Cx - Anderson East 83(1)A

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CONFIDENTIAL

1983 EXPLORATION WORK

THE GEOLOGY AND COAL RESOURCES OF THE ANDERSON EAST COAL LICENCES

CUMBERLAND COAL FIELD, COMOX LAND DISTRICT

Lat. 49 deg. 42′ TO 49 deg. 44′

Long. 125 deg. 05′ TO 125 deg. 06′

EAST CENTRAL VANCOUVER ISLAND

BRITISH COLUMBIA

COAL LICENCE Nos. 7476, 7477, 7478, 7479, NTS Sheet 92F/11

Prepared For :

WELDWOOD OF CANADA LIMITED

VANCOUVER, BRITISH COLUMBIA

Prepared By :

GARDNER EXPLORATION CONSULTANTS

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NANAIMO, BRITISH COLUMBIA

Date Work Performed :
Sept. 3, 4, 5, 1983

DATE SUBMITTED : SEPT. 30/83

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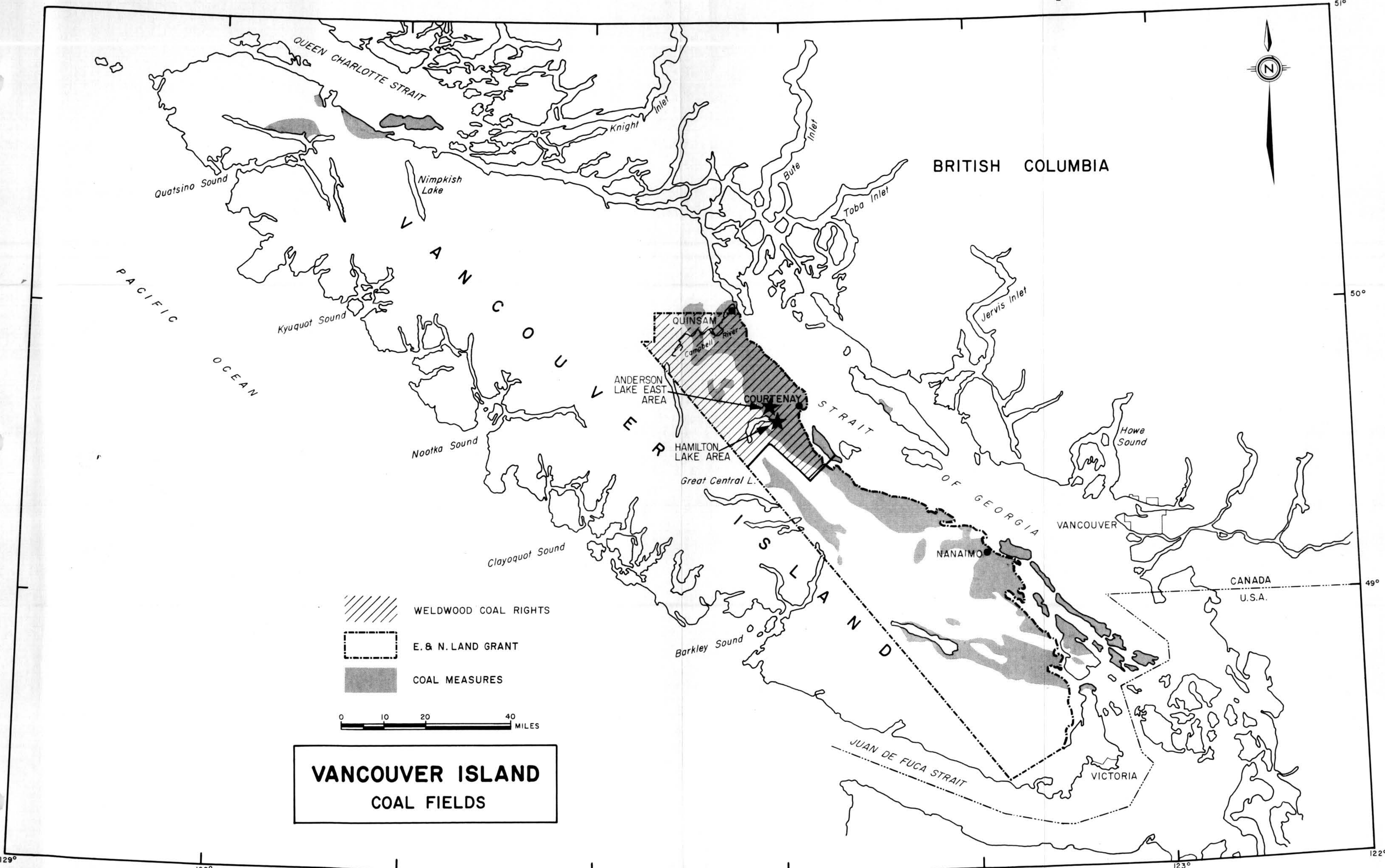


VANCOUVER ISLAND
COAL FIELDS

FIG 1

1.0 INTRODUCTION

1.1 Location and Description of Property

The Anderson East Coal Licences, held by Weldwood of Canada Ltd, are located approximately 6.4 kilometres (4 miles) northwest of the city of Courtenay on the east coast of Vancouver Island. The licence area consists of a total of 924 hectares (2282 acres) of contiguous licences covering all or portions of Sections 20, 21, 29, and 32, Township 9 in the Comox Land District (Latitude 49° 43', Longitude 125° 06').

