine-med, friable	Bedding 18°
					END OF HOLE Terratech Piezometer P1020 Ser. # 1531 installed at 14.7 m. Terratech Piezometer P1020 Ser. # 1521 installed at 12 m.	

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ROCK CORE LOG

PROJECT: QUESNEL SLIDE STUDY
B.C. DEPARTMENT OF HIGHWAYS

HOLE LOCATION
Surface Elev. 493 m

LOGGED BY: GL | CHECKED: GL | DATE OF INVESTIGATION: | JOB NUMBER: 01521 | HOLE: RMH#3

CORE RECOVERY
R.Q.D.
PERCENT 20 40 60 80 100

DEPTH (m)	SOIL SYMBOL	CORE RUN	WEATHERING	STRENGTH	DESCRIPTION	REMARKS
					Asphalt paving	
					Gravel - sandy, trace silt, gravel to 7.5 cm diameter, medium dense, layered, brown damp	
1						
2						N=26
3						N=24
4						
5						N=16

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ROCK CORE LOG

PROJECT: Quesnel Slide Study
HOLE LOCATION: B.C. Department of Highways

LOGGED BY: GL | CHECKED: GL | DATE OF INVESTIGATION: | JOB NUMBER: 01521 | HOLE: RMH#3

CORE RECOVERY ———
Atterberg Limits
Water Content PERCENT 20 40 60 80 100

DEPTH (m)	SOIL SYMBOL	CORE RUN	WEATHERING	STRENGTH	DESCRIPTION	REMARKS
					Gravel-sandy,gravel to 7.5 cm dia,med dense, layred, brn,damp	N=35
6					Shale-carb,soft,lam,med plast, dk brn	
					Lignite-shaly,v soft, lam, v dk brn	N=74
					Slick	Dip 12°
7					Shale-carb, v soft, lam med plast, brn	
						Fracture 28°
8					Lignite-shaly,v dk brn	Fault 10° Dip 5°
					Shale-v soft,high plast lt brn	Dip 0°
					Shale-carb,soft	
					Lignite-shaly,v soft, lam, v dk brn	
					Shale-carb,v soft,lam, med plast,lt brn	
					Lignite, dk brn	
9					Shale-carb,soft,lam,med plast,dk brn	
					Lignite-very dk brown	
					Shale-carb,v soft,lam, slick,high plast,brn	Fracture 45°
					Lignite-shaly,v soft, lam,slick,very dk brn	Slickensides Dip 20°
10						Dip 3°-5°

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ROCK CORE LOG

PROJECT: Quesnel Slide Study
B.C. Department of Highways

HOLE LOCATION:

LOGGED BY: GL | CHECKED: GL | DATE OF INVESTIGATION: | JOB NUMBER: 01521 | HOLE: RMH#3

CORE RECOVERY ——— R.Q.D. — — — — — — PERCENT 20 40 60 80 100

DEPTH m	SOIL SYMBOL	CORE RUN	WEATHERING	STRENGTH	DESCRIPTION	REMARKS
11					Shale-carb,v soft,lam w med & high plast,sh & lig,brn	
					Lignite-shaly,dk brn	
					Lignite-shaly, soft, slick,lam,v dk brn	
12					Shale-v soft,lam,slick, dk brn, inclus of lig, amber	Dip 0°-5° Slickensides Dip 70°
					Shale-v soft,lam,med plast,slick,dk brn, inclus of lig,amber	Dip 0°-5° Slickensides Dip 70° Pocket Penetration test = 287 KPa
13						
					Lignite-lam	
					Lignite-soft,lam,slick v dk brn	Slickensides Dip 5°
					Shale-carb,w lam of lig,v soft,med & high plast sh,lam, slick	Fracture 78° Fracture 80°
14					Lignite-shaly,v soft, lam w med & high plast sh,occ slick, v dk brn	Slickensides Dip 25° Dip 5°
15					Shale-carb,v soft,lam, slick,med & high plast, inclus lig,lt brn	Slickensides Dip 45° Fracture 38°,Bedding Dip 10°
					Shale-carb,soft,lam, slick,high plast,inclus pale gy	
					Shale-carb,soft,lam, med,plast,brn	Contact Dip 38° Contact Dip 34° Slickensides Dip 33°
					Shale-soft,slick,high plast,lig,pale grey	
					Shale-carb,soft,lam,med plast,brn	Dip 8°

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ROCK CORE LOG

PROJECT: Quesnel Slide Study
B. C. Department of Highways

HOLE LOCATION:

LOGGED BY: GL | CHECKED: GL | DATE OF INVESTIGATION: | JOB NUMBER: 01521 | HOLE: [illegible]

CORE RECOVERY
Atterberg Limits
Water Content %
20 40 60 80 100

DEPTH (ft)	SOIL SYMBOL	CORE RUN	WEATHERING	STRENGTH	DESCRIPTION	REMARKS
16					Shale-soft,slick,high plast,lig,inclu pale gy	Contact Dip 42°
					Lignite-shaly,soft,lam, v dk brn to blk	Contact Dip 18°
					Shale-soft,slick,high plast,lig inclus,pale gy	
					Shale-carb,v soft,lam, med plast,brn	
17					-Lignite-lam	Dip 25°
					-Lignite-lam	Dip 32°
					Shale-v soft,slick,high plast,lignite inclus, pale grey	
18						
					Shale-v soft,slick,high plast,lignite inclus, pale grey	
						Dip 23°
					Shale-carb,interbed w lig,lam, soft,med plast, dk brn & blk,occ slick.	Dip 18°
19						
					Lignite	Fracture 75°,Bedding 18°, Slickensides 45°
					Lignite	Fault 15°
20						
						Dip 25°
						Dip 9°
						Dip 9°
21						Dip 20°

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ROCK CORE LOG

PROJECT: Quesnel Slide Study
B.C. Department of Highways

HOLE LOCATION:

LOGGED BY: GL | CHECKED: GL | DATE OF INVESTIGATION: | JOB NUMBER: 01521 | HOLE: RMH#3

CORE RECOVERY ———
R.Q.D. — — — — — —
PERCENT 20 40 60 80 100

DEPTH	SOIL SYMBOL	CORE RUN	WEATHERING	STRENGTH	DESCRIPTION	REMARKS
					Shale-v soft,gen mass w occ carb,lam,high plast, pale bl-grn	Dip 99
					Shale-carb,v soft,lam w lig,occ slick,med plast, dk brn & blk	
22						Bedding Dips 10° Slickensides Dip 35°
					Sandstone-soft,layered	
					Shale - carb, soft	
					Lignite-shaly, very soft, lam, blk	
23					Shale-carb,v soft,lam w lig, lam, slick, med plast, v dk brn & blk	
24						
					Shale-soft,mass,slick, high plast,pale bl-grn, inclus of lig	Contact Dips 18°
25						Slickensides Dip 25°
					Carbonaceous laminae	Slickensides Dip 28°, Bedding 10°
26						
					Shale-carb,soft,brn	
					Shale-carb,soft,lam, pale bl-grn	

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ROCK CORE LOG

PROJECT: Quesnel Slide Study
B.C. Department of Highways

HOLE LOCATION:

LOGGED BY: GL | CHECKED: GL | DATE OF INVESTIGATION: | JOB NUMBER: 01521 | HOLE: RMH3

CORE RECOVERY ——— R.Q.D. — — — — PERCENT 20 40 60 80 100

DEPTH (m)	SOIL SYMBOL	CORE RUN	WEATHERING	STRENGTH	DESCRIPTION	REMARKS
					Shale-soft,lam w lig, med plast,dk brn	Dip 10° Dip 8°
27						
					Shale-carb,soft,lam w lig,lt bl-grn,brn & blk	Fracture 48°
						Fracture 65°
28						Fault 70° Fracture 45° Fracture 55° Dip 12°
					Lignite-shaly,soft,lam, med plast,shale,blk	
					Shale-carb,soft,lam w lig,lt bl-grn,brn & blk	
29					Lignite-shaly,v soft,lam med plast,shale, blk	
					Shale-v soft,lam,lt bl-grn,trace of lignite	Dip 10°
					Lignite layers	
30					Shale-carb,soft,lam,lig, med plast, dk brn	Dip 12°
					Lignite-v soft,lam	
					Lignite - soft	
					Shale-carb,v soft,lam w lig,med plast, dk brn	
31						
					Lignite-v soft,lam w shale,blk & dk brn	
						Fault 23° Bedding 8°

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ROCK CORE LOG

PROJECT: Quesnel Slide Study
HOLE LOCATION: B.C. Department of Highways

LOGGED BY: GL | CHECKED: GL | DATE OF INVESTIGATION: | JOB NUMBER: 01521 | HOLE: RMH#3

CORE RECOVERY ———
R.Q.D. — — — —
PERCENT 20 40 60 80 100

DEPTH m	SOIL SYMBOL	CORE RUN	WEATHERING	STRENGTH	DESCRIPTION	REMARKS
32					Shale-v soft,carb,high plast,lt brn	
					Lignite-soft,lam, sh, slick,blk	Slickensides From 0°-25°
33					Shale-soft,lam,some lig med plast, brn	
					Lignite-soft,lam w sh, brn	
					Shale-soft,lam. w lig-nite, plast, brown	
34					Lignite-soft,lam,some shale lam, brown	Slickensides Dip 8°
					Shale-soft,slick,high plast, light brown	
					Lignite Shale	
					Shale-soft,lam w. lig med plast, brown	
					Lignite Shaly	
35					Shale-soft, lam w. carb, sh w. slick, high plast, light brown	
					Shale-v soft,lam w carb sh & slick,high plast, lt brn	Bedding & Slick. Dip 12°
36					Shale-soft,lam w lig, slick,med plast, brn	Slickensides at 20°-45° Bedding 8°
37						

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ROCK CORE LOG

PROJECT: Quesnel Slide Study
HOLE LOCATION: B.C. Department of Highways

LOGGED BY: GL | CHECKED: GL | DATE OF INVESTIGATION: | JOB NUMBER: 01521 | HOLE: DMH#3

CORE RECOVERY — PERCENT: 20 40 60 80 100

DEPTH (m)	SOIL SYMBOL	CORE RUN	WEATHERING	STRENGTH	DESCRIPTION	REMARKS
					Shale-soft,mass,high plast, pale bl,inclus of organic material	
38						Bedding 6°-9°
					Sandstone-med soft	Bedding 8°
39					Sandstone-very soft, lam,pale blue,sand parts degrded to mat. similar to low plast clay, sand fine to med.	
40						
41						
					Shale-sandstone interbeds,v soft,lam, pale blue	
					Shale-soft,lam,high plast,brn	Bedding 8°-10°
					END OF HOLE Tiltmeter Casing Installed to 40.5 m.	

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CONSULTING ENGINEERING & PROFESSIONAL SERVICES

ROCK CORE LOG

PROJECT: Quesnel Slide Study
B.C. Department of Highways

HOLE LOCATION: Surface Elevation 471 m. Approx.

LOGGED BY: GFL | CHECKED: CFL | DATE OF INVESTIGATION: | JOB NUMBER: Q1521 | HOLE: RMH#4

CORE RECOVERY ———
R.Q.D. — — — — — —
PERCENT 20 40 60 80 100

DEPTH (m)	SOIL SYMBOL	CORE RUN	WEATHERING	STRENGTH	DESCRIPTION	REMARKS
					Sand-silty, uniform fine to med. sand, med, dense, layered, brn	
					Uniform fine to med. sand	
1						
					Gravelly, gravel to 7.5 cm, diameter	
						N=13
2						
3						
						N=14
4						Water table at time of drilling
5						N=29

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ROCK CORE LOG

PROJECT Quesnel Slide Study
B.C. Department of Highways

HOLE LOCATION

LOGGED BY GFL | CHECKED GTL | DATE OF INVESTIGATION | JOB NUMBER 01521 | HOLE RMH#4

CORE RECOVERY — PERCENT 20 40 60 80 100

DEPTH	SOIL SYMBOL	CORE RUN	WEATHERING	STRENGTH	DESCRIPTION	REMARKS
					Sand-gravelly, med., dense, layered, gravel to 7.5 cm dia., brn	
6						N=15
					Lignite, soft, lam, v dk brn	
7						N=24
					Shale-soft, med, plast, brn	
					Shale-carb, soft, lam w lig, slick plast, dk brn	Bedding 30°
8						Fault 65°
					Lignite-shaly, soft, lam, slick, blk to dk brn	Bedding 5°
					Shale - carb, soft, lam, med plast, dk brn, lig inclus.	
9					Light brown color	
					Lignite-shaly, soft, shattered, lam, blk, irridescent sheen on fracture faces	
					Shale- v soft, lam w lig, slick, med plast, brn	Bedding 25°
10					Light brown color	Slickensides 30°

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ROCK CORE LOG

PROJECT: Quesnel Slide Study
B.C. Department of Highways

HOLE LOCATION:

LOGGED BY: GFL | CHECKED: GFL | DATE OF INVESTIGATION: | JOB NUMBER: 01521 | HOLE: RMH#4

CORE RECOVERY — PERCENT: 20 40 60 80 100

DEPTH (m)	SOIL SYMBOL	CORE RUN	WEATHERING	STRENGTH	DESCRIPTION	REMARKS
					Shale-soft,lam w lig, slick,med plast,lt brn	Slickensides 30°
11					Brown color	
						Slickensides 15°
12						
					Shale-soft,mass w some lam,slick,high plast, pale bl,lig inclus.	
13						Slickensides 33°
14					Shale-soft	Bedding 6°
					Shale-soft,lam w lig, slick,med plast,dk brn & brn	pocket penetrometer test = 287 kPa
					Shale-soft,lam,slick, high plast,pale bl-grn, lig. inclus.	Slickensides 10°
15						
					Shale-v soft,lam,slick high & med, dk brn	
16					Lignite-shaly,soft,lam, slick,blk	Bedding 5° Slick.15°

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ROCK CORE LOG

PROJECT: Quesnel Slide Study
HOLE LOCATION: B.C. Department of Highways

LOGGED BY: GFL | CHECKED: GFL | DATE OF INVESTIGATION: | JOB NUMBER: 01521 | HOLE: RMH#4

CORE RECOVERY — PERCENT: 20 40 60 80 100

DEPTH | SOIL SYMBOL | CORE RUN | WEATHERING | STRENGTH

DESCRIPTION	REMARKS
Shale-soft,lam,slick, high to med. plast, dk brn & Pale bl-grn, inclus. of lig.	Bedding 5°
Lignite-shaly,soft, lam,med, plast,sh,dk brn to blk	Fracture 75°, Bedding 7° Fault 28° Bedding 10°
Shale-carb,soft,lam w lig,occ slick,med plast brn	Fracture 18° Slickensides 5° Slickensides 28° Slickensides 18° Slickensides 8°
Lignite	Slickensides 7°
Slick,med to high plast lt brn	Contact at 28°
Lignite-shaly	Slickensides 30° Slickensides 10°
	Fault 45° Fault 32° Fault 29° Fault 20° Fault 42° Bedding 15°

17 18 19 20 21

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ROCK CORE LOG

PROJECT: Quesnel Slide Study
B.C. Department of Highways

HOLE LOCATION:

LOGGED BY: GFL | CHECKED: GFL | DATE OF INVESTIGATION: | JOB NUMBER: 01521 | HOLE: 83H4

CORE RECOVERY ———
R.Q.D. — — — — — —
PERCENT 20 40 50 80 100

DEPTH (m)	SOIL SYMBOL	CORE RUN	WEATHERING	STRENGTH	DESCRIPTION	REMARKS
					Lignite-shaly, soft, lam, dk brn	Bedding 10°
						Fracture 23°
						Fracture 70°
						Fracture 48°
22						Fracture 42°
						Fracture 73°
					Shale-soft, layers of Slst, mass lyrs, hi plast pale bl, incl of carb materials	
						Fracture 65°
					Sandstone layers	
						Fracture 48°
23					END OF HOLE	
					Tiltmeter casing installed	

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ROCK CORE LOG

PROJECT: Quesnel Slide Study
B.C. Department of Highways

HOLE LOCATION: Surface Elev. 472 m. Approx.

