

2.3 Geology

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2.3.1 Regional geology

The Quinsam Coal Project mine site is located in the Nanaimo Lowlands physiographic region (Holland 1964) on the east coast of Vancouver Island. The area is characterized by low bedrock ridges separated by narrow valleys. The entire area was glaciated during the Pleistocene Epoch. The already low local relief was reduced further by glacial erosion of topographic highs accompanied by deposition of a variable thickness of ground moraine till and glaciofluvial materials in the low lying areas (Fyles 1959, Holland 1964).

The entire area from Campbell River to Deep Bay is underlain by bedrock of the Late Cretaceous Comox Formation. Throughout this region, this formation is characterized by lateral variation and lenticularity of sandstone, siltstone and coal units so that correlation of units within the formation from one area to another is difficult. The coal seams of economic importance occur along the east coast of the island in an area from Fanny Bay north to Campbell River, a distance of approximately 75 km.

2-2

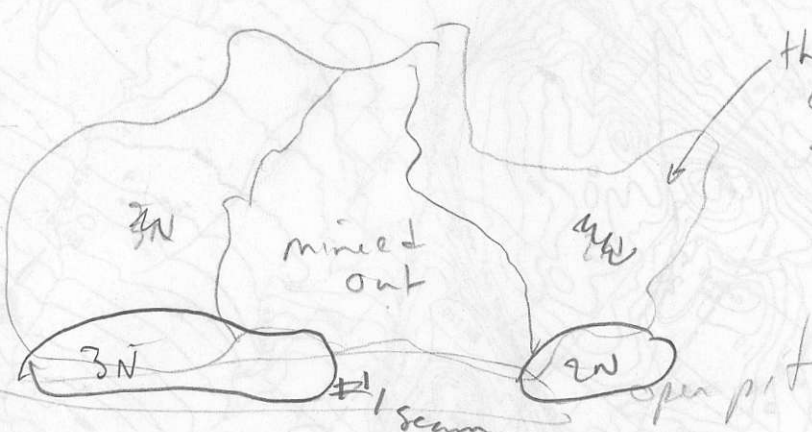
Tailings
ponds

Rider Seam - #2 Seam - a nuisance because it collapses and has high S

- currently mining under access road

thinner seam of #1 - not mined yet

#1 - caving happens within days - desirable as relieves stress
#2 - leave pillars as st doesn't cave properly



- faults - 3 to 10m displacements - Tsable River ground

mining - room + pillar - panels

Gob - mined out + collapsed areas



- 6 SHORE DELTAIC AND FLUVIAL DEPOSITS: gravel, sand, silt, clay, peat
- 7 VALLEY ALLUVIUM AND COLLUVIUM: boulders, gravel, sand, silt, clay
- 8 CAPILANO - TERRACED FLUVIAL DEPOSITS:
 - 8a Deltaic gravel, sand
 - 8b Floodplain and channel: gravel, sand, silt
- 9 CAPILANO - MARINE AND GLACIO-MARINE DEPOSITS:
 - 9a silt, clay, clayey silt
 - 9b sand, pebbly sand
 - 9c gravel, sandy gravel
 - 9d shaly, gravelly and sandy marine-coastal
 - 9e shaly, heavy and clayey marine-coastal
- 4 VASHON - GLACIO-FLUVIAL DEPOSITS:
 - 4a Hummocky, sand-and-silt and ridged: gravel, sand, till lenses
 - 4b Terrace and pitted: gravel, sand, till lenses
- 3 VASHON - GROUND MORaine DEPOSITS: silt, gravel, sand and silt lenses
- 2 PRE VASHON: gravel, sand, silt, clay, peat
- F UPPER CRETACEOUS - COMOX FORMATION: sandstone, pebbly sandstone, minor conglomerate, shale, coal
- E UPPER CRETACEOUS: boulder conglomerate, minor siltstone sandstone
- D JURASSIC AND (T) CRETACEOUS - COAST INTRUSIONS: gneiss/diorite, minor quartz diorite
- C TRIASSIC AND (T) JURASSIC - VANCOUVER GROUP: tuff, andesitic volcanic breccia and lava agglutina, tuffaceous
- B UPPER TRIASSIC - VANCOUVER GROUP: limestone, calcareous shale
- A UPPER TRIASSIC - VANCOUVER GROUP: massive basalt, pillow basalt, minor tuff, volcanic breccia
 - Aa limestone, calcareous siltstone, shale-interbedded in A