Figure 2 illustrates the location of the licence with respect to the city of Courtenay and the old shipping facility at Union Bay.

1.2 Topography and Access

The Anderson East licence area is easily accessible from Courtenay via a network of public roads and private logging roads. A major power transmission line dissects the licence block on its northeastern side, providing drivable access to most areas along its length.

The topography of the area is featureless, varying from 100 metres above sea level on its eastern margins to 120 metres above sea level on its western side. Some of the area is flat and swampy, but the southeastern end of the block consists of small farms and acreages that typify the populated part of the Comox Valley outside of the suburban areas around Courtenay. The northern and central parts of the licence area are heavily treed. Numerous gravel pits are located along the western and southern parts of the property.

The major drainage on the licence block is Dove Creek, which meanders through the central part of the licence block and flows into the Tsolum River. The Tsolum flows into Comox Harbour. Minor drainages, such as Piercy Creek and Jackpot Creek, feed into the Dove on the central portion of the licence area.

1.3 Description of Work

The present work consisted of surface mapping and reconnaissance on a scale of 1 : 50,000 covering coal licence numbers 7476, 7477, 7478, and 7479, NTS Sheet 92 F/11. This mapping identified structural control such as location of faults, and confirmed sedimentary-volcanic contacts.
No previous work was undertaken on the Anderson East area.

1.4 Cost Summary

The following is a summary of costs of the work:

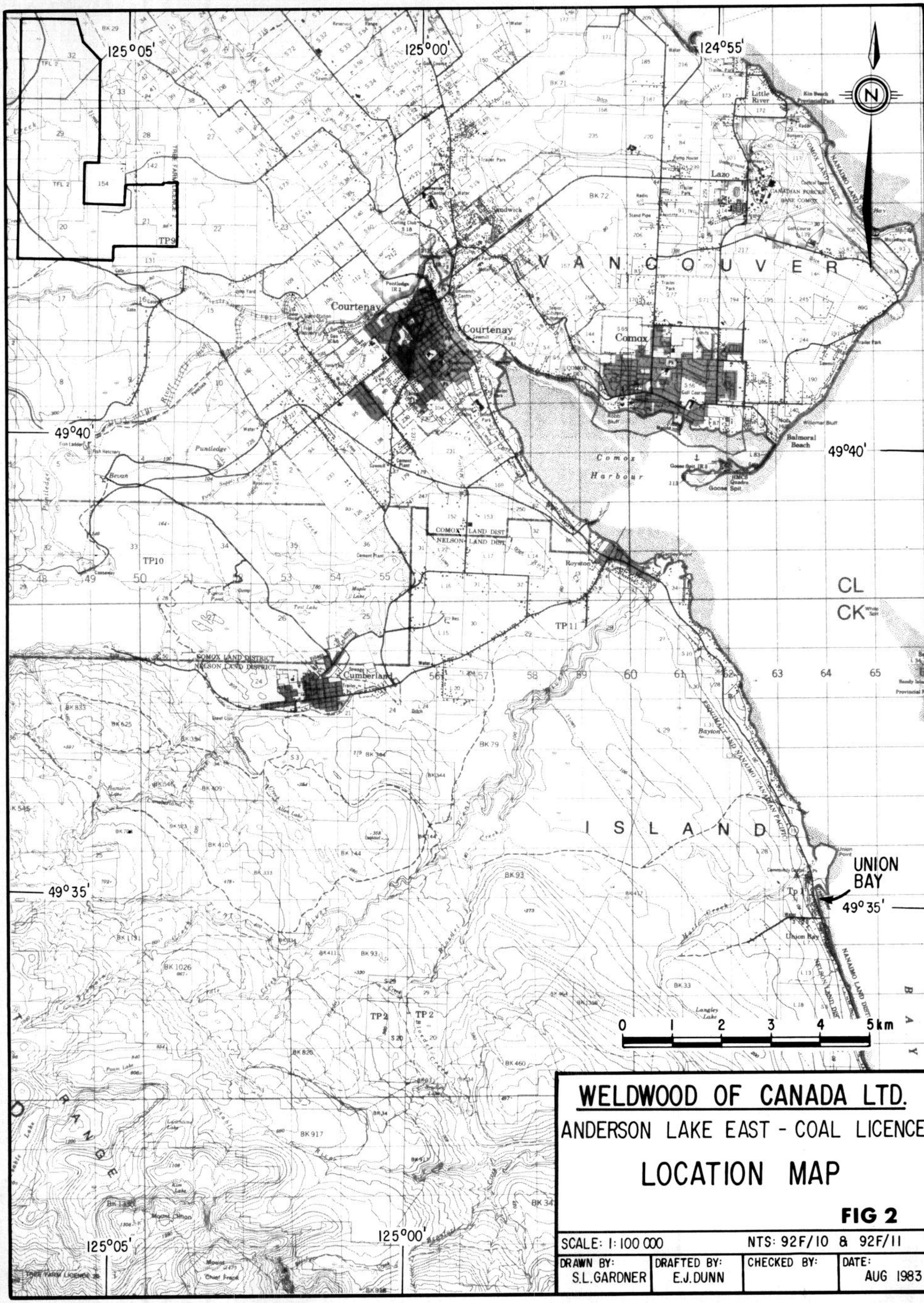
ON-PROPERTY COSTS :

