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FINAL REPORT ON EXPLORATION
OF COAL RESOURCES IN EL 1/85
CROSSWELLS FLAT, MT LLOYD
SOUTH EAST TASMANIA

OPEN FILE

REPORT PREPARED FOR
AUSTRALIAN NEWSPRINT MILLS LIMITED
BY
McELROY BRYAN AND ASSOCIATES PTY LIMITED

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Appendix 2

*Geology and Coal Potential of
Part of Exploration Licence 1/85
(North West Bay Coy. Pty. Ltd.)
Mt. Lloyd Area, Southern Tasmania*

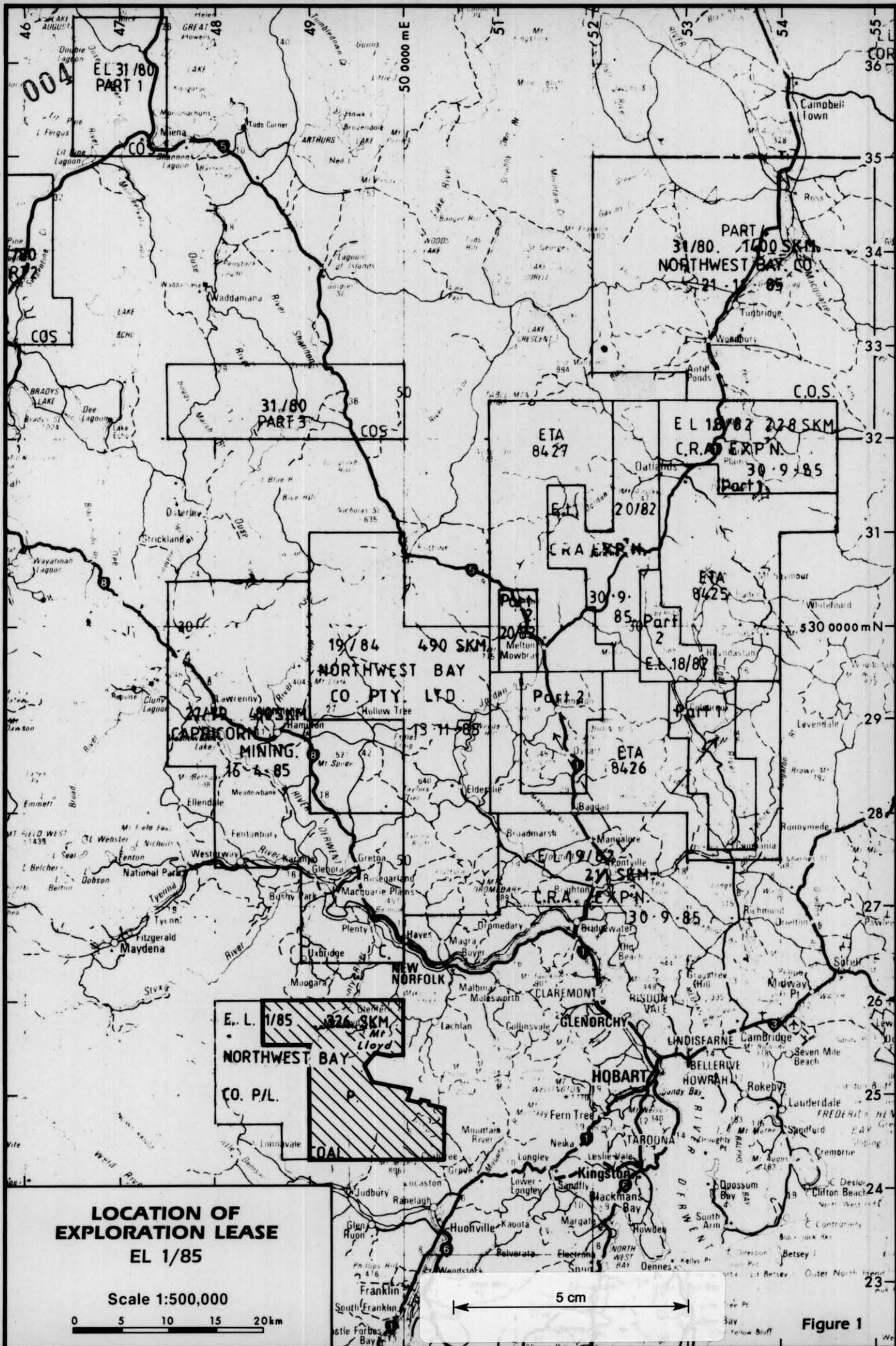
by T.G. Summons of Summons
Geoservices Pty. Ltd.

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SECTION 1. SUMMARY

The exploration lease, EL 1/85 is located in the vicinity of Mt Lloyd, 35km west of Hobart, (see Figure 1). Exploration in the vicinity of Crosswells Flat consisted of 3 drill holes to determine the stratigraphy of the area and the quality of the coal seams known to be in the area. The Upper Triassic coal measures occur over a small part of the 326 sq km exploration area (see Figure 2). The coal measures rim the Plenty River Valley and are overlain by Jurassic dolerite and Cainozoic dolerite scree. The known coal seams at Crosswells Flat are less than 1.4 m thick and although they crop out in the hillside they are covered by significant thicknesses of dolerite scree and poorly consolidated sediment nearby. Based on previous studies, the coal quality of the seams are similar to other high ash Triassic coals. There may be a section within one of the coal seams that is low (<12%) in raw ash. The low ash results reported for the coal at Mt Lloyd are most likely not representative of the coal seam as mined.