LOGGED BY: GH. | CHECKED: CL | DATE OF INVESTIGATION: | JOB NUMBER: 01521 | HOLE: RMH#5

CORE RECOVERY
R.Q.D.
PERCENT 20 40 60 80 100

DEPTH (m)	SOIL SYMBOL	CORE RUN	WEATHERING	STRENGTH	DESCRIPTION	REMARKS
					Sand-some gravel, loose to med. dense, layered brn, damp	
					Gravel-Sand mixtures, t fines, loose to dense, layered gravel to 7cm. round to subround particles, brn, damp	
1						
2						N=9
3						N=11
4						
						Approximate Water Table at Time of Drilling
5						N-47

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ROCK CORE LOG

PROJECT: Quesnel Slide Study
B.C. Department of Highways

HOLE LOCATION

LOGGED BY: GFL | CHECKED: GL | DATE OF INVESTIGATION: | JOB NUMBER: 01521 | HOLE: RMH #5

CORE RECOVERY ———
R.Q.D. — — — — — — —
PERCENT 20 40 60 80 100

DEPTH (m)	SOIL SYMBOL	CORE RUN	WEATHERING (W)	STRENGTH (S)	DESCRIPTION	REMARKS
					Shale-carb,soft,mass w some lam,med plast, incls of lig, brn	N=22
6						
7						
8					Shale-soft,slick,high plast,pale blue	PP = 200 KPa
						PP > 430 kPa
					Shale-carb,v sft,lam w lig,slick, dk brn	
9						
					Shale- v soft,slick, hi plast,pale blue	
10					Shale-carb,v soft,lam, slick,med plast,dk brn	
					Shale-v soft,lam w some lam carb sh,slick,high plast,pale bl,inclus of lignite	Slickensides 28°

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ROCK CORE LOG

PROJECT: Quesnel Slide Study
B.C. Department of Highways

HOLE LOCATION:

LOGGED BY: GFL | CHECKED: GL | DATE OF INVESTIGATION: | JOB NUMBER: 01521 | HOLE: RMH #5

CORE RECOVERY ———
R.Q.D. — — — — — —
PERCENT 20 40 60 80 100

DEPTH (m)	SOIL SYMBOL	CORE RUN	WEATHERING	STRENGTH (MPa)	DESCRIPTION	REMARKS
					Shale-soft, lam	
11					Shale-carb, soft, lam & lyred, slick, some lig lam, med plast w high Plast, shale layers	Slickensides at 45°, Bedding at 12°
					Lignite-shaly	Slickensides at 28°. Bedding at 12°
12					Shale-carb, soft, lyred & lam, slick, dk brn & pale bl, inclus of lig	
					Shale-soft, slick, high plast, lt brn	Bedding 5° Slickensides 10°- 15°
13					Shale-carb, soft, lam, slick, med plast, dk brn	
					Shale-soft, slick, high plast, pale blue	
					Lignite-shaly, soft, lam, black	Fault 5°, Bedding 3°
					Shale-carb, soft, lam w lig, slick med plast, inclus of carb material	Bedding 8°
14						Slickensides 40°
						Fault 28°
						Bedding 10° - 15°
					Lignite-shaly, soft, blk, amber inclus.	Fault 32°
15						Bedding 8°
					Shale-soft slick med plast.	Slickensides 52°
					Shale-carb, soft, mass, occ lam, med plast, dk brn.	Slickensides 8°
16						

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ROCK CORE LOG

PROJECT: Quesnel Slide Study
B.C. Department of Highways

HOLE LOCATION:

LOGGED BY: GFL | CHECKED: CL | DATE OF INVESTIGATION: | JOB NUMBER: 01521 | HOLE: RMH#5

CORE RECOVERY ——— R.Q.D. - - - - - - PERCENT 20 40 60 80 100

DEPTH (m)	SOIL SYMBOL	CORE RUN	WEATHERING	STRENGTH	DESCRIPTION	REMARKS
					Shale-carb.	
						Slickensides 5°
17					Sandstone	
					Shale-soft,mass,slick, pale bl grading to lt brn,inclus of lignite	Slickensides 38°
18						Fault 3°
						Slickensides 38° Slickensides 30° Bedding 10° Slickensides 10°
19						Slickensides 42°
20					Shale-soft,mass,high plast,pale blue inclus of organics	Terratech Piezometer P1020 Ser. No. 1522 installed at 13.4 cm Terratech Piezometer P1020, Ser. No. 1526 installed at 10.4 cm
21					Laminated	
					END OF HOLE	

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ROCK CORE LOG

PROJECT: Quesnel Slide Study

HOLE LOCATION: B.C. Department of Highways
Elevation 476 m approx.

LOGGED BY: GL | CHECKED: GL | DATE OF INVESTIGATION: | JOB NUMBER: Q1521 | HOLE: RMH#6

CORE RECOVERY ———
R.Q.D. — — — — — —
PERCENT 20 40 60 80 100

DEPTH (m) | SOIL SYMBOL | CORE RUN | WEATHERING | STRENGTH

DESCRIPTION	REMARKS
Topsoil, Organics	
Sand - gravel mix., some silt, cobbles, med. dense, non-stratified, br., dense	N=18
Sh. - soft, lam. w. lig., slick, med. plast., dk. br. & v. dk. br.	N=16 PP>431 kPa Slickensides 5°-15° PP>431 kPa
Sh., - lig. interbed., soft, lam., slick., med. plast., dk. br.	Bedding 15° Fracture 38° Fracture 30°
v. dk. br., amber inclus.	Fault 70° Fractures 70° & 80°
Lig. - shaly, soft, lam., slick, blk.	Slickensides 20° Fracture 50°, Bedding 8° Fracture 12° Fault 11°, Bedding 12° Fracture 15° Fracture 20°

0 1 2 3 4 5

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ROCK CORE LOG

PROJECT: Quesnel Slide Study
HOLE LOCATION: B.C. Department of Highways

LOGGED BY: GL | CHECKED: GL | DATE OF INVESTIGATION: | JOB NUMBER: 01521 | HOLE: RMH#6

Atterberg limits ⊠
Water content ○
PERCENT 20 40 60 80 100

DEPTH (m)	SOIL SYMBOL	CORE RUN	WEATHERING	STRENGTH	DESCRIPTION	REMARKS
					Sh. - lig., interbed., soft, lam., slick., med. plast., dk. br. & v. dk. br., amber inclus.	Fracture 18°
6						
					Sh. - soft, lam., w. lig., occ. slick., med. plast., dk. br.	Bedding 10°
					Ss. - soft, friable, lam.	Fault (upper contact) 42° Bedding 42° Fault (lower contact) 42°
7						Bedding 8° Bedding 10°, Fracture 39° Fracture 31° Fracture 18° Fault 45° Fault 35° Fault 30°, Bedding 15° Fault 50°
8						
						Fracture 65° Fault 42°
9						Fault 18°
					Ss. - soft, mass., red. br.	Bedding 29°
						Bedding 15°, Slickensides 38°
10						
						Fracture 35° Fracture 30° Fracture 38° Fracture 55°
					Amber inclus.	

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ROCK CORE LOG

PROJECT: Quesnel Slide Study
B.C. Department of Highways

HOLE LOCATION:

LOGGED BY: GL | CHECKED: GL | DATE OF INVESTIGATION: | JOB NUMBER: Q1521 | HOLE: RMH#6

Atterberg Limits ⊢⊣
Water content ○ — — —
PERCENT 20 40 60 80 100

DEPTH | SOIL SYMBOL | CORE RUN | WEATHERING | STRENGTH

DESCRIPTION	REMARKS
Sh. - soft, lam., w. lig., occ. slick., med. plast., dk. br.	Pocket penetrometer = 383 kPA
Sh. - soft, slick., high plast., pale gy.-br.	Pocket penetrometer = 48 kPA
Lig. inclus.	Slickensides 38°
Sh. - soft, slick., med. plast., lig. inclus., br. lig. lam. at 12.5 m	Bedding 8°
Sh. - soft, slick., high plast.	
Lig. - soft, lam. blk.	Bedding 6°-8° Slickensides 28°
Sh. - soft, slick., high plast., lig. inclus., lt. br.	Bedding 5°, Slickensides 28°
	Slickensides 35°
	Slickensides 49°
	Slickensides 40°
Sh. - carb., soft, lam. w. lig., slick., med. plast., dk br.	Fracture 72°, Fault 62° Fault 49°

11
12
13
14
15

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ROCK CORE LOG

PROJECT: Quesnel Slide Study
B.C. Department of Highways

HOLE LOCATION

LOGGED BY: GL | CHECKED: GL | DATE OF INVESTIGATION | JOB NUMBER: Q1521 | HOLE: RMH#6

CORE RECOVERY ———
R.Q.D. — — — — — —
PERCENT 20 40 60 80 100

DEPTH (m)	SOIL SYMBOL	CORE RUN	WEATHERING	STRENGTH	DESCRIPTION	REMARKS
16					Sh. - carb., soft, lam. w. lig., slick. med. plast., dk. br.	Bedding 9°, slick. 20°
					Lig.- sh. soft	
					Lig. - sh. soft., lam.	
17					Lig.-sh., soft. lam., med. plast., sh., v. dk. br.	
						Bedding 10°
18					Sh.-soft, mass., med. to high plast., br.	
					Lig. - shaly, soft, lam., blk.	Bedding 10°, Fault 20°
19						
					Lig. - shaly, soft, lam., blk.	Slickensides 5° Bedding 8°
					Lig - soft, lam. blk	
					Lig.-soft, lam. blk	Fracture 80° Fracture 50°
20						
						Fault
					Slst. - soft, brittle, yel.	Fractures 49°
21						

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ROCK CORE LOG

PROJECT: Quesnel Slide Study

HOLE LOCATION: B.C. Department of Highways

LOGGED BY: GL | CHECKED: GL | DATE OF INVESTIGATION: | JOB NUMBER: 01521 | HOLE: RMH#6

CORE RECOVERY ———
R.Q.D. — — — — — —
PERCENT 20 40 60 80 100

DEPTH (m)	SOIL SYMBOL	CORE RUN	WEATHERING	STRENGTH	DESCRIPTION	REMARKS
22					Sh. - carb., soft, lam. w. lig., slick., med. plast., dk. br., amber inclus. End of Hole	
					Tiltmeter casing installed	

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ROCK CORE LOG

PROJECT: Quesnel Slide Study
B.C. Department of Highways

HOLE LOCATION: Surface Elevation 478 m Approx.

LOGGED BY: MD | CHECKED: GFL | DATE OF INVESTIGATION: | JOB NUMBER: 01521 | HOLE: RMH#7

CORE RECOVERY ——— R.Q.D. — — — — — — PERCENT 20 40 60 80 100

DEPTH (m)	SOIL SYMBOL	CORE RUN	WEATHERING	STRENGTH	DESCRIPTION	REMARKS
					Topsoil - blk	
					Sand-gravelly, some silt, loose to med. dense, brn	
1					Gravel - sand mixture	
						N=9
2						
3						N=12
					Shale-soft, lam w lig. med.plast, brn & dk brn	
4						PP > 430 kPa N=11
5						
					Lignite-soft, lam, slick. dk brn to blk	

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ROCK CORE LOG

PROJECT: Quesnel Slide Study
HOLE LOCATION: B.C. Department of Highways

LOGGED BY: MD | CHECKED: GFL | DATE OF INVESTIGATION: | JOB NUMBER: 01521 | HOLE: RMH#7

CORE RECOVERY ——— R.Q.D. — — — — — — PERCENT 20 40 60 80 100

DEPTH (m)	SOIL SYMBOL	CORE RUN	WEATHERING	STRENGTH	DESCRIPTION	REMARKS
					Lignite-soft,lam,slick, dk brn to blk	
						PP > 430 kPa
6						
7					Shale-carb,soft,lam w lig.,slick.,brn	
					Lignite-soft,slick,blk	
8						
					Lignite-soft,slick. blk.	
						Fault 45°
9					Lignite-shaly,soft,lam, slick,brn & blk.	
						Fracture 50°
						Fracture 30°
10					Shale-soft,lam w lig., slick,high plast.,grey	
					Shale-carb,lig.lam.	Bedding 0°

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ROCK CORE LOG

PROJECT: Quesnel Slide Study
B.C. Department of Highways

HOLE LOCATION:

LOGGED BY: MD | CHECKED: CFL | DATE OF INVESTIGATION: | JOB NUMBER: 0 1521 | HOLE: RMH#7

CORE RECOVERY ———
R.Q.D. — — — — — —
PERCENT 20 40 60 80 100

DEPTH (m)	SOIL SYMBOL	CORE RUN	WEATHERING	STRENGTH	DESCRIPTION	REMARKS
					Shale-soft,lam.w lig., slick,high plast,grey	
11					Shale-lignite,interbed, dk brn to brn	Bedding 30-35°
12					Hard, light grey	
					Shale-carb,soft,lam.w lig,occ.slick,med.plast brn	
					Shale-lignite interbed.	Fracture 70°
						Bedding 0-15°
13						Fracture 45°
						Fracture 65°
					Lignite-soft,slick,blk	
14						
15						
					Lignite-shaly,soft,lam, slick,blk & dk brn	
16					Shale-lignite,interbed,	

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ROCK CORE LOG

PROJECT: Quesnel Slide Study
B.C. Department of Highways

HOLE LOCATION:

LOGGED BY: MD | CHECKED: GFL | DATE OF INVESTIGATION: | JOB NUMBER: 01521 | HOLE: RMH #7

CORE RECOVERY ———
R.Q.D. — — — — — —
PERCENT: 20 40 60 80 100

DEPTH | SOIL SYMBOL | CORE RUN | WEATHERING | STRENGTH

DESCRIPTION	REMARKS
soft,slick,lam,brn	
Lignite-shaly,soft, lam,slick,blk&dk brn	
Shale-carb,soft,lam w lig,occ slick,dk brn	Bedding 30°
	Fracture 25°
Lignite-shaly,soft,lam, slick,dk brn	Bedding 0°
	Fault 20°
Lignite-shaly,soft,lam, slick,dk brn	Bedding 0°
	Bedding 0°
	Terratech Piezometer P1020 Ser.No. 1527 Installed at 18.2 m
Lignite-shaly,soft,lam, slick,dk brn	Bedding 0°
	Terratech Piezometer P1020 Ser.No. 1523 Installed at 10.7 m
End of Hole	

17 18 19 20 21

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ROCK CORE LOG

PROJECT: Quesnel Slide Study
B.C. Department of Highways

HOLE LOCATION
Surface Elevation 484 m. approx.

LOGGED BY: MD | CHECKED: GL | DATE OF INVESTIGATION: | JOB NUMBER: 01521 | HOLE: RMH#8

CORE RECOVERY ——— R.Q.D. - - - - - -
PERCENT 20 40 60 80 100

DEPTH (m)	SOIL SYMBOL	CORE RUN	WEATHERING	STRENGTH	DESCRIPTION	REMARKS
					Pavement Sand-gravel mix. some carb, boulders, med., dense, brown	
1						
						N=10
2						
3						Sampler Pounding Rock
4						
					Dense	
						N=43
5						

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ROCK CORE LOG

PROJECT: Quesnel Slide Study
HOLE LOCATION: B.C. Department of Highways

LOGGED BY: YD | CHECKED: GL | DATE OF INVESTIGATION: | JOB NUMBER: 01521 | HOLE: TM148

Atterberg Limits ☐
Water Content ●
PERCENT 20 40 60 80 100

DEPTH	SOIL SYMBOL	CORE RUN	WEATHERING	STRENGTH	DESCRIPTION	REMARKS
					Lignite-shaly,soft,lam, slick,dk brn to blk	
6						PP > 431 kPa
					Lignite-shale interbed, soft,lam,slick,dk & lt brn	Fault 30° PP > 431 kPa Fault 50° Fault 30°
7						
					Shale-carb,soft,lam w lig,slick,med plast,dk & lt brn	Dip 0°
8					Lignite-soft,slick	Fracture 40°
					Lignite-shale interbed, soft,lam,slick,dk brn	Fault 20°
9						
					Lignite-shale interbedded soft	
					Lignite-soft,slick.	
10					Lignite-shale interbed, soft,lam,slick, dk brn	
					Lignite-shale interbed, soft,lam,slick	

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ROCK CORE LOG

PROJECT: Quesnel Slide Study
B.C. Department of Highways

HOLE LOCATION:

LOGGED BY: ND | CHECKED: CL | DATE OF INVESTIGATION: | JOB NUMBER: 01521 | HOLE: RMH#8

Atterberg Limits
ater Content
PERCENT 20 40 60 80 100

DEPTH	SOIL SYMBOL	CORE RUN	WEATHERING	STRENGTH	DESCRIPTION	REMARKS
11					Lignite-shale interbed soft,lam,slick,dk brn	Fault 20° Fault 45° Fault 30°
12					Shale-soft,lam,carb layers,slick	
					Lignite-shaly,soft,lam, slick,dk brn	
					Shale-carb,soft,lam w lig,slick, dk brn	Fault 60°
13					Shale-soft,lam w lig, bluish-gy	
					Carb, some lignite lam.	
14						
					Siltstone-hard,grey	
15						
					Shale-carb,soft,lam w lig,slick,high plast, dk & lt brn	Fault 20°

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ROCK CORE LOG

PROJECT: Quesnel Slide Study
B.C. Department of Highways

HOLE LOCATION:

LOGGED BY: MD | CHECKED: CL | DATE OF INVESTIGATION: | JOB NUMBER: Q1521 | HOLE: RMH#8

Atterberg Limits ⊠
Water Content ○
PERCENT 20 40 60 80 100

DEPTH m	SOIL SYMBOL	CORE RUN	WEATHERING	STRENGTH	DESCRIPTION	REMARKS
16					Shale-carb,soft,lam w lig,slick med & high plast,dk & lt brn	
					Shale-soft,lam w lig, plast.	
17						
18					Shale-carb,soft,lam w lig,slick,dk brn & brn	
						Fault 20°
					Shale-bluish-green,soft	
						Fault 20°
19					Shale-bluish-grn soft	
						Fracture 35°
20						
						Fault 30°
					Lignite- soft	
					Shale-soft,high plast, slick.	
						Fracture 45°
21						
					Shale-soft,lam w lig, bluish	

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ROCK CORE LOG

PROJECT: Quesnel Slide Study
B.C. Department of Highways

HOLE LOCATION:

LOGGED BY: MD | CHECKED: GL | DATE OF INVESTIGATION: | JOB NUMBER: 01521 | HOLE: RMH#8

CORE RECOVERY ——— R.Q.D. — — — — — — PERCENT 20 40 60 80 100

DEPTH (m)	SOIL SYMBOL	CORE RUN	WEATHERING	STRENGTH	DESCRIPTION	REMARKS
					Shale-soft,lam w lig	
					Shale-carb,soft,lam w lig,slick,dk brn	
						Slickensides 45°
					Lignite-carb,shale, interbed,soft,slick, dk brn & blk	
22						Fault 40°
					Shale-soft,slick,lt brn	
23						Bedding 15° - 20°
					Shale-soft,slick	
						Fault 20°
24						
						Fault 20°
						Fault 20°
					Shale-carb,soft,lam w lig,slick,med & high plast,dk brn & lt brn	
						Slickensides 45°
25						
					Shale-soft,lt grey	
						Slickensides 45°
					Shale-soft,slick,high plast.	
26						
						Slickensides 30°
						Slickensides 30°
					Lignite -soft	Slickensides 45°
					END OF HOLE Standpipe in Shallow at 6.1 m.	Terratech Piezometer P1020 Ser.No.1524 installed at 16.5 m.