Surface Mapping	....	$ 1,384.40

OFF-PROPERTY COSTS :

Final Reporting	....	$ 2,100.00
Drafting and Reproduction	..	$ 326.68
Office and Miscellaneous	...	$ 76.65
TOTAL EXPENDITURE*	....	$ 3,887.73

* NOTE- DOES NOT INCLUDE HEAD OFFICE AND ADMINISTRATION.



WELDWOOD OF CANADA LTD.

ANDERSON LAKE EAST - COAL LICENCE

LOCATION MAP

FIG 2

SCALE: 1: 100 000		NTS: 92F/10 & 92F/11	
DRAWN BY: S.L.GARDNER	DRAFTED BY: E.J.DUNN	CHECKED BY:	DATE: AUG 1983

2.0 SUMMARY AND CONCLUSIONS

The Anderson East coal licences are located approximately 4.8 kilometres (3 miles) north of the nearest abandoned coal mine in the Comox - Cumberland coal field. They cover an area of featureless and flat-lying topography, underlain by 200 to 300 metres of the lowermost Comox Formation sediments. These sediments, containing the coal measures mined in the Cumberland field to the south, lie unconformably on Triassic Karmutsen Formation basement rock, and are covered by 2 to 20 metres of glacial till.

Previous drilling, conducted by Weldwood of Canada Ltd. in 1975, indicates that a number of thin but relatively continuous coal seams occur in the Comox Formation in this area. The best seam intersection is found in the Brown's No. 2 borehole, which is located approximately 0.8 kilometres (0.5 miles) southwest of the southwest corner of the licence block. In this borehole, 1.37 metres (4.5 feet) of coal occurs over a total section of 3.44 metres (11.3 feet) at a depth of 68 metres (223 feet). Geologic interpretations show that this seam is continuous towards the licence area to the northeast, however its quality deteriorates to some degree. At the same time, the seam crosses a major normal fault feature a short distance west of the licence block and is downthrown by as much as 50 metres of vertical displacement.

In consideration of the thinness of this and other seams and the depths of burial involved on the downthrown side of the fault, the author recommends that the Anderson East licence are be surrendered to the Crown.

3.0 HISTORY OF MINING IN THE AREA

The Comox - Cumberland coal mines, which operated from 1888 to 1947, produced about 18 million short tons of coal from the Comox Formation coal measures. These mines were all underground room and pillar operations, either shaft or slope, that operated to maximum depths of 244 metres to 305 metres (800 to 1000 feet). Many of the Comox mines ran into methane gas problems and outbursts due to ground pressure at depths of 150 metres or greater. Poor ventilation practices contributed to the early closing of some mines after fatal explosions occurred as a result of methane gas build-up at the coal face.

The Bevan Mine, which is located approximately 4.8 kilometres (3 miles) due south of the south boundary of the Anderson East licence area, is the closest old mining operation to the licence area.

A total of five different coal seams occur in the Comox - Cumberland coal measures. Three of these seams were mined in the past, numbered from highest to lowest the No. 1, No. 2 and No. 4 seams. The seam as shown in Figure 5 (Section 5.0) as being the most well developed and continuous is probably correlative to the No. 4 seam.

4.0 REGIONAL GEOLOGY

4.1 Stratigraphy

The Comox Coal Basin, which is located in the Comox - Cumberland area on the east coast of Vancouver Island, covers part of the Vancouver Island Lowlands Belt. This long narrow belt of low, flat-lying topography covers an area approximately 16 kilometres wide by 60 kilometres long stretching from the Campbell River District south to the Nanaimo area. The Lowlands Belt is flanked by the Beaufort Mountains on the west. The Beaufort Range forms the backbone of Vancouver Island.

Volcanism and uplift associated with volcanic island building during Jurassic, Triassic and into Cretaceous time created an island arc complex which eventually emerged to form what is Vancouver Island today. This prolonged period of island building triggered a massive erosional - depositional sequence in Late Cretaceous time during which sedimentary deposits washed off the flanks of the Beaufort Range and were deposited along the island margins, extending the coastline seaward. This is termed the Nanaimo Series.