- >>>>>>> Eskers
- / Dip / Strike Symbol
- ~ Fault, assumed
- Geological Boundary
- ↕ Syncline (plunging)
- ↕ Anticline (plunging)
- ⊙ Drumlinoid Ridges, Crag and Tail Hills

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PROJECT: QUINSAM COAL LIMITED
 LOCATION: CAMPBELL RIVER, B.C.
 TITLE:

REGIONAL GEOLOGY MAP

FIG. 3.2-1

DRAWN BY:	DATE:	CHECKED BY:	DATE:
DRAFTED BY:	DATE:	APPROVED BY:	DATE:
SECTION:		PROJECT NO.	
SCALE:	DWG No.		REV

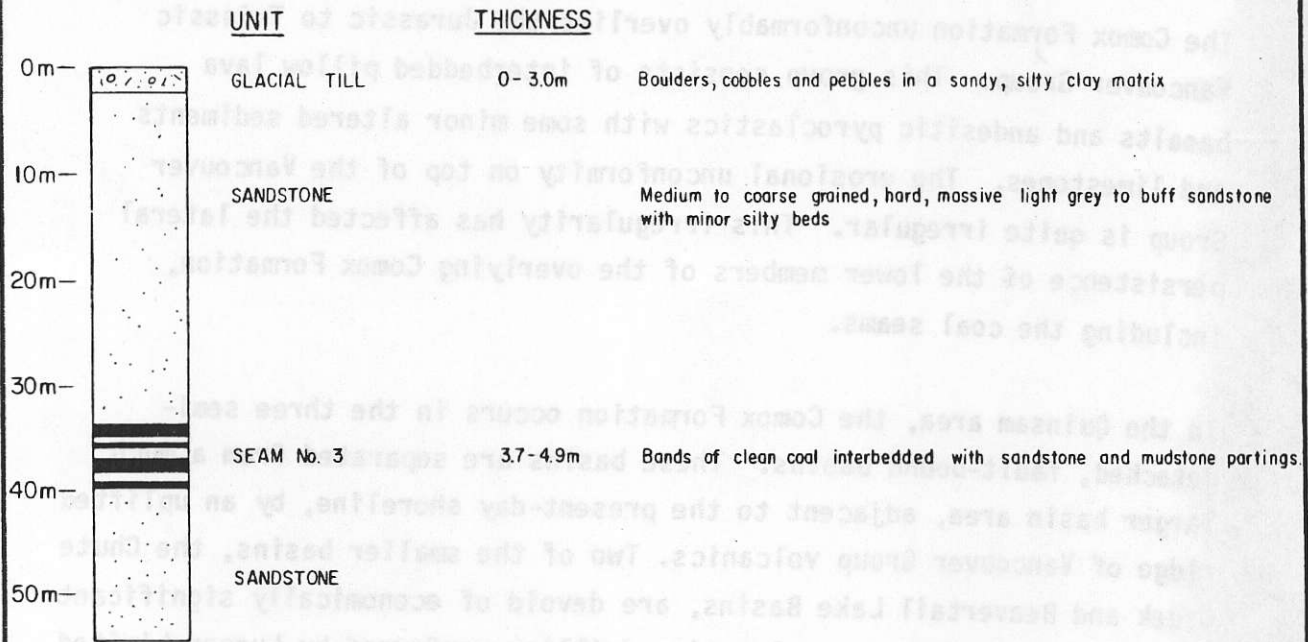
The Comox Formation unconformably overlies the Jurassic to Triassic Vancouver Group. This group consists of interbedded pillow lava basalts and andesitic pyroclastics with some minor altered sediments and limestones. The erosional unconformity on top of the Vancouver Group is quite irregular. This irregularity has affected the lateral persistence of the lower members of the overlying Comox Formation, including the coal seams.

In the Quinsam area, the Comox Formation occurs in the three semi-detached, fault-bound basins. These basins are separated from a much larger basin area, adjacent to the present-day shoreline, by an uplifted ridge of Vancouver Group volcanics. Two of the smaller basins, the Chute Creek and Beavertail Lake Basins, are devoid of economically significant coal seams according to exploration drilling performed by Luscar Limited. The third basin, called the Middle Quinsam Lake area, contains significant reserves of coal. The current mining project is located in the Middle Quinsam area.