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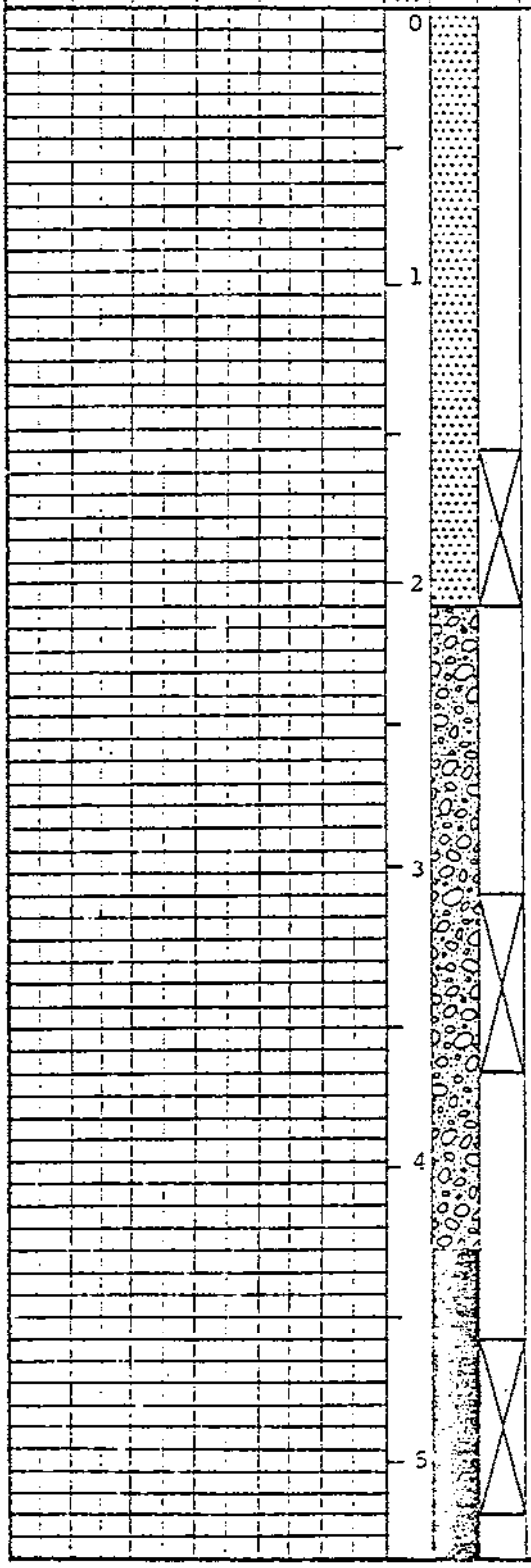
ROCK CORE LOG

PROJECT: Quesnel Slide Study
B.C. Department of Highways

HOLE LOCATION: Surface elevation 478 m approx.

LOGGED BY: M.D. | CHECKED: G.L. | DATE OF INVESTIGATION: | JOB NUMBER: Q1521 | HOLE: RMH #9

CORE RECOVERY ———
R.Q.D. — — — —
PERCENT 20 40 60 80 100



DEPTH (m)	SOIL SYMBOL	CORE RUN	WEATHERING	STRENGTH	DESCRIPTION	REMARKS
0					Sand - gravel mix, silty, gravel to 5 cm dia med. dense, br.	
1						
						N=16
2					Gravel - sandy, some cobbles, med. dense	
3						N=22
4						Water table at time of drilling
					Lig. - Shaly, soft, lam., slick., dk. br. blk.	N=49
5						

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ROCK CORE LOG

PROJECT: Quesnel Slide Study
HOLE LOCATION: B.C. Department of Highways

LOGGED BY: M.D. | CHECKED: G.L. | DATE OF INVESTIGATION: | JOB NUMBER: 01521 | HOLE: RMH#9

CORE RECOVERY ———
R.Q.D. — — — — — —
PERCENT: 20 40 60 80 100

DEPTH (m)	SOIL SYMBOL	CORE RUN	WEATHERING	STRENGTH	DESCRIPTION	REMARKS
					Lig. - shaly, soft, lam., slick., dk. br., & blk.	
6					Sh. - Carb., soft, lam. w. lig., slick. amber. inclus.	
					Sh. - soft, high plast., slick.	Fault 20°
					Sh. - soft, high plast.	Fault 20°
7					Lig. - soft, slick., lam., dk. br.	
					Sh. - lig. interbed., soft, lam., slick., dk. br. & blk.	Bedding 20° Loss of circulation Fault 30°
8						Fault 60°
					Sh., - soft, slick., high plast., lt. br.	Fault 30°
9					Lig., soft, blk.	Fault 30°
					Lig. - shaly, soft, friable, lam.	
10						Fracture 45°

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ROCK CORE LOG

PROJECT: Quesnel Slide Study
B.C. Department of Highways

HOLE LOCATION:

LOGGED BY: M.D. | CHECKED: G.L. | DATE OF INVESTIGATION: | JOB NUMBER: 01521 | HOLE: RMH#9

Atterberg limits ⊟
water content ⊖
PERCENT 20 40 60 80 100

DEPTH	SOIL SYMBOL	CORE RUN	WEATHERING	STRENGTH	DESCRIPTION	REMARKS
					Sh. - lig., interbed., soft, lam., slick.	Fault 15°
11					Lig. - shaly, soft, friable, lam.	
					Sh. - soft, slick.	
					Sh. - carb., soft, lam. w. lig., slick., dk. br. & lt. br.	Bedding 15-20°
12						
						Fault 30°
13					Lig. - shaly, soft, friable	Slick. 35°
					Sh. - carb., soft, lam.w.lig., slick., med. & high plast., sh gy br	Bedding 0°
					Lig., soft, blk.	
14						Fault 30°
					High plast.	Fault 15°
15						
						Slick. 40°

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ROCK CORE LOG

PROJECT: Quesnel Slide Study
B.C. Department of Highways

HOLE LOCATION:

LOGGED BY M.D. | CHECKED G.L. | DATE OF INVESTIGATION | JOB NUMBER Q1521 | HOLE RMH#9

CORE RECOVERY ———
R.Q.D. — — — —
PERCENT 20 40 50 80 100

DEPTH	SOIL SYMBOL	CORE RUN	WEATHERING	STRENGTH	DESCRIPTION	REMARKS
16					Sh. - soft, slick., med. to high plast., bl. gy.	
					Lig. - carb., sh. interbed.	
					Sh., carb., soft lam. w. lig.	
					Lig. - carb. sh., interbed., soft. slick	Fault 30°
17						
					Sh. - soft, lam. w. lig., med. plast.,	
18						
						Slick. 45°
						Fracture 20°
					Lig. - shaly, soft, lam., slick., dk. br.	Fault 35°
19						
					Lig. - shaly, soft, lam. slick. dk. br.	Fault 15°
					Sh. - soft, med. to low plast., bl. gy., carb.	Fault 30°
20						
						Slick. 45°
						Slick. 45°
21						
					Sh. - carb., soft, lam. w. lig., slick., med. & high plast., br. & dk. br.	
					Lig. - shaly, soft, lam., slick.	

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ROCK CORE LOG

PROJECT: Quesnel Slide Study
B.C. Department of Highways

HOLE LOCATION:

LOGGED BY: M.D. | CHECKED: G.L. | DATE OF INVESTIGATION: | JOB NUMBER: 01521 | HOLE: RMH#9

CORE RECOVERY ———
R.Q.D. — — — —
PERCENT 20 40 60 80 100

DEPTH (m)	SOIL SYMBOL	CORE RUN	WEATHERING	STRENGTH	DESCRIPTION	REMARKS
					Sh. - carb., soft, lam. w. lig., slick, med. & high plast., br. & dk. br.	Slickensides 30° Fault 25°
22						Fault 30°
					Lig. - soft, lam., slick. blk.	Fault 30° Bedding 0°
23						
					Lig. - shaly, soft, lam., slick., dk. br. & blk.	Fractures 20° Bedding 0°
						Bedding 0-15°
24						Fault 30°
						Fracture 30°
25						Fracture 20°
					Ss - med., soft, yel.	Fracture 20°
26						Fracture 45°
						Slickensides 30° Slickensides 45°
					Sh. - soft., med. plast., bl. gy.	

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ROCK CORE LOG

PROJECT: Quesnel Slide Study
B.C. Department of Highways

HOLE LOCATION

LOGGED BY: M.D. | CHECKED: G.L. | DATE OF INVESTIGATION: | JOB NUMBER: 01521 | HOLE: RMH89

Atterberg Limits
Water content
PERCENT 20 40 60 80 100

DEPTH	SOIL SYMBOL	CORE RUN	WEATHERING	STRENGTH	DESCRIPTION	REMARKS
27					Sh. - carb., soft, lam w. lig., slick., med. & high plast., br. & dk. br.	Fault 45°
28					Lig. - soft, blk.	
					Lig. - shaly, soft, some slick., blk.	
29					Sh. - soft, med. plast., lig. inclus., bl. gy.	
30						
31						
					End of hole. Terratech piezometer P1020 Ser. No. 1525 installed at 17.7 m Standpipe installed at 4.6 m	

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ROCK CORE LOG

PROJECT: Quesnel Slide Study
B.C. Department of Highways

HOLE LOCATION: Surface Elevation 483 m. Approx.

LOGGED BY: MD | CHECKED: GL | DATE OF INVESTIGATION: | JOB NUMBER: Q1521 | HOLE: RMH#10

CORE RECOVERY ———
R.Q.D. — — — — — —
PERCENT 20 40 60 80 100

DEPTH m	SOIL SYMBOL	CORE RUN	WEATHERING	STRENGTH	DESCRIPTION	REMARKS
					Silt-sandy, firm to stiff, low plast br, moist	
1						
2					Sand-silty, loose, light br, damp	N=8
					Gravel sand mixture medium dense damp	
3						Sampler Pounding Boulder
4						Water Table at time of drilling
5						N=13

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ROCK CORE LOG

PROJECT Quesnel Slide Study
B.C. Department of Highways

HOLE LOCATION

LOGGED BY MD | CHECKED GL | DATE OF INVESTIGATION | JOB NUMBER Q1521 | HOLE RMH#10

CORE RECOVERY ———
R.Q.D. — — — — — —
PERCENT 20 40 60 80 100

DEPTH m	SOIL SYMBOL	CORE RUN	WEATHERING	STRENGTH	DESCRIPTION	REMARKS
					Gravel-sand mixture med, dense, damp	
6						
7						
8					Shale-soft lam w lig gy,moist	
9					Slst hard,light br	
10					Lig-Sh, soft, lam slick dark br	Fault 20° Fault 15°

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ROCK CORE LOG

PROJECT Quesnel Slide Study
B.C. Department of Highways
HOLE LOCATION

LOGGED BY MD | CHECKED GL | DATE OF INVESTIGATION | JOB NUMBER Q1521 | HOLE RMH#10

PERCENT 20 40 60 80 100	DEPTH	SOIL SYMBOL	CORE RUN	WEATHERING	STRENGTH	DESCRIPTION	REMARKS
						Lig-Sh, soft lam slick dk br to bl	
	11					Sh-Carb soft lam w lig slick dk br	
							Bedding 20°
						Sh-Carb soft lam w lig slick high & med plas lt & dk br	
						High Plas	
	12						
						Sh-soft low to med plas gy	
	13					Lig-soft slick	
							Fault, 30°, Note white film on surface
						Lig-soft, lam	
	14						
							Fault 20°
						Lam of Red-y Sh	Bedding 20°
	15						
						Sh-carb, soft, lam w lig low & med plas, lt, dk gy	
						Sh, lam, red	Bedding 20°
	16						

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ROCK CORE LOG

PROJECT Quesnel Slide Study
B.C. Department of Highways

HOLE LOCATION

LOGGED BY MD | CHECKED GL | DATE OF INVESTIGATION | JOB NUMBER Q1521 | HOLE RMH#10

CORE RECOVERY ———
R.Q.D. — — — —
PERCENT 20 40 60 80 100

DEPTH m	SOIL SYMBOL	CORE RUN	WEATHERING	STRENGTH	DESCRIPTION	REMARKS
					Sh-Carb, soft, lam w lig low & med plas lt dk & gy br	
					Lig-Sh, soft slick lam dk br & bl	Fault 15°
17						
18					Lig-Sh, soft, lam slick br & blk Sh-lig interbed soft, lam lt & dk br	Fault 20°
19					Sh-lig interbed, soft lam slick lt & dk br	Fault 25°
20						
					Sh-soft, lam carb slick gy	Slick 30°-40°
21					Lig-Sh, soft lam slick dk br & blk	

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ROCK CORE LOG

PROJECT Quesnel Slide Study
B.C. Department of Highways

HOLE LOCATION

LOGGED BY MD | CHECKED GL | DATE OF INVESTIGATION | JOB NUMBER Q1521 | HOLE RMH10

Atterberg Limits ____ L
Water Content _ _ _ _ O
PERCENT 20 40 60 80 100

DEPTH (m) | SOIL SYMBOL | CORE RUN | WEATHERING | STRENGTH

DESCRIPTION	REMARKS
Sh-Carb, soft lig low med lt dk & gy br	
Sh-soft, lam w carb lig low to med plas gy, lig inclus	
Lt gy-br colour	
Sc- f grained, hard fis	
Sh-soft slick med plas gy	Bedding 30°-40°
Sh-carb, soft, lam w lig slick med to high plas lt br	
Sh-soft gy lig-Sh, soft slick	Bedding 30°
Sh Carb soft, lam lig slick med to high plas lt br	
Lig-Sh, soft, lam slick dk br to blk	Bedding 45°
	Bedding 0°

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ROCK CORE LOG

PROJECT: Quesnal Slide Study
B.C. Department of Highways

HOLE LOCATION:

LOGGED BY: MD | CHECKED: GL | DATE OF INVESTIGATION: | JOB NUMBER: Q1521 | HOLE: RMH#10

CORE RECOVERY ———
R.Q.D. — — — — — —
PERCENT 20 40 60 80 100

DEPTH	SOIL SYMBOL	CORE RUN	WEATHERING	STRENGTH	DESCRIPTION	REMARKS
					Lig-Sh soft lam slick dk br to blk	
27					End of hole Terratech Piezometer P1020, SER#1528 Int.at 20.1 m. Tiltmeter Casing Installed	

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BOREHOLE LOG

PROJECT QUESNEL SLIDE STUDY
B.C. DEPARTMENT OF HIGHWAYS

Logged/Dwn. CKD | Date of Investigation Jan. 18-24/67 | JOB NO. 1A

20 40 60
Wp - □ W - ○ Wl - △
WATER CONTENT %

DATUM A denotes Tiltmeter
SURFACE ELEVATION 490 m.