The Nanaimo Series, which is Late Cretaceous in age, is made up of a number of transgressive - regressive cycles of deposition governed by the rise and fall of sea level throughout the Late Cretaceous period. Each cycle consists of a range of coarse clastic near-shore sediments to fine-grained marine shales. The coal measures of the Comox Formation are contained in the first depositional cycle and rest unconformably on the pre-Cretaceous volcanic basement rock of the Karmutsen Formation. In certain paleotopographically low areas, the beginnings of Comox Formation deposition is marked by a basal conglomeratic facies called the Benson Member. The Benson Member consists of large pebbles and cobbles of angular to sub-rounded cherts and basalts well-cemented in a medium to coarse grained green sandstone matrix.

Throughout the Cretaceous Age and into Tertiary time, acid volcanic intrusions, called the Island Intrusions, periodically erupted. These acid volcanics intruded through the Triassic basement rock and penetrated the Cretaceous sediments to form sills, dykes and occasionally surfacing as laccoliths. An example of one of these Tertiary volcanic emplacements is Constitution Hill, a major topographic feature that occurs a short distance north and west of the Comox Coal Basin. Because of the younger age of these volcanics, they can be in direct contact with the older Comox Formation sediments, including the coal measures. In these localized instances, the volcanics have hypothermally altered the coal seams to form natural coke, with a halo of low volatile semi-anthracite coal surrounding the contact zone.