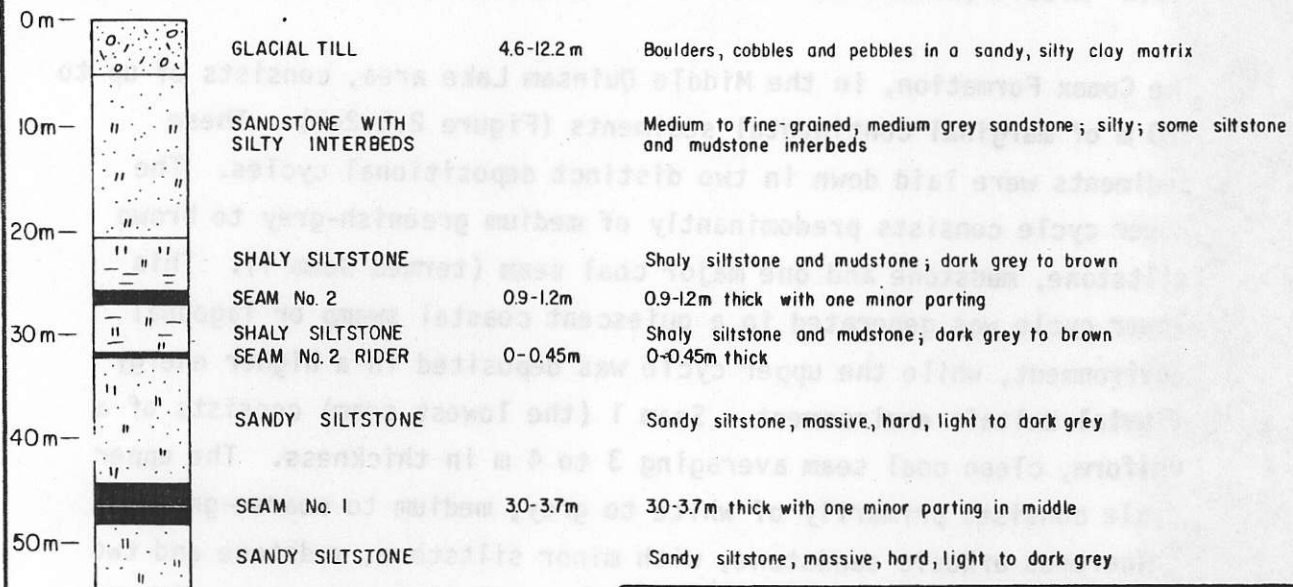
2.3.2 Middle Quinsam Lake area stratigraphy

The Comox Formation, in the Middle Quinsam Lake area, consists of up to 120 m of marginal continental sediments (Figure 2.3.2-1). These sediments were laid down in two distinct depositional cycles. The lower cycle consists predominantly of medium greenish-grey to brown siltstone, mudstone and one major coal seam (termed Seam 1). This lower cycle was generated in a quiescent coastal swamp or lagoonal environment, while the upper cycle was deposited in a higher energy fluvial deltaic environment. Seam 1 (the lowest seam) consists of a uniform, clean coal seam averaging 3 to 4 m in thickness. The upper cycle consists primarily of white to grey, medium to coarse-grained, calcareous arkosic sandstone, with minor siltstone, mudstone and two coal seams (2 and 3). The upper cycle resulted in the generation of Seam 2, which averages only 1.2 m in thickness, and Seam 3 (the highest in the series), which consists of up to 4.5 m of interbedded coal and rock bands. The average separation between Seam 1 and Seam 3 is approximately 60 m.

TYPICAL STRATIGRAPHIC SECTION - PIT 4 SOUTH



TYPICAL STRATIGRAPHIC SECTION - PIT 3 NORTH



STRATIGRAPHIC SECTIONS

figure no.	QUINSAM COAL PROJECT	
2.3.2-1		
date	prepared by	scale
JULY 1982	Brinco Mining Ltd	

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In some areas, paleo-topographic "highs" in the basement rock interrupted the lower cycle deposition and affected the generation of the Seam 1. Drilling in the Middle Quinsam Lake area, particularly in the area of Pits 2N and 3N, has shown that these basement "highs" are of limited areal extent and of erratic distribution.