DEPTH m.	SOIL DESCRIPTION	CONDITION	TYPE	PENETRATION RESISTANCE	DRILL TYPE / OTHER TESTS
2	GRAVEL (GM) silty (From drillers log July 11/66) silty, sandy, dark grey, highly organic (roots), moist, maximum size 1.0"	X	D1	N= 5	Rec.= 17%
4	GRAVEL (GP) sandy, little or no fines, maximum size 3/4", grey, moist	X	D2	N=35	Rec.= 13%
		X	D3	N=34	Rec.= 8%
6					
	GRAVEL-SILT (GM-ML) slightly sandy, dark grey to black, highly organic (OH), soft, maximum size 1.0"	X	D4	N=33	Rec.= 7%
8		X	D5	N=33	Rec.= 8%
	CLAY (OH-OL) very silty, highly organic, black, firm	X	D6	N=18	Rec.= 50%
10	(OL) very silty, dark grey, stiff, ML lumps and OH lumps		U1		
	SILT (OH-ML) clayey, slightly organic, grey, very stiff to hard, slow dilatancy	X	D7	N=35	Rec.= 75%
12			U2		
			U3		
		X	D8	N=47	Rec.= 50%
			U4		
14	CLAY (CH) silty, highly organic, black and grey, hard, slow dilatancy	X	D9	N=33	Rec. 75%
			U5		
			U6		
16		X	D10	N=36	Rec.= 50%
			U7		
	soft	X	D11	N=48	Rec.= 62%
	B denotes Peizometer Elevation: 490 m T.H. 1B				
5	GRAVEL (GP) little or no fines, small boulders				

TA 446 12.77

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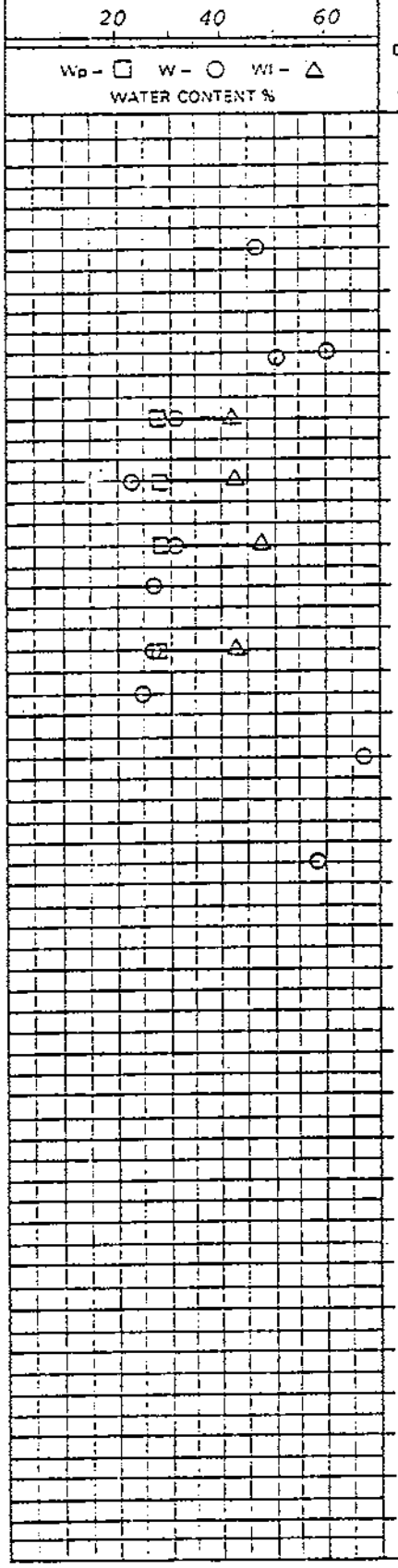
BOREHOLE LOG

PROJECT QUESNEL SLIDE STUDY
B.C. DEPARTMENT OF HIGHWAYS

Logged/Dwn.	CKD	Date of Investigation Feb. 6-8/67	JOB NO.	2



DEPTH m.	SOIL SYMBOL	SOIL DESCRIPTION (DATUM SURFACE ELEVATION 493.4 m.)	SOIL SAMPLE CONDITION	SOIL SAMPLE TYPE	SOIL SAMPLE PENETRATION RESISTANCE	DRILL TYPE / OTHER TESTS
		GRAVEL (GP) little or no fines (drillers log July 11/66) trace of lignite at 5.0'				
2		CLAY (CL) medium sand sizes, dark grey, damp, stiff, organics		D_1	N=25	Rec.= 25%
				D_2	N=30	Rec.= 33%
		CLAY (OH) organic, black, stiff lignite		U_1		
4		CLAY (CL) silty, blue grey, stiff, low plastic		U_2		
		SILT (ML) hard, grey		D_2	N=29	Rec.=67%
6				U_3		
				D_3	N=35	Rec.= 50%
				U_4		
8				D_4	N=34	Rec.= 75%
		LIGNITE black brown, hard		D_5	N=81	Rec.= 63%
10				D_6	N=110	Rec.= 67%

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BOREHOLE LOG

PROJECT QUESNEL SLIDE STUDY
B.C. DEPARTMENT OF HIGHWAYS

Logged/Dwn. CKD | Date of Investigation Feb. 1-8/67 | JOB NO. | 3B

20 40 60 Wp - □ W - ○ Wl - △ WATER CONTENT %	DEPTH m.	SOIL SYMBOL	SOIL DESCRIPTION (DATUM SURFACE ELEVATION 490 m.)	SOIL SAMPLE CONDITION	TYPE	PENETRATION RESISTANCE	DRILL TYPE / OTHER TESTS
			GRAVEL (GP) little to no fines				
	2		(GM) silty, maximum size 1 1/4"		D_1	N=37	Rec.= 25%
			(GP) grey, maximum size 3/4", dense		D_2	N=99	Rec.= 17%
	4						
			CLAY (CL) grey, hard		U_1		
	6						
			CLAY (CL) high plastic, hard, grey, organic seams (OH) at 22'		D_3	N=40	Rec.= 33%
	8		SILT (ML-MH) grey (some OH material, low plastic, hard)		U_2 U_3		
			(MH) brown, siltstone lumps		U_4		
					D_4	N=39	Rec.= 50%
			CLAY (CH) highly organic lignite, black, hard		U_5		
	10				D_5	N=128	Rec.= 78%
					U_6		
					D_6	N=85	Rec.= 63%
	12				D_7	N=81	Rec.= 58%
	14				D_8	N=81	Rec.= 58%
					D_9	N=80	Rec.= 80%
	16						
					D_{10}	N=83	Rec.= 50%
			TEST HOLE 3B SURFACE ELEVATION 490 m.				
			GRAVEL (GP) little or no fines				

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BOREHOLE LOG

PROJECT QUESNEL SLIDE STUDY
B.C. DEPARTMENT OF HIGHWAYS

Logged: Dwn	CKD	Date of Investigation Feb. 23/67	JOB NO.	4

Wp – □ W – ○ Wl – △
WATER CONTENT %
20 40 60

DATUM
SURFACE ELEVATION 472.5 m.

DEPTH m.	SOIL DESCRIPTION	SOIL SAMPLE CONDITION	TYPE	PENETRATION RESISTANCE	DRILL TYPE / OTHER TESTS
	GRAVEL (GP-GM) fine and course, sandy, brown to grey, loose, maximum size 3/4"				▽
2	coarse silt	X	D_1	N= 5	Rec.= 42%
	(SM) sand, silty, grey, maximum size 1/2"	X	D_2	N= 5	Rec.= 42%
4	GRAVEL (GP) sandy, grey, maximum size 1", medium dense at 15'	X	D_3	N=10	Rec.= 25%
6	CLAY (CL) some organics, silty, grey, rocky, (TILL) stiff	X	D_4	N=16	Rec.= 13%
	CLAY (OH) highly organic, silty lignite, dark grey to black, hard	△ X	U_1 D_5	N=26	Rec.= 75%
8					
10	CLAY (CL) silty, some organics, grey, hard, low plastic	X	D_6	N=18	Rec.= 38%
	CLAY (OH) highly organic lignite, black, very stiff	X	D_7	N=30	Rec.= 50%
12		X	D_8	N=13	Rec.= 25%
14		X	D_9	N=44	Rec.= 75%

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PROJECT QUESNEL SLIDE STUDY
B.C. DEPARTMENT OF HIGHWAYS

Logged: Dwn.	CKD	Date of Investigation Feb. 9/67	JOB NO.	5A

Wp - □ W - ○ Wl - △
WATER CONTENT % (20, 40, 60)

DATUM
SURFACE ELEVATION 494.4 m.

DEPTH m.	SOIL DESCRIPTION	CONDITION	TYPE	PENETRATION RESISTANCE	DRILL TYPE / OTHER TESTS
	GRAVEL (GP) course sand, grey, loose, maximum size 1"				
2		☒	D_1	N= 6	Rec.= 13%
	dense	☒	D_2	N=44	Rec.= 13%
4		☒	D_3	N=41	Rec.= 25%
6	CLAY (OH) highly organic lignite, dark grey, hard	◪	U_1		
8		☒	D_4	N=37	Rec.= 100%
		☒	D_5	N=47	Rec.= 75%
10		☒	D_6	N=35	Rec.= 75%
12		☒	D_7	N=46	Rec.= 75%

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PROJECT QUESNEL SLIDE STUDY
B.C. DEPARTMENT OF HIGHWAYS

Logged/Dwn.	CKD	Date of Investigation	Feb. 10/67	JOB NO.	6

Wp - □ W - ○ Wl - △
WATER CONTENT %

DATUM
SURFACE ELEVATION 493.9 m.

DEPTH m.	SOIL DESCRIPTION	SOIL SAMPLE CONDITION	TYPE	PENETRATION RESISTANCE	DRILL TYPE / OTHER TESTS
	GRAVEL (GP) coarse and medium sand, slightly silty (10%), grey, maximum size 3/4", damp	☒	D_1	N=38	Rec.= 17%
		☒	D_2	N=12	Rec.= 17%
5		☒	D_3	N=11	Rec.= 17%
		☒	D_4	N=19	Rec.= 17%
	SAND (SM) fine, silty, brown, few roots	☒	D_5	N=14	Rec.= 45%
	GRAVEL (GP) (5% silt), coarse and medium sand, maximum size 1.0", grey, medium dense	☒	D_6	N=18	Rec.= 17%
10		☒	D_7	N=24	Rec.= 8%
		☒	D_8	N=26	Rec.= 13%
		☒	D_9		
15		☒	D_{10}	N= 39	Rec.= N.R.
		☒	D_{11}	N=15	Rec.= 13%
		☒	D_{12}	N=14	Rec.= 8%
20		☒	D_{13}	N= 14	Rec.= 8%
	SAND (SM) silty, yellow grey, 3/4" sizes	☒	D_{14}	N=12	Rec.= 17%
	CLAY (OH) highly organic, layered lignite, dark grey to black	☒	D_{15}	N=33	Rec.= 50%
25	medium sand lenses, light grey	☒	D_{16}	N=48	Rec.= 68%
		☒	D_{17}		
		☒	D_{18}	N=49	Rec.= 50%
30		☒	D_{19}	N=75	Rec.= 50%
		☒	D_{20}	N=43	Rec.= 100%

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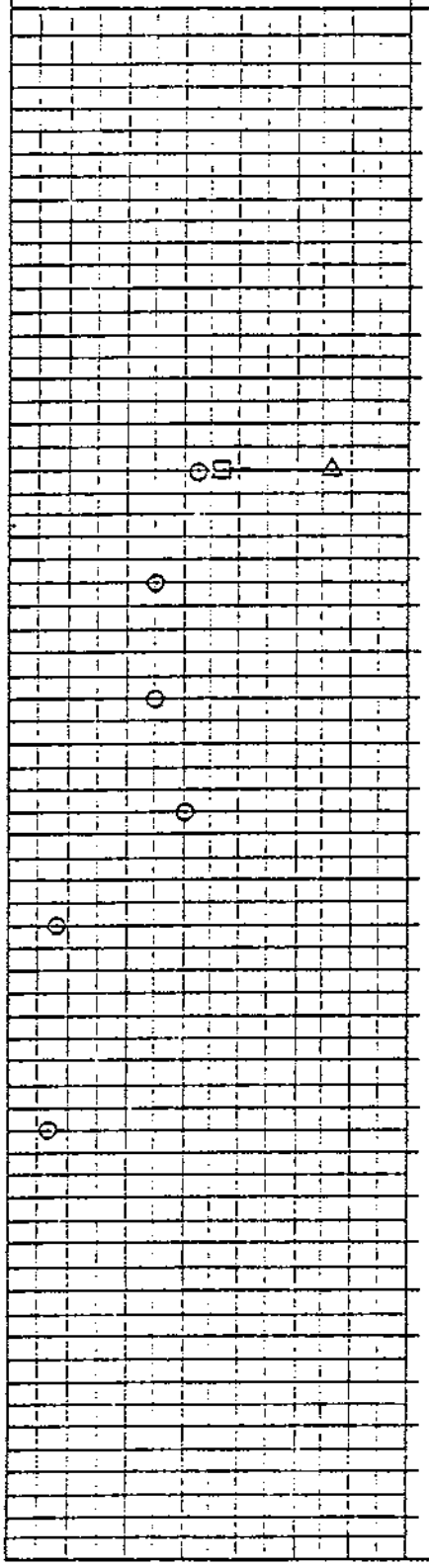
BOREHOLE LOG

PROJECT QUESNEL SLIDE STUDY
B.C. DEPARTMENT OF HIGHWAYS

Logged/Dwn.	CKD	Date of Investigation	JOB NO.	7



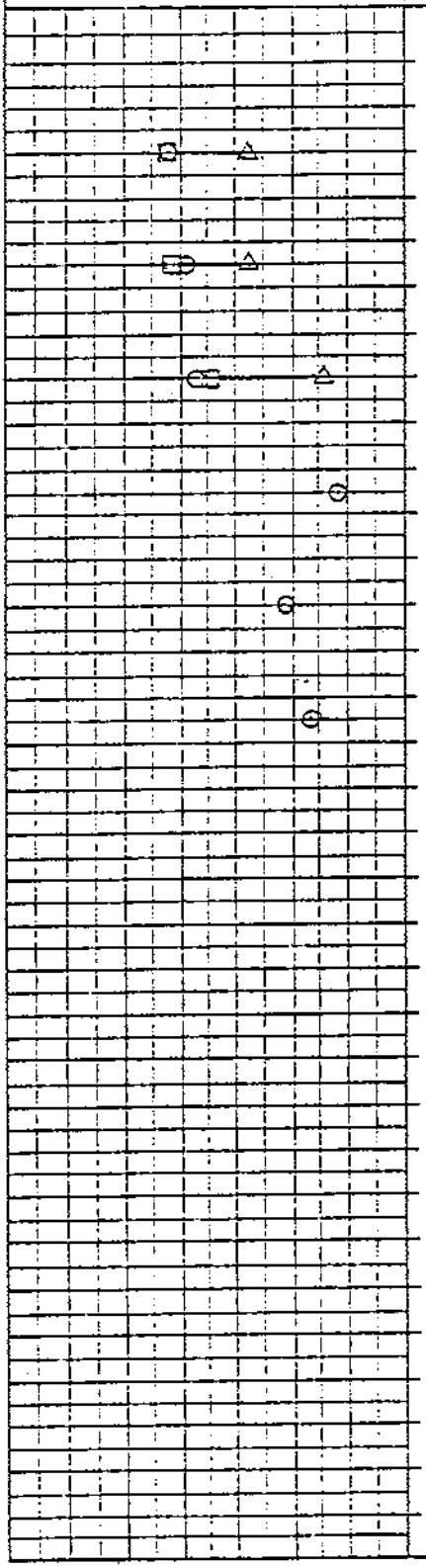
DEPTH m.	SOIL SYMBOL	SOIL DESCRIPTION (DATUM / SURFACE ELEVATION 480.9 m.)	CONDITION	TYPE	PENETRATION RESISTANCE	DRILL TYPE / OTHER TESTS
		GRAVEL (GP)P medium coarse sand, maximum size 1", grey, damp, loose				
2			X	D_1	N= 3	Rec.= 25%
			X	D_2	N= 5	Rec.= 17%
4			X	D_3	N=10	Rec.= 13%
6		*CLAY (OH) highly organic, silty layered lignite, grey and black stiff*	X	D_4	N=16	Rec.= 33%
8		*GRAVEL (GP) seam*	X	D_5	N=25	Rec.= 75%
		SILT (ML) coarse sand and fine gravel 1" rock, grey (TILL) hard	X	D_6	N=31	Rec.= 91%
10		*CLAY (OH) highly organic lignite, black, hard*	X	D_7	N=26	Rec.= 50%
12			X	D_8	N=63	Rec.= 25%
14			X	D_9	N=60	Rec.= 50%
			X	D_{10}	N=67	Rec.= 100%
16				D_{11}	N=46	Rec.= 100%

R.M.HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERING AND PROFESSIONAL SERVICES

BOREHOLE LOG

PROJECT QUESNEL SLIDE STUDY
B.C. DEPARTMENT OF HIGHWAYS

Logged/Dwn.	CKD	Date of Investigation Feb. 20/67	JOB NO.	8



DEPTH m.	SOIL SYMBOL	SOIL DESCRIPTION (DATUM SURFACE ELEVATION 492.9 m.)	CONDITION	TYPE	PENETRATION RESISTANCE	DRILL TYPE / OTHER TESTS
		GRAVEL (GP) little to no fines				
2		SILT (ML) slightly organic, medium sand, light grey, stiff	☒	D_1	N=11	Rec.= 50%
4			☒	D_2	N=13	Rec.= 68%
6		CLAY (OH) highly organic, silty lignite layers, black, very stiff to hard	☒	D_3	N=27	Rec.= 50%
			☒	D_4	N=64	Rec.= 50%
8			☒	D_5	N=54	Rec.= 68%
			☒	D_6	N=97	Rec.= 67%

TA 446 12.77

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CONSULTING ENGINEERING AND PROFESSIONAL SERVICES

BOREHOLE LOG

PROJECT QUESNEL SLIDE STUDY
B.C. DEPARTMENT OF HIGHWAYS

Logged, Dwn.	CKD	Date of Investigation	Feb. 20/67	JOB NO.	9

20 40 60 Wo – □ W – ○ Wl – △ WATER CONTENT %	DEPTH m.	SOIL SYMBOL	SOIL DESCRIPTION (DATUM SURFACE ELEVATION 494.4 m.)	SOIL SAMPLE CONDITION	TYPE	PENETRATION RESISTANCE	DRILL TYPE / OTHER TESTS
			GRAVEL (GP)				
			CLAY (CL)				
	2		CLAY (OH) highly organic layers of lignite, dark grey,	X	D_1	N=20	Rec.= 8%
				X	D_2	N=25	Rec.= 68%
	4			X	D_3	N=24	Rec.= 68%
	6			X	D_4	N=31	Rec.= 68%
	8			X	D_5	N=33	Rec.= 50%