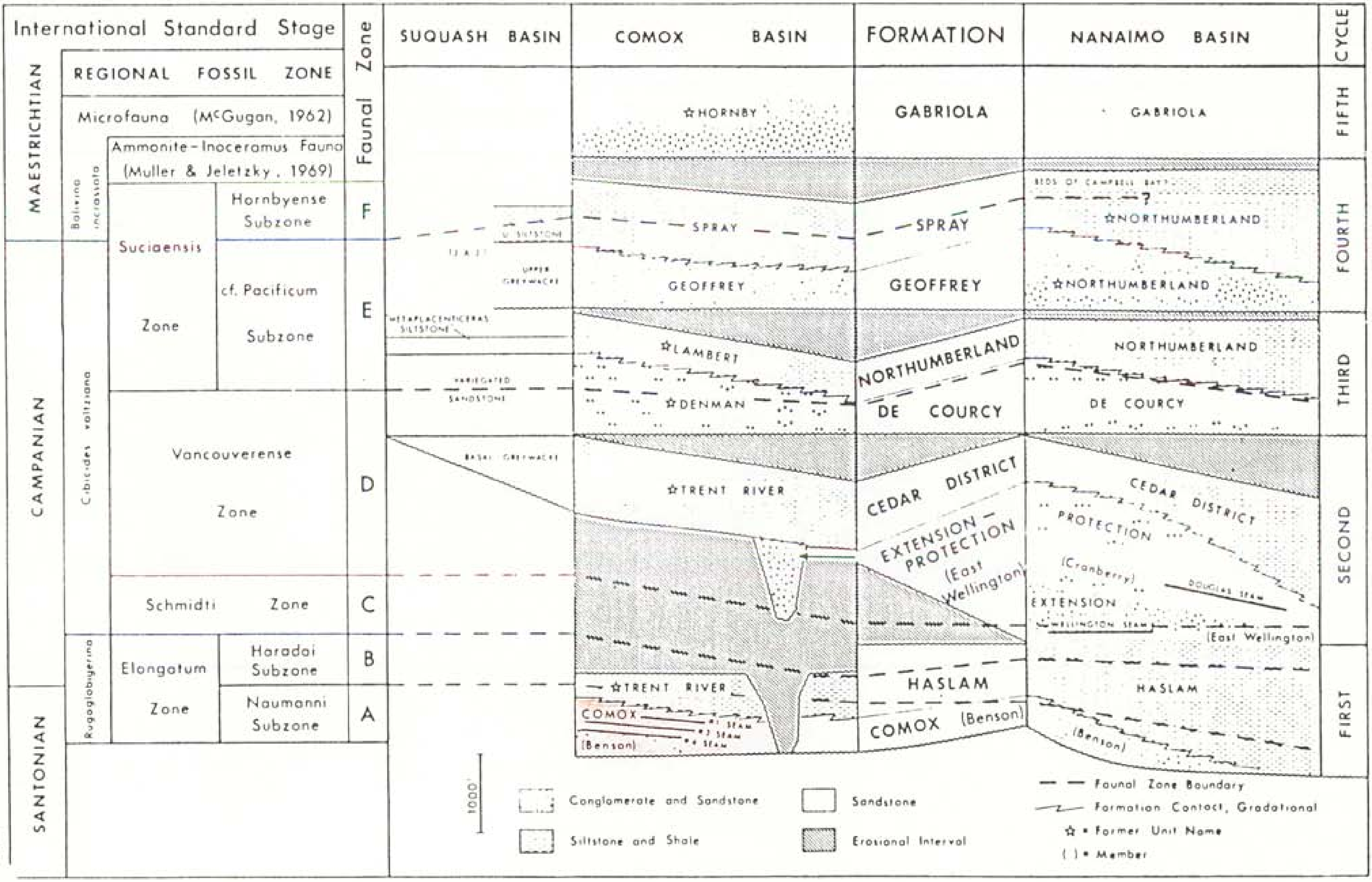


FIG 3

Biochronological and lithological divisions of Nanaimo Group (after Muller and Jeletzky, 1970).
Courtesy: G.S.C. Paper 70 - 53, J.E. Muller and M.E. Atchison.

4.2 Structure

The main structural features of the Comox coal basin are a number of sub-parallel major normal faults with displacements of from tens to hundreds of metres. Sometimes these normal faults consist of two or more closely-spaced subsidiary normal faults that create "steps" in the sedimentary sequence. Usually there is some degree of rotation involved with the normal fault sequences. One of these fault structures was observed in the recent field work on Dove Creek, just west of the licence area.

Minor faulting, according to old mine records, is rare. Minor secondary structures usually occur in the form of small folds, associated with intra-formational slumping and localized stresses. These small folds are usually more evident in the softer formations, such as the shales and coal seams, where rolls occur in the floor or the roof of the seam. Some abnormal thickening or thinning can occur in these areas.

5.0 GEOLOGY OF THE ANDERSON EAST LICENCE AREA

5.1 Surficial Geology

A number of road traverses in the area on and adjacent to the licences resulted in the identification of only one outcrop of Comox Formation sandstone just west of the powerline in the central part of the licence block (see Figure 4). The attitude of this outcrop is to the northeast at approximately 3 degrees. A traverse down the length of the power-line and two traverses up Dove and Jackpot Creeks resulted in no visible exposures of bedrock.

As a result, the licence area appears to be covered by a mantle of Quaternary and Recent glacial boulder till from 2 to 20 metres thick. The thickness of the till appears to be greatest on the southwest part of the area, where adjacent gravel deposits are being excavated. In the central part of the licence area, the till cover is thinner, being in the order of 2 to 5 metres thick.

The till cover consists of a layer of sandy clay mixed with numerous pebbles, cobbles and boulders of granite and basaltic origin, with chert pebbles being quite numerous. Some alluvial gravel deposits also are found. Beneath the sandy clay layer, a thin layer (up to 2 metres thick) of greenish grey silt is found in many locations. In the creeks such as Dove Creek and Jackpot Creek, this silty layer can be mistaken for the bedrock contact. It is expected that the older bedrock of the Comox Formation lies directly below this silt layer, although this was not observed in the field.