2.3.3 Middle Quinsam Lake area geological structure

In general, the Comox Formation sediments dip uniformly to the northeast at angles of 6° to 10° . Structural complications arise in areas of localized basement "highs". The draping effect of sedimentary deposition over these ancient hills created tensional forces which, in a few places, has been relieved by brittle fracturing and faulting, resulting in displacement in the order of a few metres. This minor faulting appears to be limited to the immediate area surrounding the "high".

Broad synclinal folds are evident in several areas on the Quinsam mining block such as Pits 2-3S and Pit 3N, and are due to the bowl-shaped nature of the depositional basins. Structure contour maps of the coal seams indicate that localized flat areas and gentle rolls occur within these broad structures, however, no faulting is indicated.

Structural complexity occurs in the area of Pit 4S, and the adjacent linear topographic trough which lies between Pits 4S and 5S. This trough is an extension of Long Lake and is the most important structural feature in the Quinsam mining block. Core hole information along this linear structural zone, which averages 150 m wide, is limited because it is not part of the proposed pit areas. Interpretation indicates a major fault that originates in the basement rock and propagates into the Comox formation.

A significant anticline occurs approximately 1 km south of the Long Lake fault zone on the south edge of Pit 4S. Dips on the limbs of the fold average 10° to 14° and the fold gently plunges to the east. As it

approaches the east end of Pit 4S, the anticline culminates in a normal fault with an indicated vertical displacement of up to 20 m. The displacement on the fault lessens to the east.

2.3.3 Middle Quaternary Lake Area Geological Structure

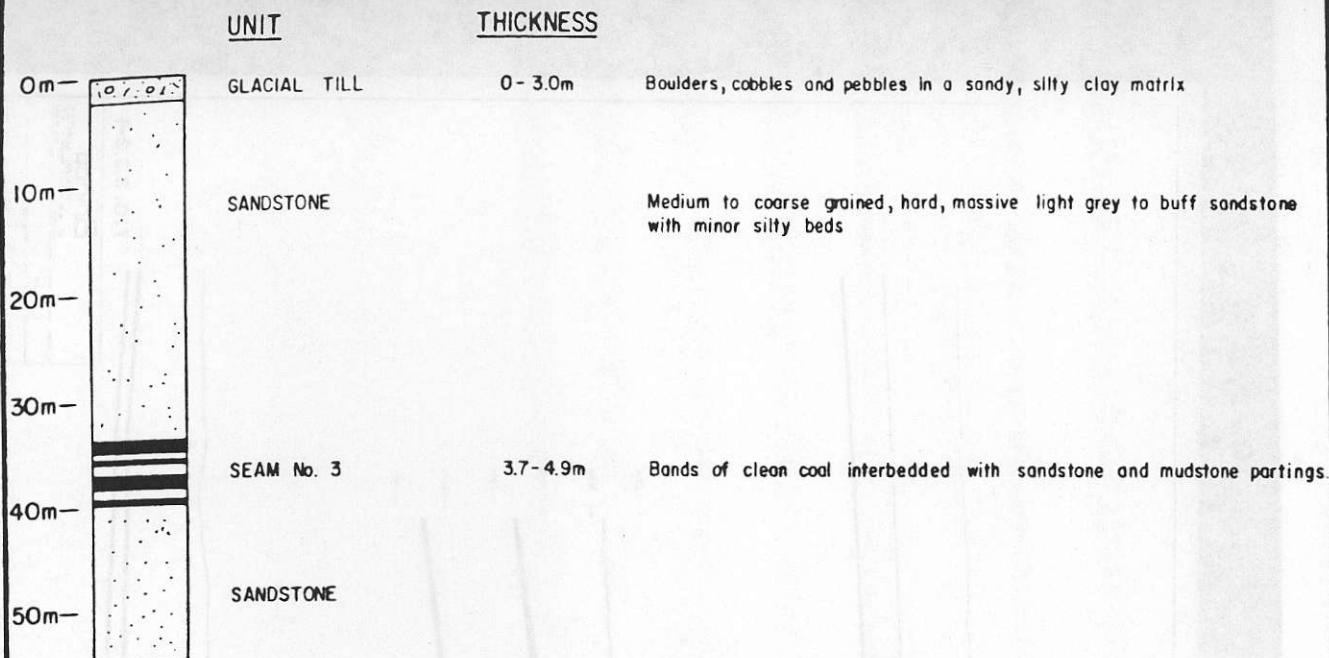
In general, the Comox Formation sediments dip uniformly to the north-east at angles of 5° to 10°. Structural complications arise in areas of localized basement "high". The dragging effect of sedimentary deposition over these ancient hills created tensional forces which, in a few places, has been relieved by brittle fracturing and faulting, resulting in displacement in the order of a few metres. This minor faulting appears to be limited to the immediate area surrounding the "high".