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BOREHOLE LOG

PROJECT QUESNEL SLIDE STUDY
B.C. DEPARTMENT OF HIGHWAYS

Logged/Dwn. MD | CKD | Date of Investigation Feb. 17/67 | JOB NO. | 10A

20 40 60
Wp – □ W – ○ Wl – △
WATER CONTENT %

DEPTH m.	SOIL SYMBOL	SOIL DESCRIPTION (DATUM / SURFACE ELEVATION 494.5 m.)	CONDITION	TYPE	PENETRATION RESISTANCE	DRILL TYPE / OTHER TESTS
		GRAVEL (GP) little or no fines				
2		SAND (SP-SM) fine to medium, grey, damp, maximum size 3/8"	X	D_1	N=20	Rec.= 8%
		silty, coarse, maximum size 1/2"	X	D_2	N= 7	Rec.= 25%
4		CLAY (OH) highly organic lignite, dark grey to black, hard	X	D_3	N=39	Rec.= 25%
6			X	D_4	N=50	Rec.= 100%
8			X	D_5	N=37	Rec.= 100%
			X	D_6	N=31	Rec.= 100%
		TEST HOLE 10B SURFACE ELEVATION 494.5 m.				10B
2		GRAVEL (GP) little or no fines				

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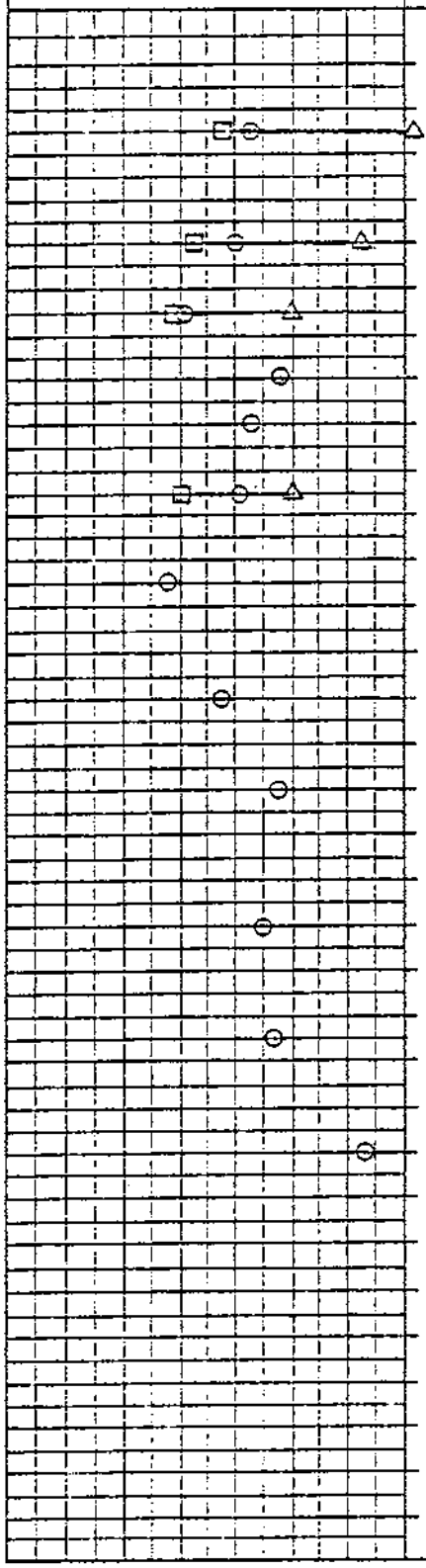
CONSULTING ENGINEERING AND PROFESSIONAL SERVICES

BOREHOLE LOG

PROJECT QUESNEL SLIDE STUDY
B.C. DEPARTMENT OF HIGHWAYS

Logged/Dwn. CKD | Date of Investigation Feb. 20/67 | JOB NO. 11



DEPTH m.	SOIL SYMBOL	SOIL DESCRIPTION (DATUM / SURFACE ELEVATION 492.3 m.)	CONDITION	TYPE	PENETRATION RESISTANCE	DRILL TYPE / OTHER TESTS
		GRAVEL (GP)				
2		CLAY (CH) highly organic, light brown to light grey, firm, crumbly		D_1	N= 8	Rec.= 100%
				U_1		
				D_2		
4		CLAY (OL) some organics, silty, light grey, hard, low plastic		U_2		
		CLAY (OH) highly organic, lignite present, dark grey, hard		D_3	N= 8	Rec.= 50%
				U_3		
6				D_4	N=11	Rec.= 75%
		CLAY (OL) some organics, light grey, hard				
8				U_4		
		silt cores present, light grey		D_5	N=22	Rec.= 50%
10		CLAY (OH) highly organic, lignite, black, hard crumbly		D_6	N=48	Rec.= 68%
12		softer cores of OH		D_7	N=12	Rec.= 83%
14				D_8	N=60	Rec.= 75%
16				D_9	N=48	Rec.= 50%

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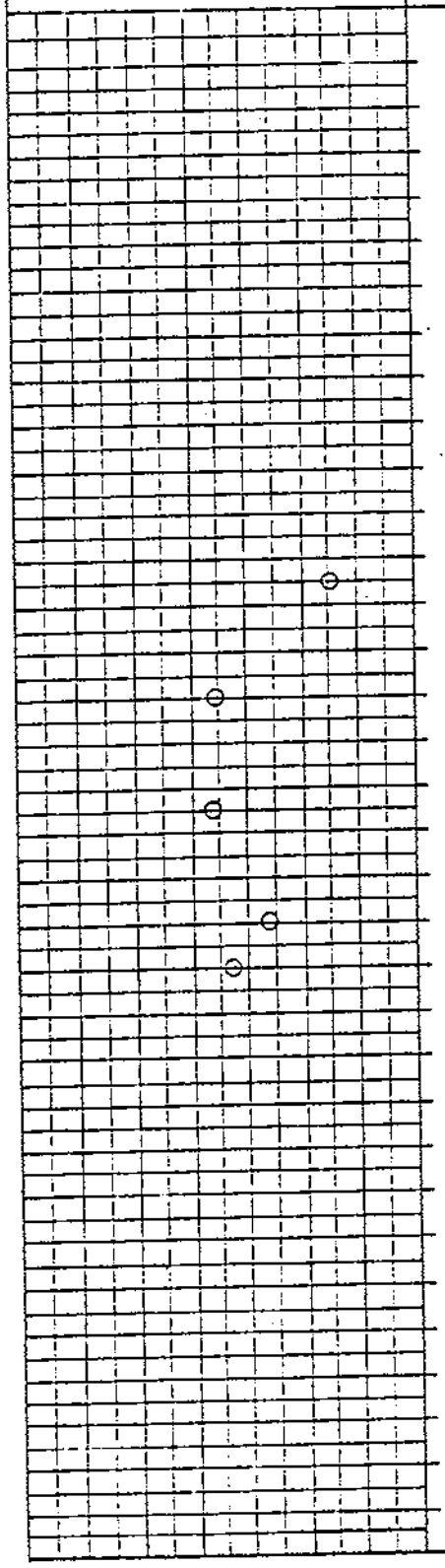
CONSULTING ENGINEERING AND PROFESSIONAL SERVICES

BOREHOLE LOG

PROJECT QUESNEL SLIDE STUDY
B.C. DEPARTMENT OF HIGHWAYS

Logged/Dwn.	CKD	Date of Investigation Feb. 2/67	JOB NO.	12



DEPTH m.	SOIL SYMBOL	SOIL DESCRIPTION (DATUM / SURFACE ELEVATION 483.1 m.)	SOIL SAMPLE CONDITION	TYPE	PENETRATION RESISTANCE	DRILL TYPE / OTHER TESTS
		GRAVEL (GM) coarse and medium sand, silty, maximum size 1/2" ø, grey, medium dense to very dense				
2				D_1	N=10	Rec.= 50%
				D_2	N=40	Rec.= 25%
4				D_3	N=67	Rec.= 50%
6				D_4	N=33	Rec.= 50%
		CLAY (OH) highly organic, lignite layers, black, hard				
8				D_5	N=46	Rec.= 17%
				D_6	N=49	Rec.= 50%
10		-- silty, dark grey		D_7	N=25	Rec.= 100%
12				D_8	N=75	Rec.= 32%
				D_9	N=23	Rec.= 75%

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BOREHOLE LOG

PROJECT QUESNEL SLIDE STUDY
B.C. DEPARTMENT OF HIGHWAYS

Logged/Dwn.	CKD	Date of Investigation March 1/67	JOB NO.	13

20 40 60 Wp - □ W - ○ Wl - △ WATER CONTENT %	DEPTH m.	SOIL SYMBOL	SOIL DESCRIPTION (DATUM; SURFACE ELEVATION 492.5 m.)	SOIL SAMPLE CONDITION	TYPE	PENETRATION RESISTANCE	DRILL TYPE / OTHER TESTS
			GRAVEL (GP) medium course sand, grey, maximum size 1" ø				
	2			X	D_1	N=15	Rec.= 13%
				X	D_2	N=16	Rec.= 13%
	4						
			(GP-GM) silty	X	D_3	N=22	Rec.= 17%
	6		(GP-GC) clayey				
			CLAY (CL) silty, grey, stiff	X	D_4	N=14	Rec.= 50%
	8		(CH) high plasticity, bits of lignite	X	D_5	N=16	Rec.= 17%
	10		(OH) highly organic, lignite, dark grey to black, hard	X	D_6	N=19	Rec.= 17%
				X	D_7	N=50	Rec.= 50%

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BOREHOLE LOG

PROJECT QUESNEL SLIDE STUDY
B.C. DEPARTMENT OF HIGHWAYS

Logged/Dwn.	CKD	Date of Investigation March 1/67	JOB NO.	14

20 40 60 Wp - □ W - ○ Wl - △ WATER CONTENT %	DEPTH m.	SOIL SYMBOL	SOIL DESCRIPTION (DATUM; SURFACE ELEVATION 491.3 m.)	SOIL SAMPLE CONDITION	TYPE	PENETRATION RESISTANCE	DRILL TYPE / OTHER TESTS
	2		GRAVEL (GM) medium and course sand, silty, grey, maximum size 1" ø	☒	D_1	N=60	Rec.= 33%
	4		CLAY (OH) highly organic lignite, 1" rocks, black	☒	D_2	N=35	Rec.= 25%
	6			☒	D_3	N=61	Rec.= 50%

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BOREHOLE LOG

PROJECT QUESNEL SLIDE STUDY
B.C. DEPARTMENT OF HIGHWAYS

Logged/Dwn.	CKD	Date of Investigation March 2/67	JOB NO.	15

20 40 60
Wp – □ W – ○ Wl – △
WATER CONTENT %

DEPTH m.	SOIL SYMBOL	SOIL DESCRIPTION (DATUM; SURFACE ELEVATION 488.4 m.)	SOIL SAMPLE CONDITION	SOIL SAMPLE TYPE	PENETRATION RESISTANCE	DRILL TYPE / OTHER TESTS
2		GRAVEL (GP) large boulders	☒	D_1	N= 6	Rec.= NR
4		SAND (SM) fine sand, course silt, yellow grey, pieces of wood	☒	D_2	N= 3	Rec.= 50%
		GRAVEL (GM) silty, maximum size 1" ø, grey	☒	D_3	N=23	Rec.= 17%
6		CLAY (OL) organic, silty, grey, hard; grey-black, firm	☒	D_4	N=18	Rec.= 33%
8		till like, few medium rocks, little to no organics; dark grey, hard	☒	D_5	N=26	Rec.= 21%
			☒	D_6	N=24	Rec.= 50%
10			☒	D_7	N=33	Rec.= 50%

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BOREHOLE LOG

PROJECT QUESNEL SLIDE STUDY
B.C. DEPARTMENT OF HIGHWAYS

Logged/Dwn.	CKD	Date of Investigation March 2/67	JOB NO.	16

20 40 60 Wp - □ W - ○ Wl - △ WATER CONTENT %	DEPTH m.	SOIL SYMBOL	SOIL DESCRIPTION (DATUM SURFACE ELEVATION 492.9 m.)	SOIL SAMPLE CONDITION	TYPE	PENETRATION RESISTANCE	DRILL TYPE / OTHER TESTS
	2		GRAVEL (GP) medium to course sand, slightly silty, grey, maximum size 1" ø, loose to medium dense, damp		D1	N= 7	Rec.= 17%
					D2	N=19	Rec.=13%
	4		SILT (ML) yellow, hard, slightly clayey		D3	N=31	Rec.=25%
	6		yellow-black, few bits of lignite at 20'		D4	N=55	Rec.=50%

CANADIAN ARCTIC SURVEY SYSTEMS LTD. 708 - 35 A STREET N.W. CALGARY, ALTA.

GAMMA DENSITY & RESISTANCE

COMPANY GEOLOGICAL SURVEY OF CANADA
WELL Q - 1
FIELD AUSTRALIAN ROAD (QUESNEL)
PROVINCE BRITISH COLUMBIA
Lat. 52° 47' 10"
122° 28' 05"
Sec. ___ Twp. ___ Rge. ___ W. ___
Other Services
Detail Section

Permanent Datum G.L. ___ Elev. ___
Log measured from G.L. ___ ft. above perm. Dat.
Drilling measured from G.L.
Elev. K.B. ___
D.F. ___
G.L. 552.5M

Date	27 September '78
Run No.	One
Type Log	Nuclear
	Resistance
	Caliper
Depth - Driller	707'
Depth - Logger	709'
Bottom logged interval	708'
Top logged interval	0
Type fluid in hole	Water
Salinity, PPM Cl.	N/A
Density	N/A
Level	Full
Max. rec. temp. deg. F.	N/A
Operating rig time	Full
Recorded by	G
Witnessed by	P. Graham

BORE-HOLE RECORD				CASING RECORD			
Run No.	Bit	From	To	Size	Wgt.	From	To
1	BQ		TD	PW		0	52'

Fold here

This Heading and Log Conforms to API RP 33

EQUIPMENT DATA

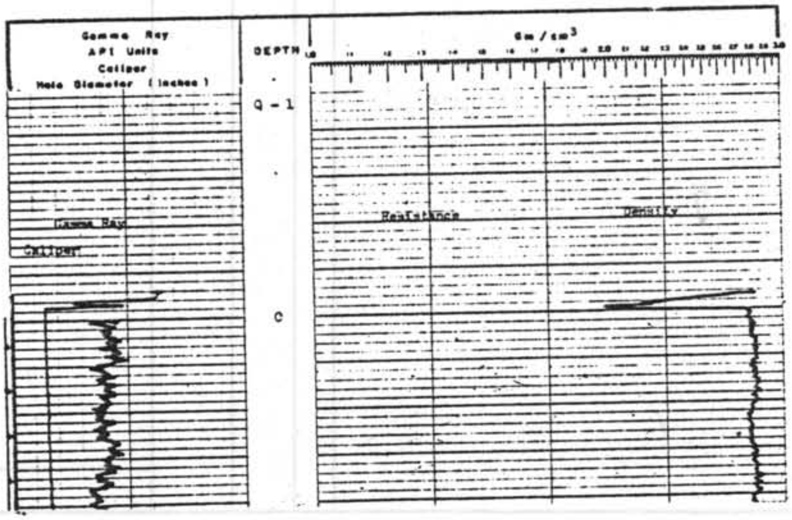
Gamma Ray					Resistance	Density	Caliper
Run No.	One			Run No.		One	One
Tool Model No.	L-104			Tool Model No.	L-104	L-104	L-104
Diameter	1.25"			Diameter	1.25"	1.25"	1.25"
Detector Model No.	CP 516			Type	MCBO	F	FM
Type	Scint.			Spacing		2"	
Length	2.5"						
				Length		.5"	
				Horiz. Scale	8.3 ohms/div.		1 div.=1"
General				Rm @ °F	N/A		
Meter Truck No.				Source Model		H D V P	
Inst. Truck No.				Serial No.		687	
Location				Isotope		Cs 137	Am 241
				Strength		125 mC	20 mC

LOGGING DATA

General				Gamma Ray				Density			
	Depths										
Run No.	From	To	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	
1	708	0	10	4	100	1R	7	1	1K	2R	