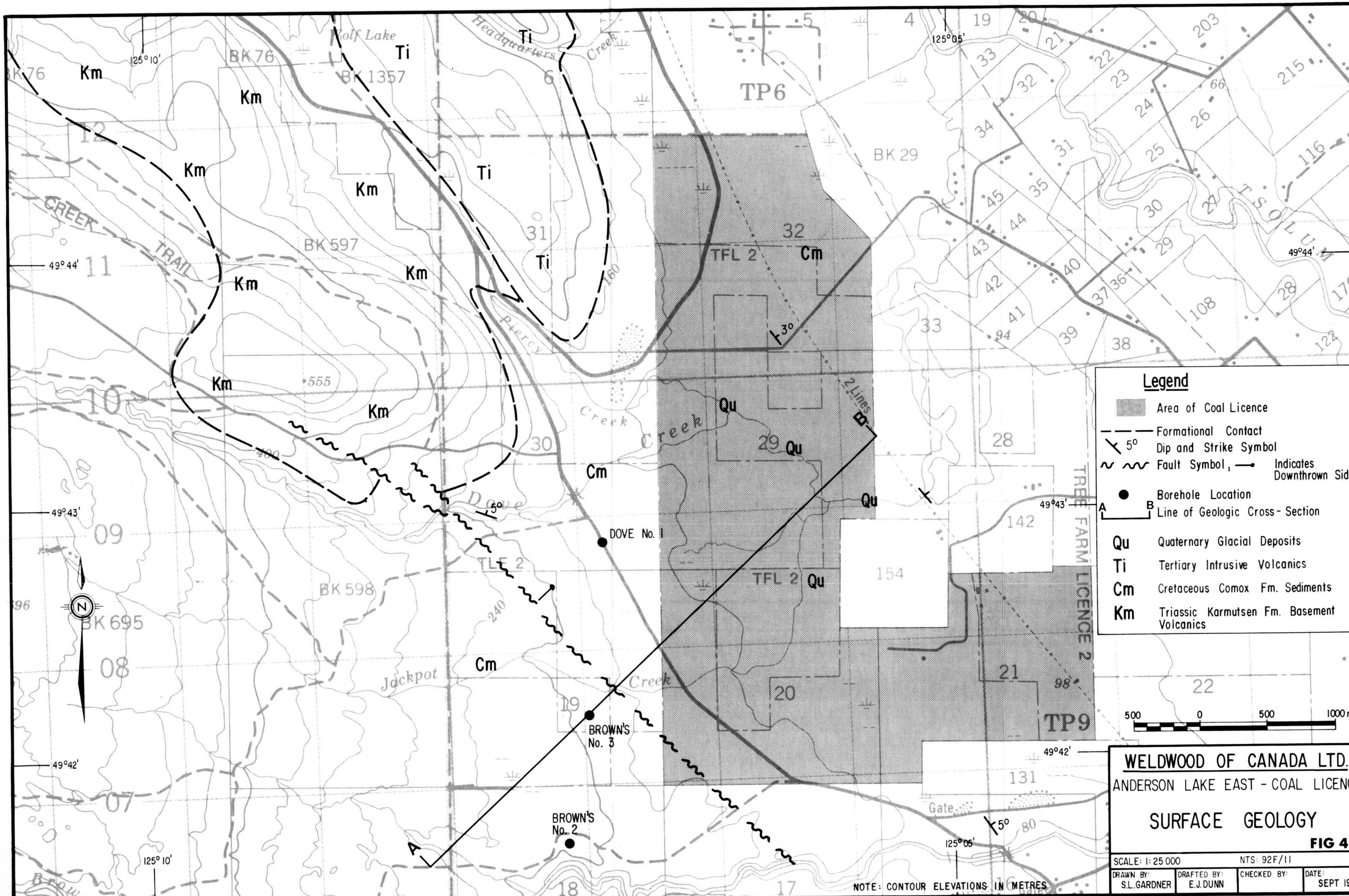

Legend
Area of Coal Licence
Formational Contact
5° Dip and Strike Symbol
Fault Symbol, Indicates Downthrown Side
Borehole Location
A B Line of Geologic Cross-Section
Qu Quaternary Glacial Deposits
Ti Tertiary Intrusive Volcanics
Cm Cretaceous Comox Fm. Sediments
Km Triassic Karmutsen Fm. Basement Volcanics
500 0 500 1000 m
WELDWOOD OF CANADA LTD.
ANDERSON LAKE EAST - COAL LICENCE
SURFACE GEOLOGY
FIG 4
SCALE: 1:25 000
NTS: 92F/11
DRAWN BY: S.L.GARDNER
DRAFTED BY: E.J.DUNN
CHECKED BY:
DATE: SEPT 1983
NOTE: CONTOUR ELEVATIONS IN METRES
DOVE No. 1
BROWN'S No. 3
BROWN'S No. 2
TP6
TP9
TFL 2
TREE FARM LICENCE 2
Headquarters Creek
Piercy Creek
Dove Creek
Jackpot Creek
TSOLUM
CREEK TRAIL
2 Lines
Gate
49°44'
49°43'
49°42'
125°10'
125°05'

PLATE I: Major normal fault feature on Dove Creek approximately 1.6 km west of the Anderson East Licence Area. Note coal seam in faulted contact with the sandstones of the down-faulted block. Photo looking north.

PLATE II: Outcropping of Comox Formation Sandstone a short distance from the fault feature on the downthrown side.

5.3 Coal Geology

A number of coal seams occur in boreholes located to the west of the Anderson East licence area (see Figure 5). The most well-developed of these occurs in the Brown's No. 2 borehole at a depth of 69.4 metres in the Brown's No. 3 borehole it is found at a depth of 85 metres and in the Dove No. 1 borehole it is found at a depth of 148 metres. In none of these holes is it of an economically recoverable thickness. The best intersection is in Brown's No. 2 borehole where the coal is contained in three thin bands totalling 1.37 metres (4.5 feet) over a total seam section of 3.44 metres (11.3 feet). Figure 4 illustrates that some deterioration in the character of the seam to the northeast (i.e. towards the Anderson East Licence Block). This is the general rule rather than the exception in most localities on Vancouver Island. The deterioration of coal seams with depth is dictated by the environment of deposition in which the seams were generated.

The amount of rock material present as partings within the seam as shown in the borehole logs in Figure 5 renders this particular seam as uneconomic to recover in an underground situation, given the present market conditions. The remaining seams in the section vary in thickness from 0.2 metres to 0.8 metres but none are of a thickness amenable to underground production.

It is most probable that the character and thickness of the seams will not change over the area of the Anderson East Licence Block.