Broad synclinal folds are evident in several areas on the Quaternary mining block such as Pits 2-32 and Pit 3N, and are due to the bowl-shaped nature of the depositional basin. Structure contour maps of the coal seams indicate that localized flat areas and gentle rolls occur within these broad structures, however, no faulting is indicated.

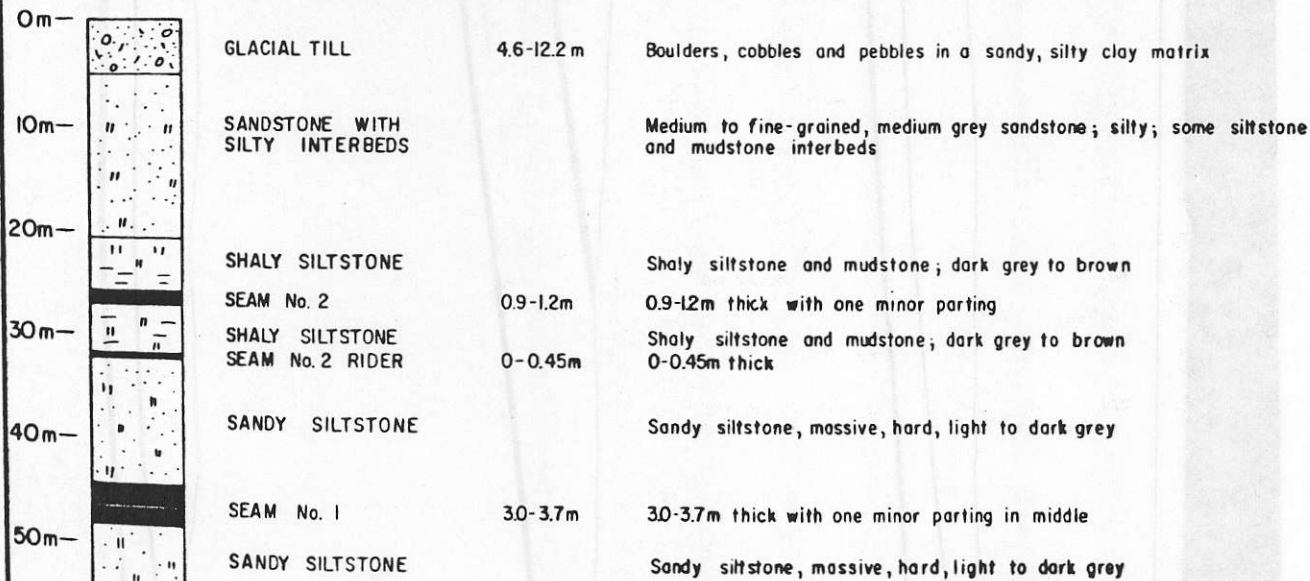
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A significant anticline occurs approximately 1 km south of the Long Lake fault zone on the south edge of Pit 4S. Dips on the limbs of the fold average 10° to 14°, and the fold gently hinges to the east. As it