Reference Literature: N/A

Remarks: -- Poor Hole



■ Coal

▤ Shale - claystone

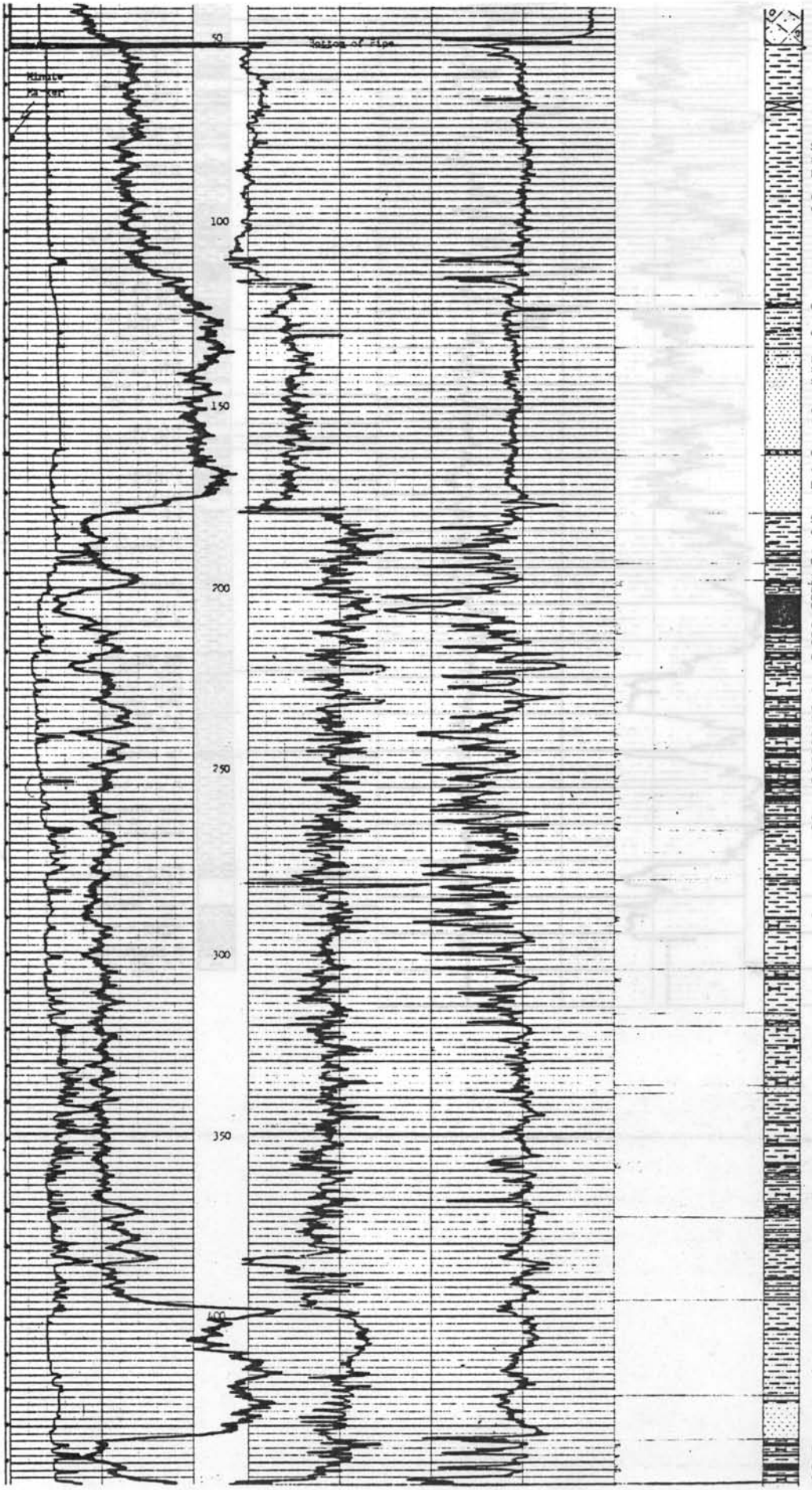
▤ Siltstone

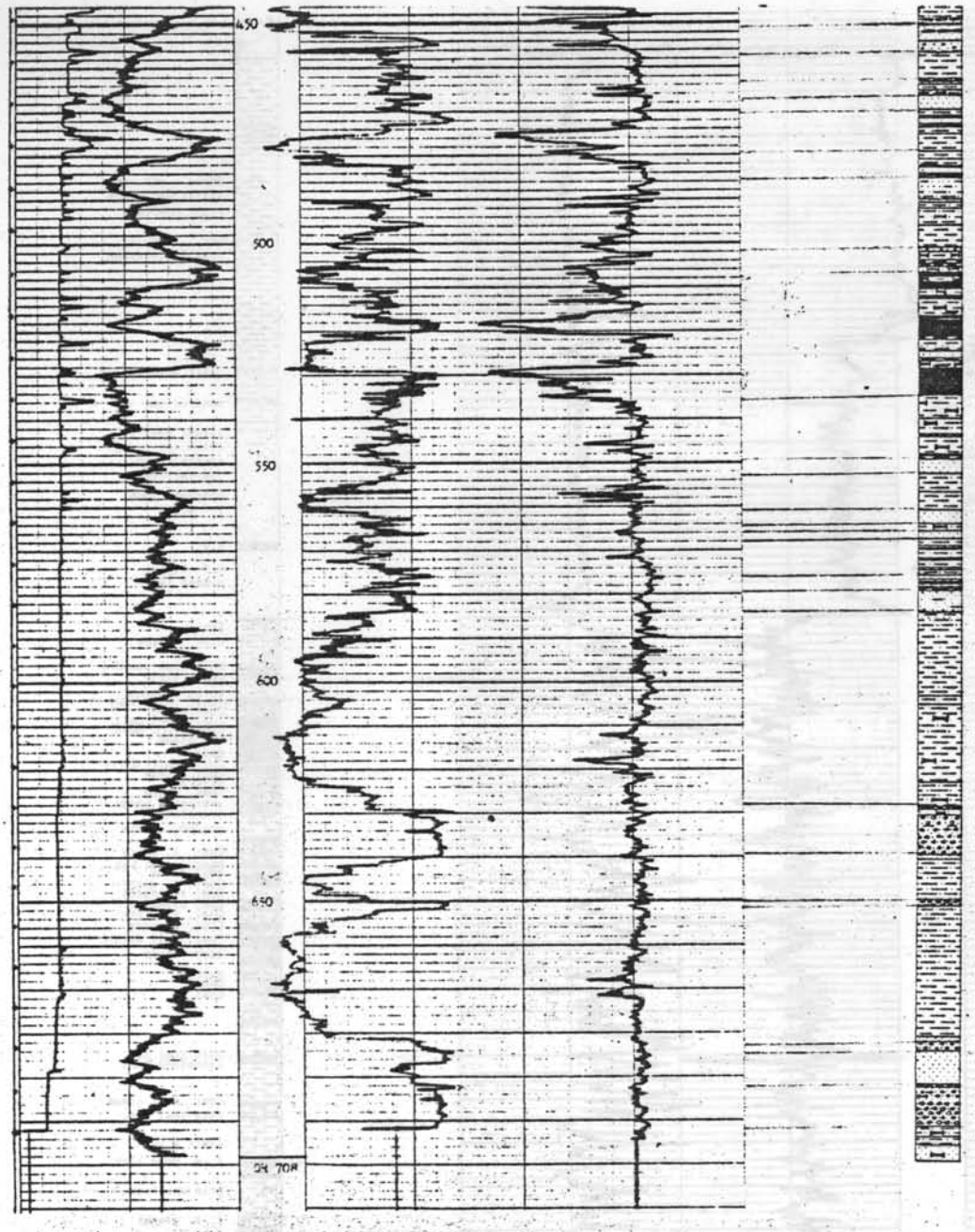
▨ Sandstone

▨ Conglomerate

▨ Coaly and carbonaceous material

▨ Overburden
clay with some sand & gravel


50
Bottom of Pipe
Minate
Marker
100
150
200
250
300
350
400
Shale - occ. thin
siltstone layers
Plant debris
occ. irregular
coal laminations
coaly & silty lam
concretions
grades down to
silty ss. v.f.g.
scattered coal
laminations
coarsens down
f.- m.g.
c.g.
v.f.-f.g.,
planar lam
Shale
carb. layers
thin coal seams
Coal, dirty
silty, occ/carb
Coal, very dirty
Coal, blebs
Coal, hard dull
Coal, dull hard
clean
Coal
Coal, dull, dirty
Coal, clean
f.-c.g.
Coal, clean
vitrinite bands
ironstone
occ/coal blebs
Coal, v. dirty
banded coal & sh.
coal blebs
Coal, v. dirty
Coal stringers
Coal blebs
Coal, v. dirty
Coal, cleaner
Coal, dull dirty
carb. shale
carb.
Coal
Coal
thin coal str.
ironstone band
Coal, dull clean
thin coal str.
coaly & carb
f.-m. poor sort.
thin coal str.
f.-m. clayey
f.-m.
carb & coaly str
coal blebs & str
f.g.
m.-c.g.
coal blebs &
carb lyr.
m.-c.g.
coal blebs & str
carb. layers
Coal, dull dirty
coal & carb mat
f.-c.
coal blebs
m.-c.
f.-c.
f.-m. w/silts
silty
c.g.
slightly silty
carb.
c. poor sorting
c. poor sorting
c.g.
silty
bands carb. sh.
homogenous,
shaley
f. shaley
f. homogenous
silty
Coal, hard dull
coaly lam
silty
Coal, v. dirty
coaly shale
silty


450
500
550
600
650
DH 708
ironstone conc
v.f.-f.
v.c. congl.
silty occ/coaly
f.-c
silty
f.-m v. shaley
sandy
f. shaley
carb. sh. & coal
f. coaly mat.
Coal
clayey
silty
f.-c.g.
coaly shale
Coal, dull hard
Coal, dull hard
coal blebs
Coal, dull hard
thin sh. dirty
thin f-m ss.
f.-m.g.
carb. sh.
Coal, dull hard
clean
coal & carb lyr.
silty occ/coal
m.g.
silty occ/coal
v.f. v. shaley
silty at top
v.f.-f.g.
silty coal str
v.f.- c.
c.-v.c.v.
c.-v.c.g.
v.c.g.
v.f.-f.g. silty
c.g.
s.s.
dk grey, silty
lt greenish grey
gr/grey
silty
dk grey occ lt.
grey
med grey, homo.
lam. coaly
congl. pebbles
f-m.
shaly w/coal
ss.
congl pebbles
f.g. coaly lam.
dk grey, homo.
lge pebbles
dk grey, homo.
thin shaley lam
silty, dk grey,
homogenous
m.-c.g.
v.c.g. - pebbles
f.g. shaley w/
carb. sh.
congl. pebbles
s.s.
pebbles m.-c
matrix
dk grey-gr.grey
lt greenish grey
f.g. carb. sh.
& coal

CANADIAN ARCTIC SURVEY SYSTEMS LTD. — 708 - 33 A STREET N.W. CALGARY, ALTA.

GAMMA DENSITY & RESISTANCE *

COMPANY: [illegible] SUPPLY OF CANADA

WELL: Q-2

FIELD: [illegible] BEAR (MISSEL)

PROVINCE: BRITISH COLUMBIA

Lsd. [illegible] Sec. [illegible] Twp. [illegible] Rge. [illegible] W.

Permanent Datum: G.L. Elev. ____

Log measured from: G.L. ____ ft. above perm. Dat.

Drilling measured from: G.L.

Other Services

Elev. K.B. ____ D.F. ____ G.L. 5766'

Date	October [illegible]
Run No.	One
Type Log	Density
Depth - Driller	[illegible]
Depth - Logger	[illegible]
Bottom logged interval	[illegible]
Top logged interval	[illegible]
Type fluid in hole	Water & Mud
Salinity, PPM Cl.	N/A
Density	[illegible]
Level	[illegible]
Max. rec. temp. deg. F.	N/A
Operating rig time	[illegible]
Recorded by	[illegible]
Witnessed by	F. Graham

CASING RECORD			
Size	Wgt.	From	To
		11"	991

BORE-HOLE RECORD			
Bit	From	To	
9"	0	993	

RUN	
No.	
1	

Fold Here

This Heading and Log Conforms to API RP 33

EQUIPMENT DATA

Gamma Ray				Resistance	Density	Caliper
Run No.	One			One	One	One
Tool Model No.	1-104			1-104	1-104	1-104
Diameter	1.25"			1.25"		
Detector Model No.	CP 516			MSD	F	SV
Type	Scint				2"	
Length	2.5"					
				Length	.375"	
				Horiz. Scale	12.8 ohms/div.	1 div. = 1"
General				Rm @ °F	N/A	
Hoist Truck No.	4			Source Model		HOVP
Inst. Truck No.	4			Serial No.		667
Location	Calgary			Isotope		Cs 137 ← Wm 2.1
				Strength		125 mC ← 20 mC

LOGGING DATA

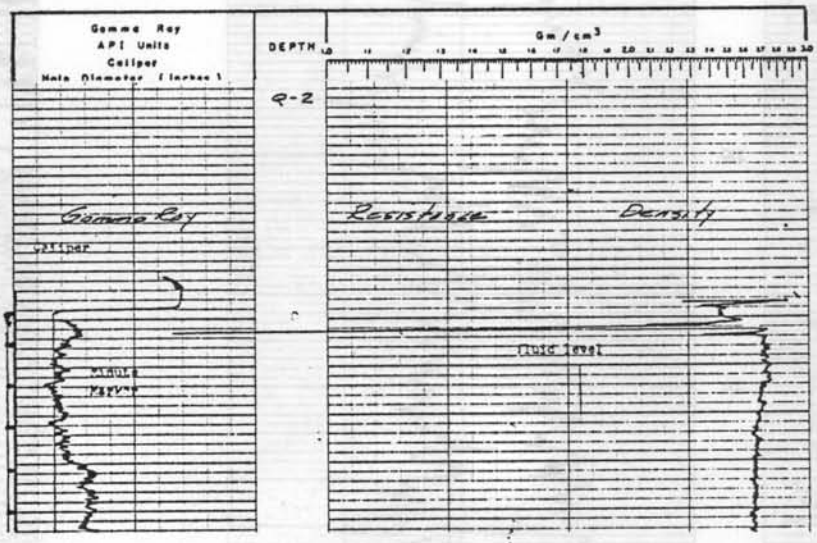
General				Gamma Ray				Density			
Run No.	Depths From	Depths To	Speed Ft/Min.	T.C. Sec.	Sens. Settings	Zero Div. L or R	API G.R. Units per Log Div.	T.C. Sec.	Sens. Settings	Zero Div. L or R	
1	525'	0	10	4	100		9	1	1000	18	

Reference Literature: N/A

Remarks:

Good hole

* - Micro Contact Bed Definer



Coal

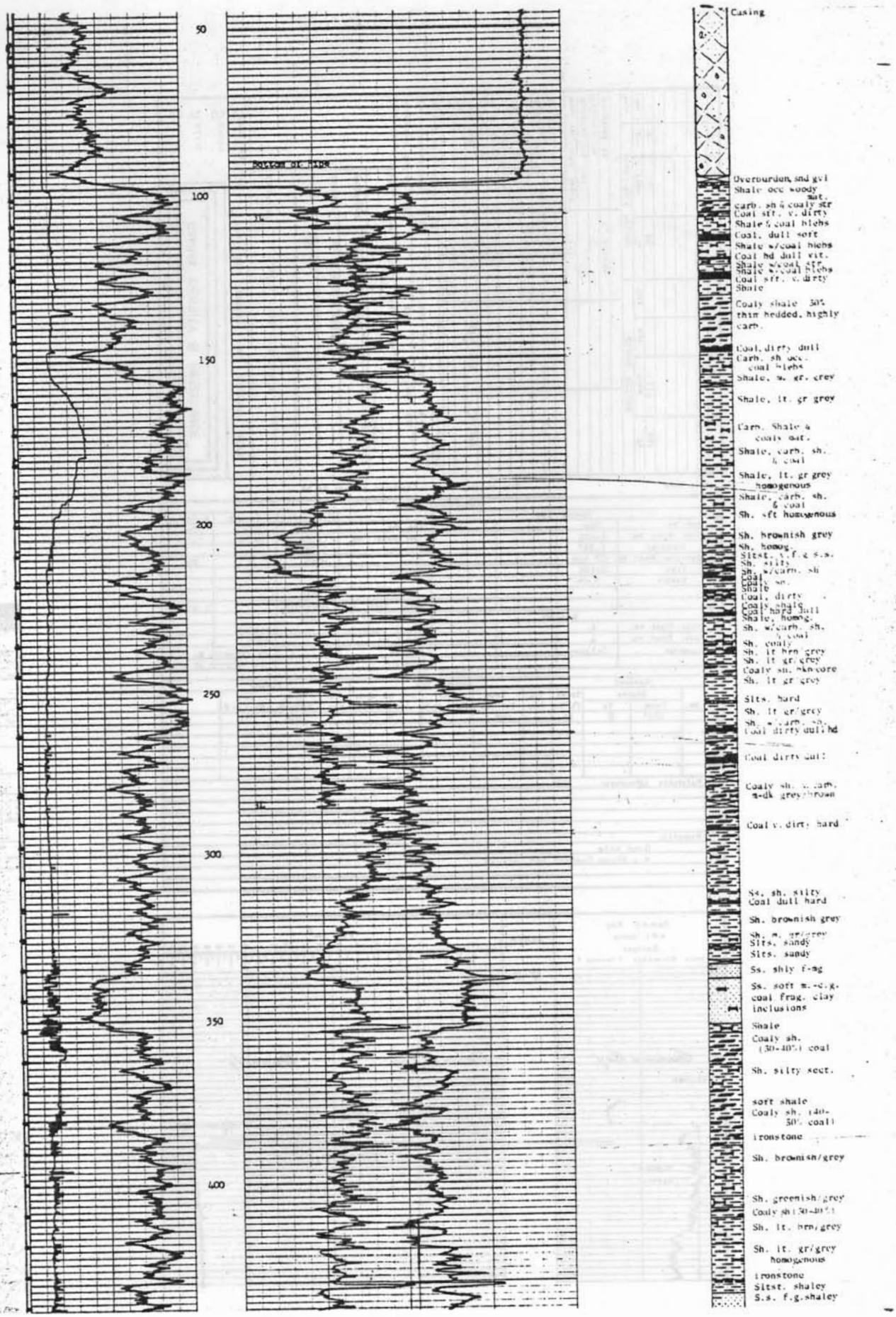
Shale - claystone

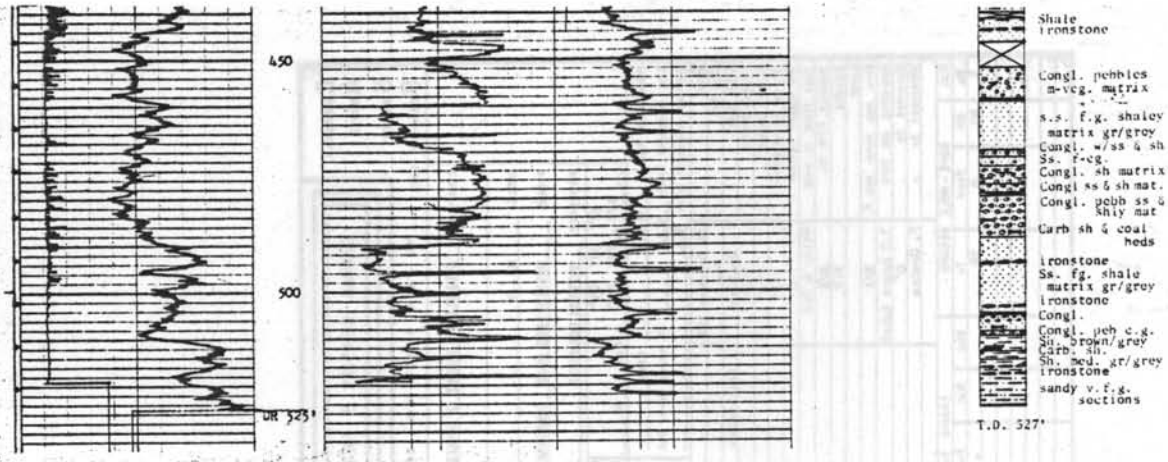
Siltstone

Sandstone

Conglomerate

Coaly and carbonaceous material


50
100
150
200
250
300
350
400
Bottom of Hole
Casing
Overburden, snd gvl
Shale occ woody mat.
carb. sh & coaly str
Coal sft. v. dirty
Shale & coal blebs
Coal, dull soft
Shale w/coal blebs
Coal hd dull vit.
Shale w/coal sft.
Shale w/coal blebs
Coal sft. v. dirty
Shale
Coaly shale 30% thin bedded, highly carb.
Coal, dirty dull
Carb. sh occ. coal blebs
Shale, m. gr. grey
Shale, lt. gr grey
Carb. Shale & coaly mat.
Shale, carb. sh. & coal
Shale, lt. gr grey homogenous
Shale, carb. sh. & coal
Sh. sft homogenous
Sh. brownish grey
Sh. homog.
Sltst. v.f.g s.s.
Sh. silty
Sh. w/carb. sh
Coal
Coaly sh.
Shale
Coal, dirty
Coaly shale
Coal hard dull
Shale, homog.
Sh. w/carb. sh. & coal
Sh. coaly
Sh. lt brn/grey
Sh. lt gr/grey
Coaly sh. sh/core
Sh. lt gr grey
Slts. hard
Sh. lt gr/grey
Sh. w/carb. sh.
Coal dirty dull hd
Coal dirty dull
Coaly sh. w/carb. m-dk grey/brown
Coal v. dirty hard
Ss. sh. silty
Coal dull hard
Sh. brownish grey
Sh. m. gr/grey
Slts. sandy
Slts. sandy
Ss. shly f-mg
Ss. soft m.-c.g. coal frag. clay inclusions
Shale
Coaly sh. (30-40%) coal
Sh. silty sect.
soft shale
Coaly sh. (40-50% coal)
ironstone
Sh. brownish/grey
Sh. greenish/grey
Coaly sh (30-40%)
Sh. lt. brn/grey
Sh. lt. gr/grey homogenous
ironstone
Sltst. shaley
S.s. f.g.shaley


450
500
DR 525'
Shale
ironstone
Congl. pebbles
m-veg. matrix
s.s. f.g. shaley
matrix gr/grey
Congl. w/ss & sh
Ss. f-cg.
Congl. sh matrix
Congl ss & sh mat.
Congl. pebb ss &
shly mat
Carb sh & coal
beds
ironstone
Ss. fg. shale
matrix gr/grey
ironstone
Congl.
Congl. peb c.g.
Sh. brown/grey
Carb. sh.
Sh. bed. gr/grey
ironstone
sandy v.f.g.
sections
T.D. 527'

CANADIAN ARCTIC SURVEY SYSTEMS LTD. 708 - 35 A STREET N.W. CALGARY, ALTA.

GAMMA DENSITY & RESISTANCE*

COMPANY GEOLOGICAL SURVEY OF CANADA

WELL Q - 3

FIELD BUTTERFIELD ROAD (QUESNEL)

PROVINCE BRITISH COLUMBIA

Lat. 52° 57' 25" N. Long. 122° 31' 30" W.

Permanent Datum G.L. Elev.

Log measured from G.L. ft. above perm. Dat.

Drilling measured from G.L.

Other Services

Elev. K.B.

D.F.

G.L. 1602.0 M

Date	24. October 1978
Run No.	One
Driller Log	Nuclear
Depth - Driller	762'
Depth - Logger	757'
Bottom logged interval	757'
Top logged interval	0
Type fluid in hole	Water & Mud
Salinity, PPM Cl.	N/A
Density	N/A
Level	
Max. rec. temp. deg. F.	N/A
Operating rig time	3.0 hours total
Recorded by	G.
Witnessed by	F. Graham

BORE-HOLE RECORD

Bit No.	From	To	Size
1	0	TD	

CASING RECORD

Size	Wgt.	From	To
		+ 2'	168'

Fold Here

This Heading and Log Conforms to API RP 33

EQUIPMENT DATA

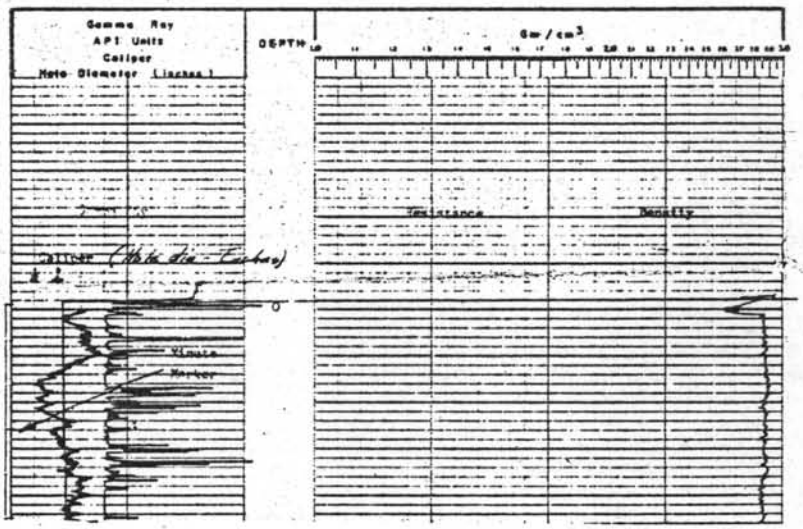
	Gamma Ray				Resistance	Density	Caliper
Run No.	One	757'		Run No.	One	One	One
Tool Model No.	L-103			Tool Model No.	L-103	L-103	L-103
Diameter	1.25"			Diameter	1.25"	1.25"	1.25"
Detector Model No.	CP 516			Type	4CBD	NEBD	EX
Type	Scint.			Spacing		2	
Length	2.5"						
				Length	.175"		
				Horiz. Scale	20 ohms/div.		1 div =1"
General				Rm @ °F			
Hoist Truck No.				Source Model		HOVP	
Inst. Truck No.				Serial No.		687	
Location				Isotope		Cs 137	Am 241
				Strength		125 mC	20 mC

LOGGING DATA

General				Gamma Ray				Density		
Run No.	Depths From	Depths To	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
1	757'	0	10	4	100		8	1	1X	2.52

Reference Literature:

Remarks: - some fill on bottom



Coal

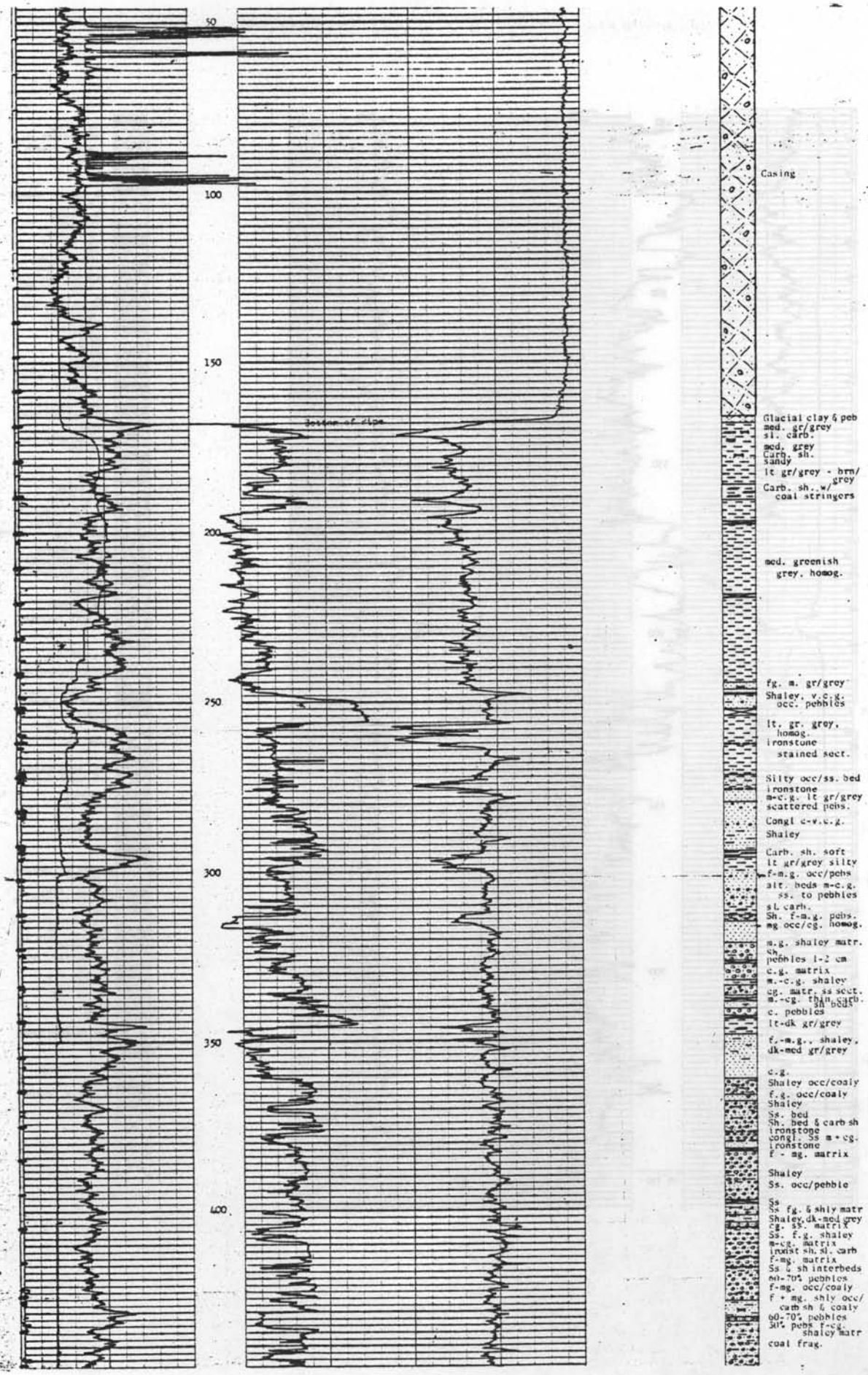
Shale - claystone

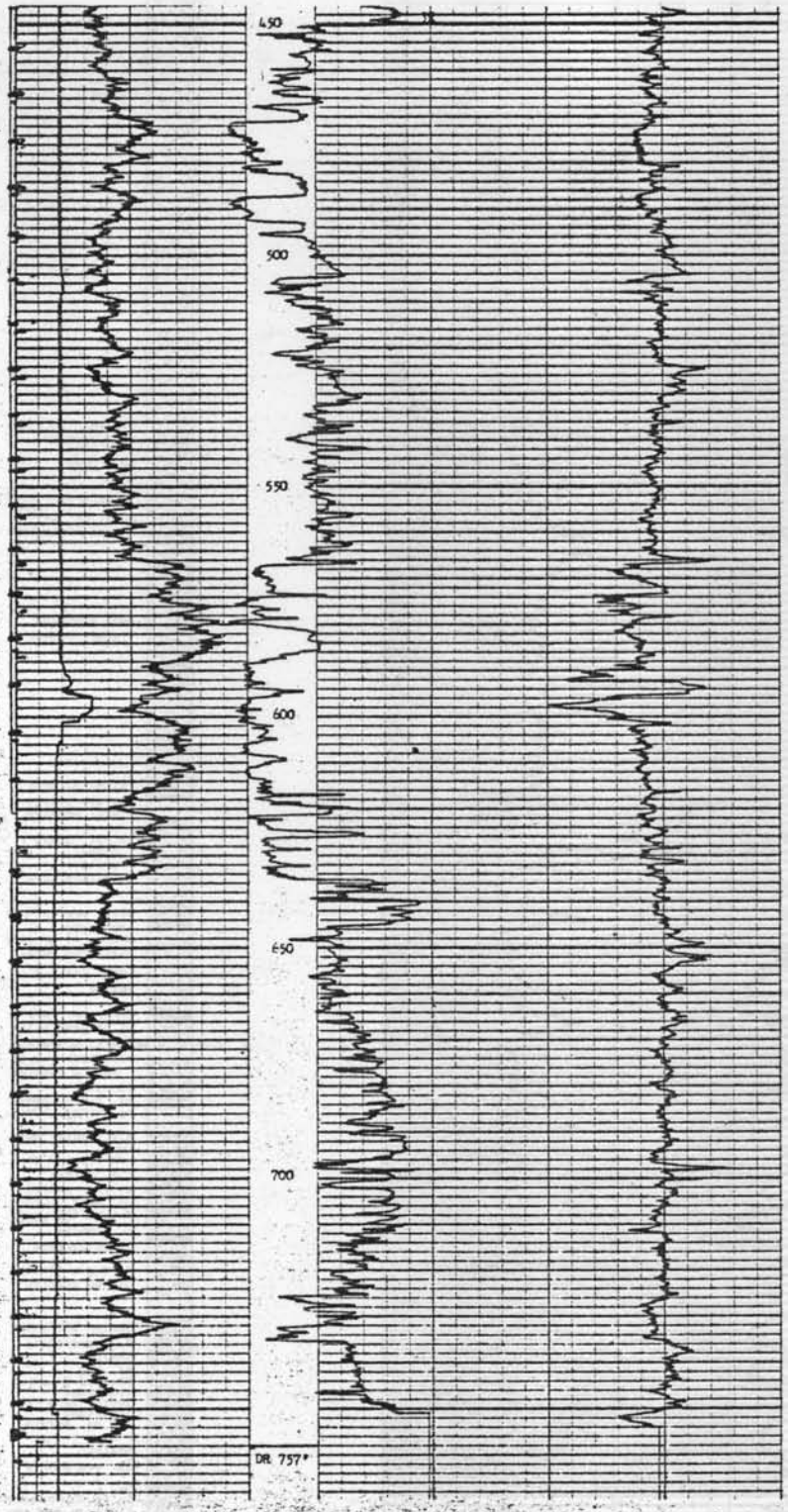
Siltstone

Sandstone

Conglomerate

Coaly and carbonaceous material


50
100
150
200
250
300
350
400
Casing
Glacial clay & peb
med. gr/grey
sl. carb.
med. grey
Carb. sh.
sandy
lt gr/grey - brn/grey
Carb. sh. w/
coal stringers
med. greenish
grey, homog.
fg. m. gr/grey
Shaley, v.c.g.
occ. pebbles
lt. gr. grey,
homog.
ironstone
stained sect.
Silty occ/ss. bed
ironstone
m-c.g. lt gr/grey
scattered pebs.
Congl c-v.c.g.
Shaley
Carb. sh. soft
lt gr/grey silty
f-m.g. occ/pebs
silt. beds m-c.g.
ss. to pebbles
sl. carb.
Sh. f-m.g. pebs.
mg occ/cg. homog.
m.g. shaley matr.
Sh
pebbles 1-2 cm
c.g. matrix
m.-c.g. shaley
cg. matr. ss sect.
m.-cg. thin carb.
sh beds
c. pebbles
lt-dk gr/grey
f.-m.g., shaley,
dk-med gr/grey
c.g.
Shaley occ/coaly
f.g. occ/coaly
Shaley
Ss. bed
Sh. bed & carb sh
ironstone
congl. Ss m + cg.
ironstone
f - mg. matrix
Shaley
Ss. occ/pebble
Ss
Ss fg. & shly matr
Shaley, dk-med grey
cg. ss. matrix
Ss. f.g. shaley
m-cg. matrix
ironst sh. sl. carb
f-mg. matrix
Ss & sh interbeds
60-70% pebbles
f-mg. occ/coaly
f + mg. shly occ/
carb sh & coaly
60-70% pebbles
30% pebs f-cg.
shaley matr
coal frag.