6.0 CONCLUSIONS AND RECOMMENDATIONS

As a result of field work and interpretations of existing borehole information, the following conclusions can be drawn with respect to the Anderson East Licence area:

1. The licences contain the lowermost 200 metres to 300 metres of Comox Formation.

2. The area is bounded on the southwest by a major normal fault, being downthrown as much as 50 metres to the northeast. The licence area covers part of the downthrown portion.

3. A number of thin but continuous coal seams are indicated to occur over the licence area. None of these seams are sufficiently thick enough nor close enough to the surface to be mined by surface or underground methods. The best seam occurs near the base of the Comox section at depths of 150 metres or greater and is badly split by rock bands and partings. Given the historical and geological background knowledge of the Comox coalfield, there is little chance of this seam improving over the licence area.

4. Unless additional seams were found to occur near the surface on the licence area, its location on the downthrown side of a major normal fault would dictate an underground shaft mining operation as no surface access to the seams is possible. Even if the best seam were of a minimum mineable thickness of 1.5 metres of clean coal, the economics of shaft sinking and deep underground mining operations would not be favorable, given present market conditions.

As a result of the above conclusions, the author recommends that all of the Anderson East licence area be surrendered to the Crown.

REFERENCES

1. Geology, History and Potential of Vancouver Island Coal Deposits
J.E. Muller and M.E. Atchison
G.S.C. Paper 70 - 53, 1971

2. Vancouver Island Coal Resources, Comox Coal Basin
M.P. Curcio, 1975
Prepared for: Weldwood of Canada Ltd.

5.2 Structure

The Anderson East Licence Block lies in the northerly part of the Cumberland coal field. The Cumberland coal field occupies a down-faulted block on which the Late Cretaceous coal measures of the Comox Formation have escaped erosion in Quaternary and recent time. Mining in the Cumberland field was confined to the area from south of the Brown's River to Cumberland, a distance of approximately 8 kilometres.

The Anderson East coal licences cover an area of Comox Formation sediments that, according to drilling in the area, are between 200 and 300 metres thick and rest directly on Karmutsen Formation basalt.

The flat-lying, featureless topography on the licence block indicates that the area is not structurally deformed and the formations are dipping gently and uniformly to the northeast.

Surface mapping has indicated that the Anderson East licence area is located on the northeast side of a major normal fault feature that trends in a northwest to southeast orientation, cutting through Dove Creek near the southwest corner of Section 30, Twonship 9, approximately 1.6 kilometres west of the west boundary of the licence block. At this location the fault consisted of two closely spaced parallel step faults trending at 320° Azimuth. The faults were typical high angle normal faults with an attitude of 67°, downthrown to the northeast. This fault zone probably cuts through the extreme southwest corner of the licence area.

The indicated vertical displacement of this fault structure is approximately 50 metres. This displacement is the result of borehole interpretations as illustrated in Figure 5.

The presence of this fault structure has important implications for the Anderson East Licence Block, because it insures that the lowermost seams in the sequence of Comox Formation deposition (i.e. those with the best potential for reaching a thickness amenable to underground mining methods) would not be directly accessible from surface outcrops. This necessitates the development of costly rock slope drivages or vertical shafts, either of which greatly increase the capital and operating costs of underground mine development.


A
B
1000 m
2000m
3000m
4000m
550m EAST BOUNDARY ANDERSON EAST LICENCE AREA
260 m
240 m
220 m
200 m
180 m
160 m
140 m
120 m
100 m
80 m
60 m
40 m
20 m
Sea Level
-20 m
-40 m
-60 m
ROAD
Creek (Unnamed)
Swampy Ground
BROWN'S No. 2 BOREHOLE (offset 600m S.E.)
Elevation : 189.0m
0.24m
0.40m
0.73m
68.1m
69.4m
70.6m
0.27m
plus shaley coal and mudstone
2.40m
110.2m
T.D. 123m
BROWN'S No. 3 BOREHOLE
Elevation 167.6m
0.67m
0.64m
1.0m
85.0m
87.4m
116.9m
T.D. 128.6m
Jackpot Creek
MAIN ROAD (WEST BOUNDARY ANDERSON EAST LICENCE AREA)
DOVE No. 1 BOREHOLE (offset 800m N.W.)
Elevation 131.0m
0.49m
0.64m
148.2m
150.4m
T.D. 180m
Swampy Ground
Creek (Unnamed)
Dove Creek
unconformity
Cm
Km
Comox Fm. (Late Cretaceous)
Karmutsen Fm. (Triassic)
Normal Fault
Vertical Displacement
~ 50metres
?
Dove No. 1
Brown's No. 3
Brown's No. 2
LOCATION MAP SCALE 1:100,000
0 1 2 3 4 5 km
38 (M1)
FIGURE 5
WELDWOOD OF CANADA LTD.
ANDERSON LAKE EAST LICENCE AREA
SOUTHWEST TO NORTHEAST GEOLOGIC CROSS SECTION OF STRATA
#5
SCALE: HORIZONTAL 1:5000, VERTICAL 1:1000
DRAWN BY: S.L.GARDNER
DRAFTED BY: E.J.DUNN
CHECKED BY:
DATE: SEPT 1983