TYPICAL STRATIGRAPHIC SECTION - PITS 4S & 6S



TYPICAL STRATIGRAPHIC SECTION - PITS 2N, 3N, 5S, 2-3S



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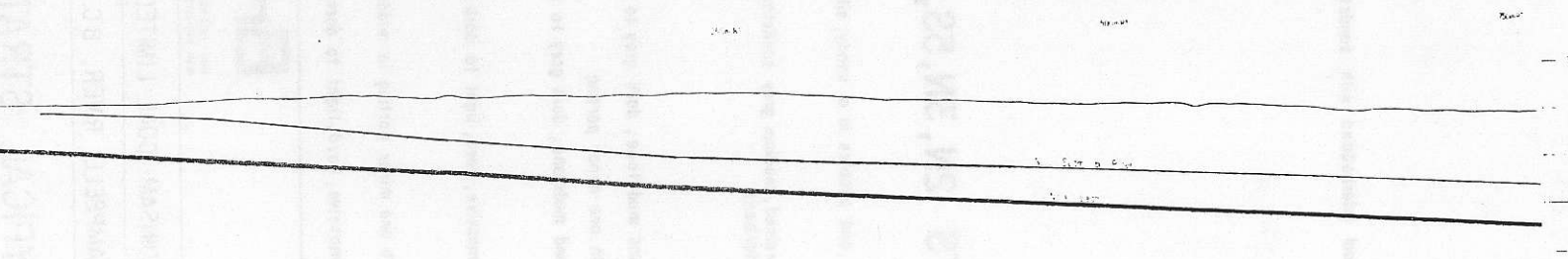
PROJECT: QUINSAM COAL LIMITED

LOCATION: CAMPBELL RIVER, B.C.

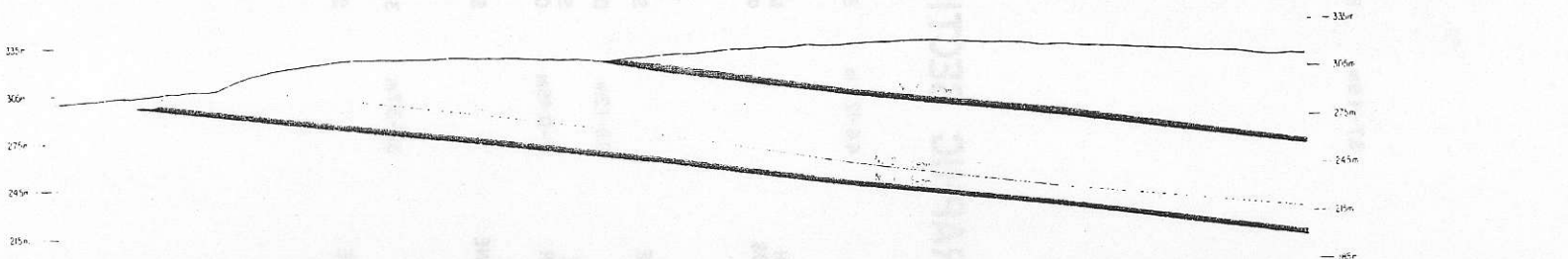
TITLE: TYPICAL STRATIGRAPHIC SECTIONS

FIG. 3.3.1-1

LINE 48.00mN (Pit 3 North)



LINE 16.76mN (Pits 5 & 6 South)



LINE 13.72mN (Pit 2 & 3 South)

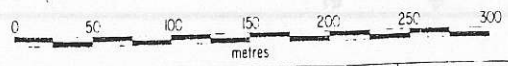
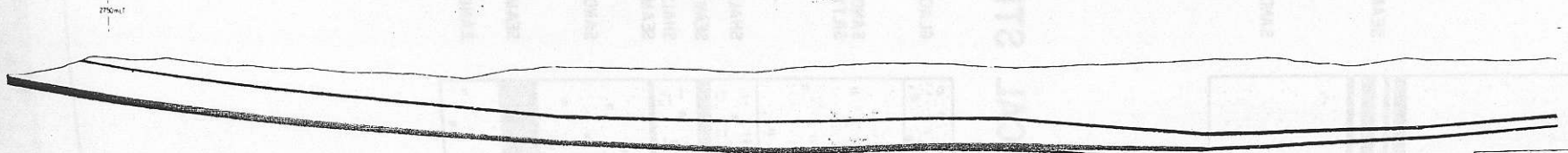