450
500
550
600
650
700
DR. 757'

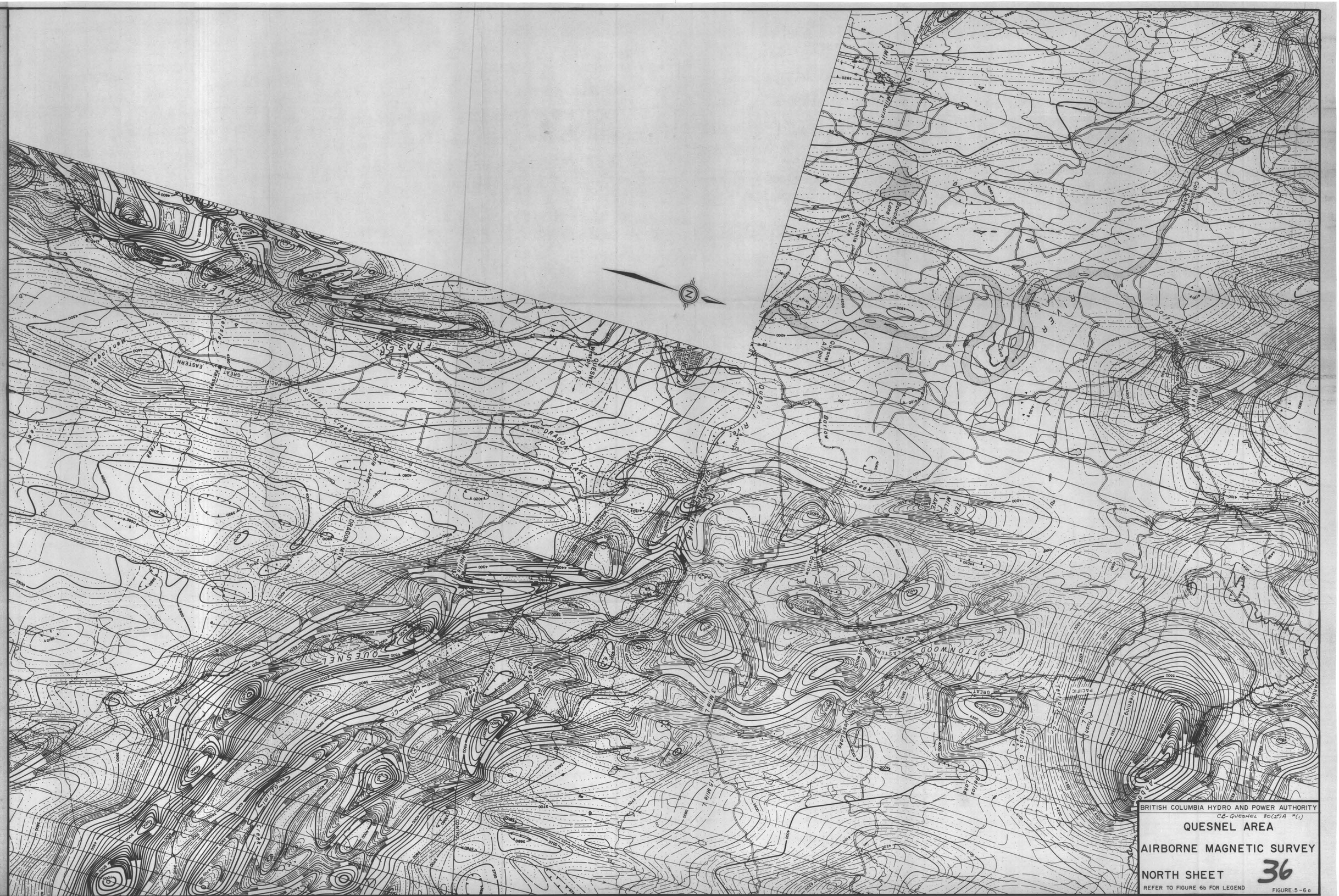

coal frag.
interbedded congl
& ss. w/carb
sh.
dk gr/grey homog.
f.g.
Ss. shaley
ironstone
m.g. + c.g.
c.g. matrix
f.g.
f-mg. shaley
occ c.g. bed
pebbles (60-70%)
f + cg. shly matr
Sh.
med gr/grey homog
f.g. shaley
sandy
f.g. shaley
sandy
sandy
silst.
congl.
Shaley
cemented
fg. ss & sh matr.
sl. silty
coaly debris
med gr/grey homog
congl.
med gr/grey sl.
silty
Ss. f.g. shaley
Sl. silty.
congl & ss.
Sh. hd. cemented
coaly matter
sandy f.g.
hard cemented
med gr/grey homog
Carb. sh. coaly
cemented
cemented
med gr/grey
dk grey section
f.g. shaley
bedded w/carb mat.
pebs shaley matr.
fg. shly & coaly
congl.
Shaley. f.g.
Carb. sh.
Alt. beds congl.
& sandy shale
cemented
cemented
med. grey
Shaley fg. occ/sm
pebble
Shaley, f-mg.
matrix. pebbles
congl.
f.g. occ/peb. shly
Sh. f.g. ss.
pebbles, shly fg.
ss matrix
fg. occ/mg. shly
shaley
shaley f.g.
pebbles
sh. ss. fg.
sh. ss. fg.
congl.
congl.
med gr/grey homog
thin ss. beds
congl.
m.g.-c.g. shaley
matrix

T.D. 762'


FRASER
RIVER
COTTONWOOD
FOREST
BRITISH COLUMBIA HYDRO AND POWER AUTHORITY
QB-QUESNEL BOZIA #(1)
QUESNEL AREA 36
PRELIMINARY GEOLOGY
NORTH SHEET
REFER TO FIGURE 5-1b FOR LEGEND
FIGURE 5-1a


LEGEND
OUTCROP AREA
DRILL HOLE
ADIT
FORMATIONS
QUATERNARY
PLEISTOCENE AND RECENT
TILL, GRAVEL, SAND, CLAY AND SILT
TERTIARY
MIOCENE AND (?) PLIOCENE OR PLEISTOCENE
BASALT, ANDESITE, RELATED TUFF AND BRECCIA; MINOR CONGLOMERATE, GREYWACKE, SHALE AND DIATOMITE.
MIDDLE-UPPER MIOCENE
UPPER FRASER RIVER FORMATION
CONGLOMERATE, SANDSTONE, SILTSTONE, CLAYSTONE, MINOR CLAY, COAL, DIATOMITE AND TUFF.
LOWER OLIGOCENE
LOWER FRASER RIVER FORMATION
CLAYSTONE WITH LESSER SANDSTONE, CONGLOMERATE AND COAL.
EOCENE
BASALT, ANDESITE, RELATED TUFF AND BRECCIA; MINOR CONGLOMERATE, SANDSTONE AND SHALE.
CENOZOIC
LOWER JURASSIC AND (?) LATER
GRANODIORITE, QUARTZ DIORITE, QUARTZ MONZONITE, MONZONITE, GRANITE AND MINOR GABBRO.
UPPER TRIASSIC (?) AND LOWER JURASSIC(?)
ARGILLITE, GREYWACKE, GREEN, GREY, BLACK AND PURPLE ANDESITE AND BASALT, RELATED TUFFS AND BRECCIAS; MINOR CONGLOMERATE AND LIMESTONE.
MESOZOIC
PENNIAN AND (?) EARLIER
CACHE CREEK GROUP
GREY RIBBON CHERT, BLACK ARGILLITE
GREEN TO BLACK BASIC VOLCANIC ROCKS,
GREY LIMESTONE, MINOR ARGILLITE,
GREYWACKE AND CHERT, GREY LIMESTONE.
PALEOZOIC
SCALE
1 0 1 2 3 4 Kilometres
N
BRITISH COLUMBIA HYDRO AND POWER AUTHORITY
QUESNEL AREA
PRELIMINARY GEOLOGY
SOUTH SHEET 36

FIGURE 5-1b



BRITISH COLUMBIA HYDRO AND POWER AUTHORITY

CB-QUESNEL 80(2E)A *(1)

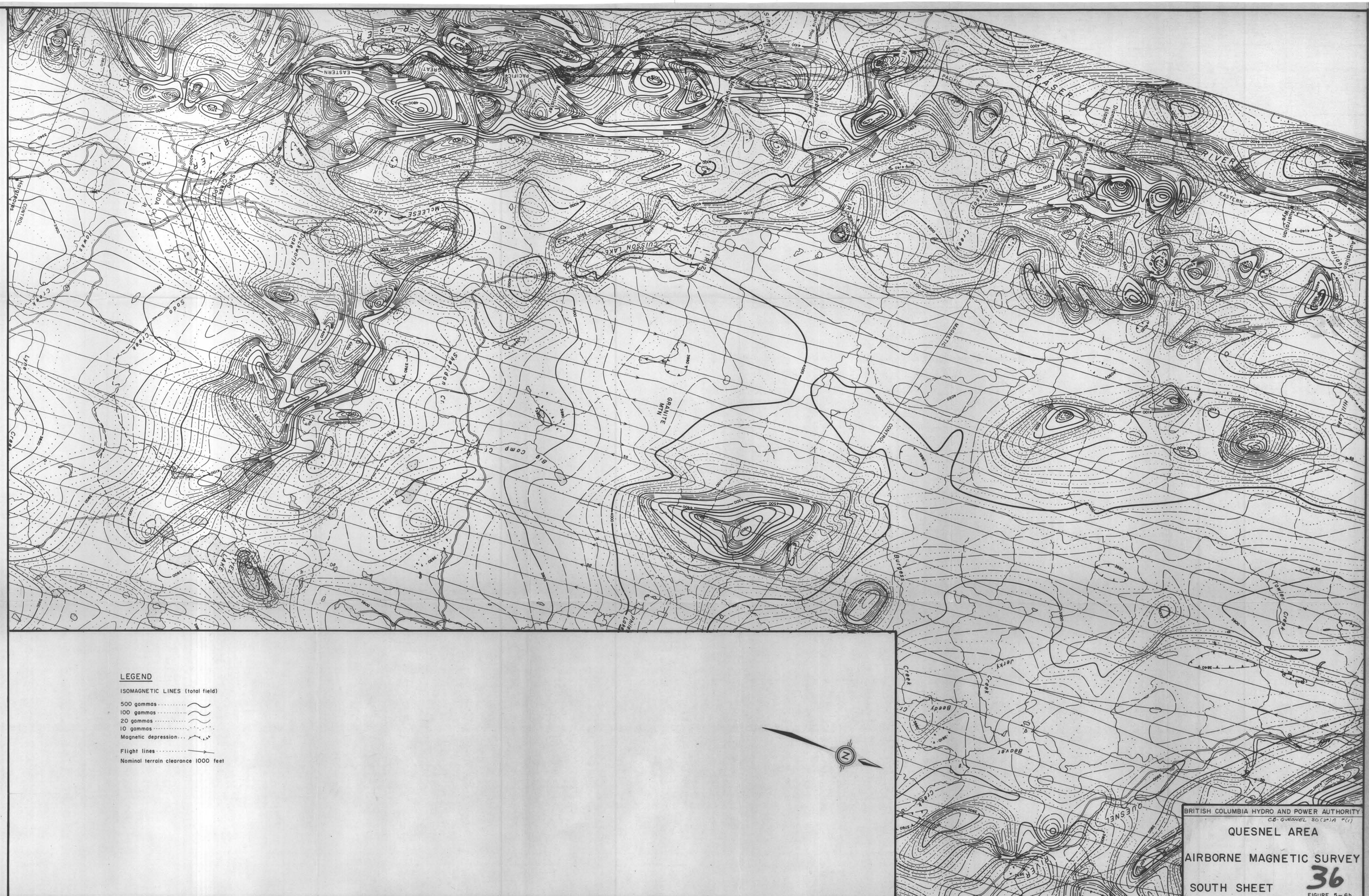
QUESNEL AREA

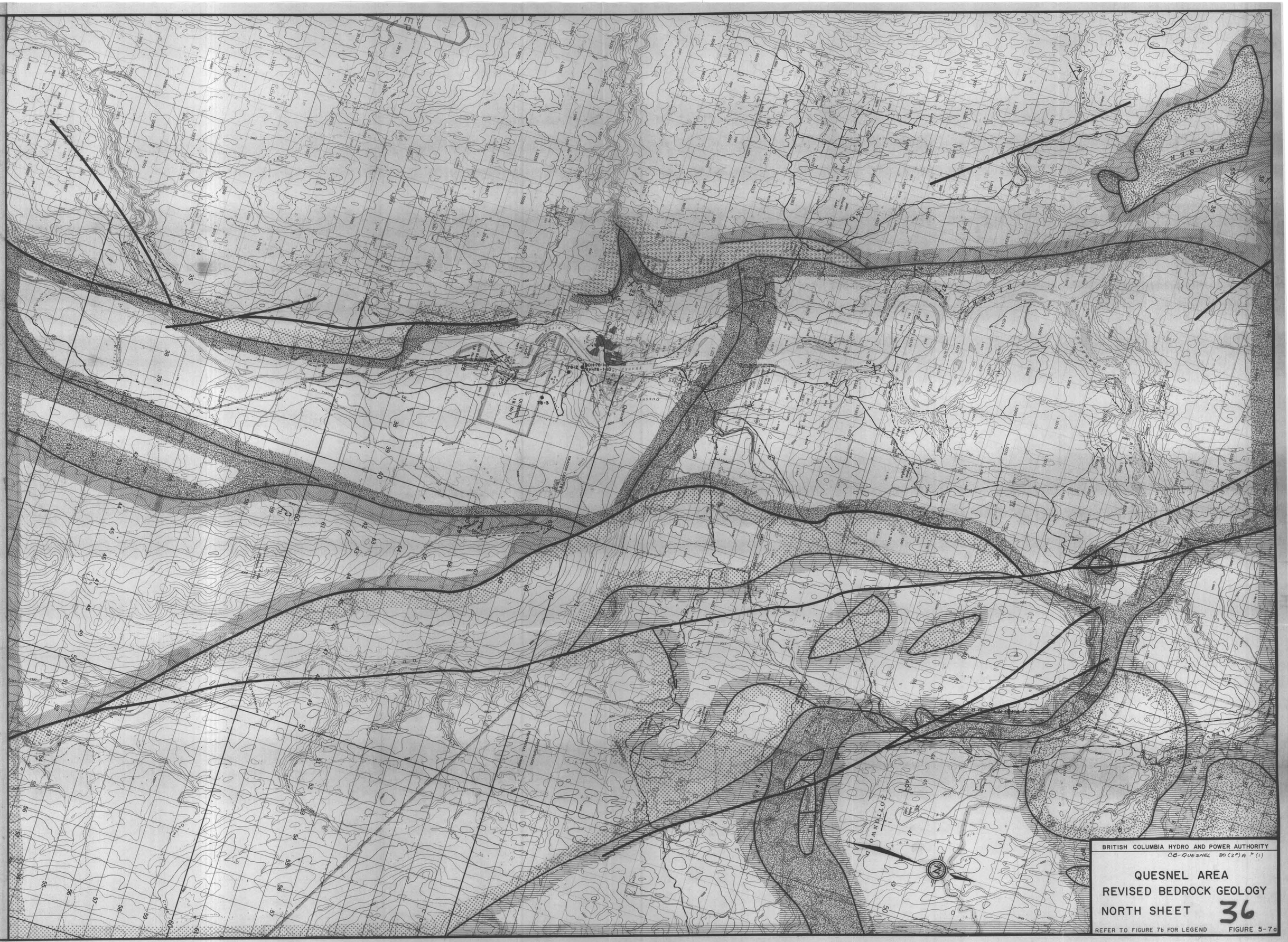
AIRBORNE MAGNETIC SURVEY

NORTH SHEET 36

REFER TO FIGURE 6b FOR LEGEND

FIGURE: 5-6a


LEGEND
ISOMAGNETIC LINES (total field)
500 gammas
100 gammas
20 gammas
10 gammas
Magnetic depression
Flight lines
Nominal terrain clearance 1000 feet
BRITISH COLUMBIA HYDRO AND POWER AUTHORITY
CB-QUESNEL 80(30)A 7(1)
QUESNEL AREA
AIRBORNE MAGNETIC SURVEY
SOUTH SHEET
36
FIGURE 5-6b


BRITISH COLUMBIA HYDRO AND POWER AUTHORITY
CB-QUESNEL 80(2P)A * (1)
QUESNEL AREA
REVISED BEDROCK GEOLOGY
NORTH SHEET 36
REFER TO FIGURE 7b FOR LEGEND
FIGURE 5-7a


LEGEND
OUTCROP AREA
DRILL HOLE
ADIT
STRIKE & DIP
40
65 FOLD PLUNGE
GEOLOGIC CONTACT
FAULT
SYNCLINE
ANTICLINE
FORMATIONS
TERTIARY
MIOCENE AND (?) PLIOCENE OR PLEISTOCENE
BASALT, ANDESITE, RELATED TUFF AND BRECCIA; MINOR CONGLOMERATE, GREYWACKE, SHALE AND DIATOMITE.
CENOZOIC
MIDDLE-UPPER MIOCENE
UPPER FRASER RIVER FORMATION
CONGLOMERATE, SANDSTONE, SILTSTONE, CLAYSTONE, MINOR CLAY, COAL, DIATOMITE AND TUFF.
LOWER OLIGOCENE
LOWER FRASER RIVER FORMATION
CLAYSTONE WITH LESSER SANDSTONE, CONGLOMERATE AND COAL.
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PERMIAN AND (?) EARLIER
CACHE CREEK GROUP
GREY RIBBON CHERT, BLACK ARGILLITE
GREEN TO BLACK BASIC VOLCANIC ROCKS, GREY LIMESTONE, MINOR ARGILLITE, GREYWACKE AND CHERT, GREY LIMESTONE.
PALEOZOIC
SCALE
1 0 1 2 3 4 Kilometres
N
BRITISH COLUMBIA HYDRO AND POWER AUTHORITY
QUESNEL AREA
REVISED BEDROCK GEOLOGY
SOUTH SHEET 36
FIGURE 5-7b