Cx- Anderson East 83(3*)A *1

FORMATION DENSITY LOG

PROVINCE
FIELD
WELL
COMPANY

COMPANY WELDWOOD of CANADA Ltd.
WELL BROWNS RIVER #1 37 (41)
FIELD BROWNS RIVER (CUMBERLAND)
PROVINCE BRITISH COLUMBIA
LOCATION LSD Sec. Twp. Rge.
Other Services:
Permanent Datum Elev. 405
Log Measured From G.L. 0 Ft. Above Perm. Datum
ELEV: KB 405
Gl 405
CBF

Date	JUNE 11/'75
Run No.	ONE
First Reading	713 ft
Last Reading	0 ft
Feet Measured	713 ft
Depth Reached	713 ft
Bottom Driller	713 ft
Csg.	
Mud Nature	WATER
Dens. / Visc.	
Mud pH	
Water Loss	
Res.	
Bit Size	5 in.
Source to Detector Spacing	13 in.
Equipment Type	COMPROBE
Opr. Rig Time	
Truck No.	13
Recorded By	G. STOBART
Witness	G. GREEN

FLUID LEVEL 31 ft
CASING AT 48 ft

GAMMA RAY API UNITS	DEPTHS	BULK DENSITY ρ_b - gm/cc
Sens. 0.70 T.C. 2 Zero div. to left		SEN 2.90 T.C. 1
CALIPER hole diameter in inches 4 5 6 7 8 9 10 11 12		1.50 1.75 2.0 2.75

Speed in FPM

FORMATION DENSITY LOG

GREAT GUNS

Cx - Anderson East 83(3*)A #1

PROVINCE
FIELD
WELL
COMPANY

COMPANY	WELDWOOD of CANADA Ltd
WELL	BROWNS RIVER #2
FIELD	BROWNS RIVER (CUMBERLAND)
PROVINCE	BRITISH COLUMBIA
LOCATION	LSD Sec. Twp. Rge.
Other Services:	
Permanent Datum	Elev.
Log Measured From	GL, 0 Ft. Above Perm. Datum
ELEV: KB	
GL	
CBF	

38 (L2)

Date	JUNE 12/'75		
Run No.	ONE		
First Reading	420 ft		
Last Reading	0 ft		
Feet Measured	420 ft		
Depth Reached	423 ft		
Bottom Driller	425 ft		
Csg.			
Mud Nature	DRY		
Dens. / Visc.			
Mud pH			
Water Loss			
Res.	● °F	● °F	● °F
Bit Size	5 IN.		
Source to Detector Spacing	13 IN.		
Equipment Type	COMPROBE		
Opr. Rig Time	60 MIN.		
Truck No.	13		
Recorded By	G. STOBART		
Witness	G. GREEN		

FLUID LEVEL 374 ft
DENSITY SCALE AT 360 ft
CASING AT 54 ft

GAMMA RAY API UNITS	DEPTHS	BULK DENSITY ρ_b - gm/cc
Sens. 0.60 T.C. 2		SEN 2.90 T.C.1
Zero ___ div. to left		1.50 1.75 2.0 2.75
CALIPER hole diameter in inches		
4 5 6 7 8 9 10 11 12		

Speed in FPM

FORMATION DENSITY LOG

GREAT GUNS

PROVINCE
FIELD
WELL
COMPANY

COMPANY WELD WOOD OF CANADA LTD
CX-ANDERSON EAST (& 2ST)A*1
WELL DOVE CREEK #1
FIELD
PROVINCE BRITISH COLUMBIA
LOCATION (L3)
LSD ___ Sec. ___ Twp. ___ Rge. ___
Other Services:
Permanent Datum G.L. Elev. 430'
Log Measured From G.L., 0 Ft. Above Perm. Datum
ELEV.: KB 430
GL 430
CBF

Date	JUNE 14/75		
Run No.	ONE		
First Reading	596		
Last Reading	0		
Feet Measured	596		
Depth Reached	597		
Bottom Driller	597		
Csg.			
Mud Nature	SALT WATER		
Dens. / Visc.			
Mud pH			
Water Loss			
Res.	@ °F	@ °F	@ °F
Bit Size	4 3/4		
Source to Detector Spacing	13"		
Equipment Type	COMPROBE		
Opr. Rig Time			
Truck No.	13		
Recorded By	G STOBART		
Witness	G GREEN		

24' CASING IN HOLE
FLUID 4.5' DOWN

GAMMA RAY API UNITS	DEPTHS	BULK DENSITY ρ_b - gm/cc
Sens. 70 T.C. 2 / Zero ___ div. to left		SEN 290 T.C. 1
CALIPER hole diameter in inches: 4 5 6 7 8 9 10 11 12		1.50 1.75 2.0 2.75

Speed in FPM