FIG. 3.3.2-1

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TYPICAL CROSS SECTION

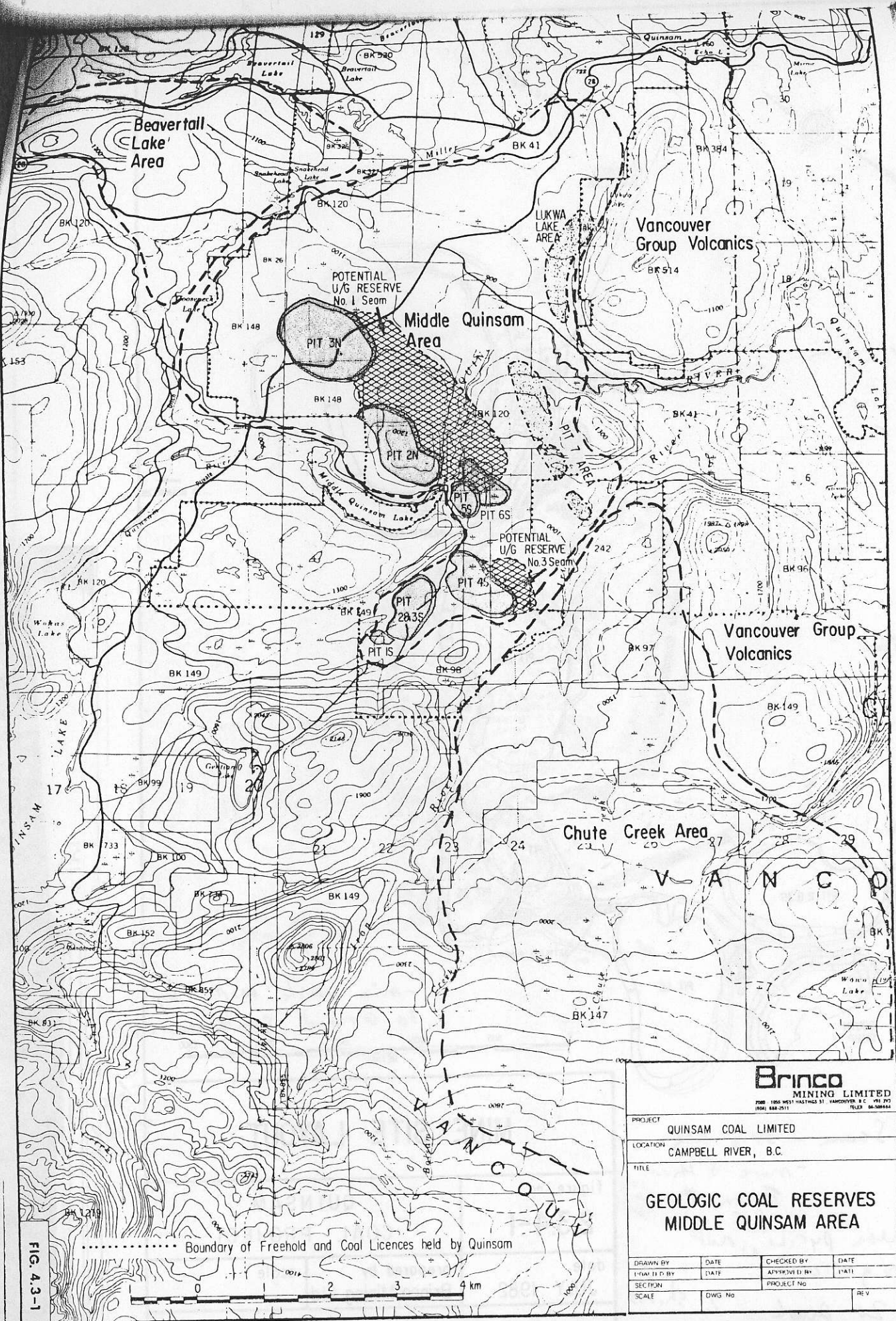
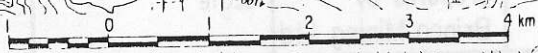


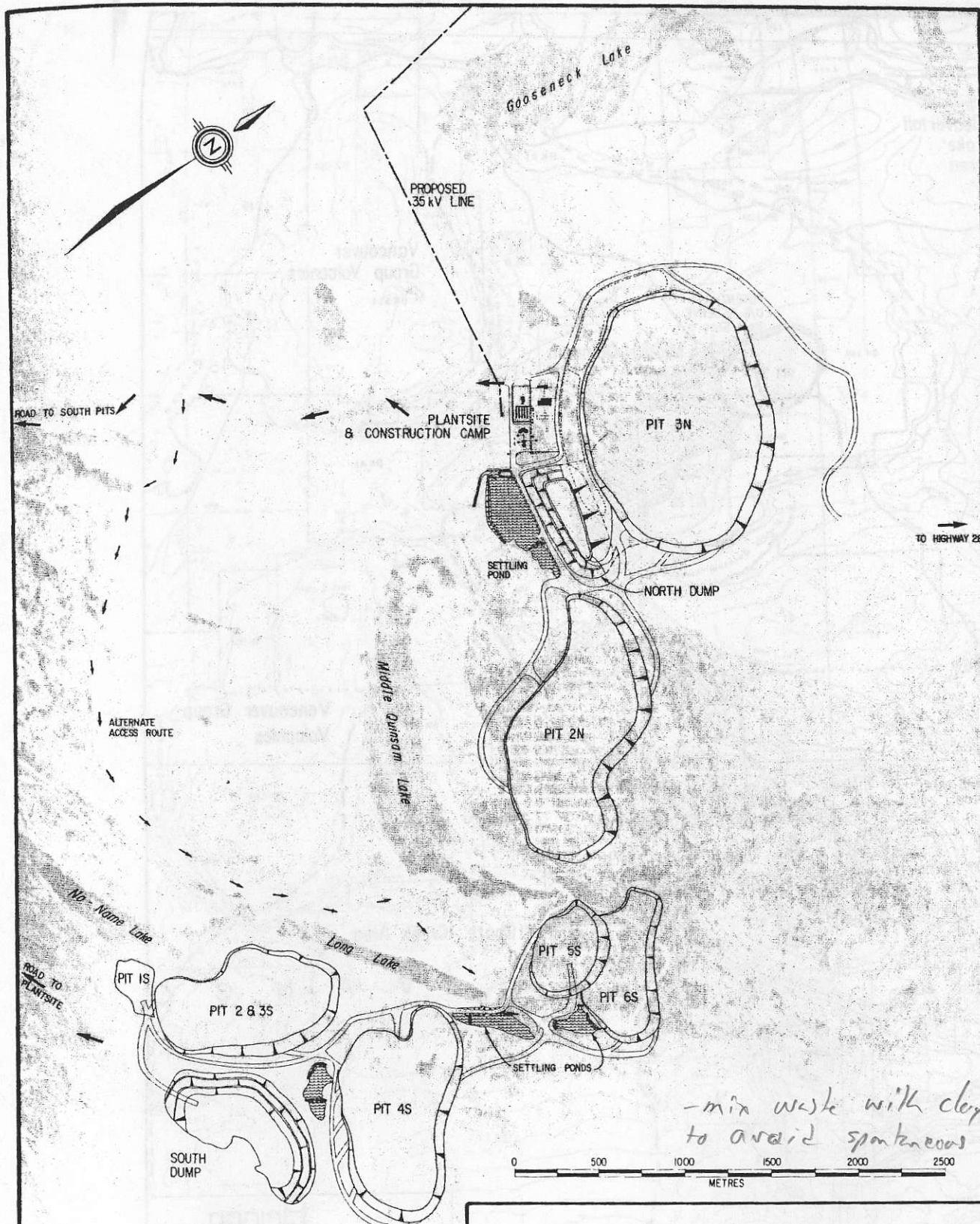
FIG. 4.3-1

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PROJECT QUINSAM COAL LIMITED			
LOCATION CAMPBELL RIVER, B.C.			
TITLE GEOLOGIC COAL RESERVES MIDDLE QUINSAM AREA			
DRAWN BY	DATE	CHECKED BY	DATE
DESIGNED BY	DATE	APPROVED BY	DATE
SECTION		PROJECT NO.	
SCALE	DWG No.		REV

..... Boundary of Freehold and Coal Licences held by Quinsam





#3 Seam - 34% ash
 - more S than seam #1
 - clean pyrite for organic S
 2000 - 20 people - 2 shifts
 (4000 tpd)

MINE SITE LAYOUT		
figure no.	QUINSAM COAL PROJECT	
2.3.4-1		
date	prepared by	scale
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PLAN SHEET 1

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