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**LOCATION OF
EXPLORATION LEASE
EL 1/85**

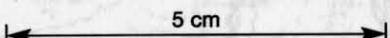
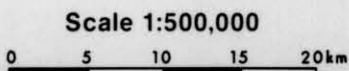
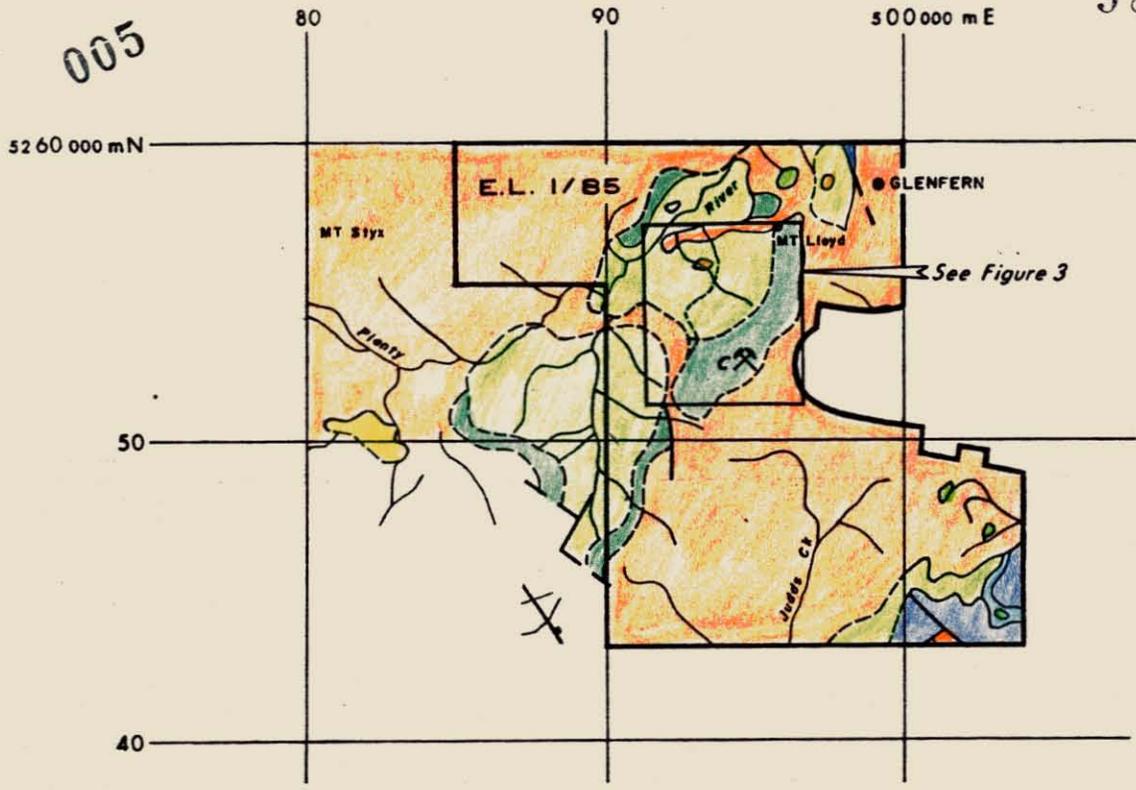


Figure 1

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- PLEISTOCENE : Till, fluvioglacial, periglacial and associated deposits.
 - TERTIARY : Basalt and related rock types
 - JURASSIC : Dolerite and related rock types.
 - TRASSIC : Fluvio-lacustrine sequences of sandstones, siltstone mudstone with carbonaceous sequences indicated. UPPER
 - TRASSIC : Fluvio-lacustrine sequences of sandstone siltstone mudstone. UPPER
 - PERMIAN : Fresh water sequence with some coal measures. LOWER
 - PERMIAN : Upper glacio-marine sequence of pebbly mudstone, pebbly sandstone and limestone. LOWER
- PARMEENAR SUPER - GROUP**
- Fault with relative downthrown side indicated
 - Geological boundary, established
 - Geological boundary, inferred

GEOLOGY OF EL 1/85

from Hobart 1:250,000 Series Sheet SK 55-8

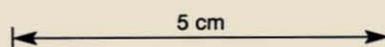
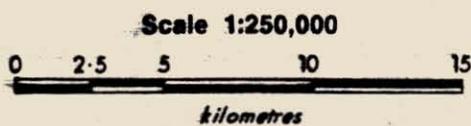


Figure 2

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SECTION 2. PREVIOUS EXPLORATION

The first documentation of the occurrence of coal in the Mt Lloyd - Crosswells Flat area was made in 1952 by T.D. Hughes. Two seams recorded were 0.68 m and 1.14 m thick and had an ash of 42.8% and 16.1% respectively. Hughes reported another three seams in 1955 and the analytical results are in Table 1. It should be noted that the sampled interval in East 2 seam and West 1 seam are not of the full seam and therefore not fully representative. The results of the first drill holes at Mt Lloyd were reported by K.L. Burns (1959). The results of the analytical tests on two coal seams are included in Table 1. The core recovery of the coal seams in the drill hole was very poor which makes the results of the tests unreliable.

The Department of Mines drill hole, (DOM 1), (see Figure 3) was located to intersect the coal seams that Lloyd Teakle was mining lower down the slope, as well as intersecting any seams higher up in the sequence. The results of the hole are shown in Figure 4, together with a generalized stratigraphic section drawn up from data taken from Burns (1959).

Since 1955, A.N.M. has had an interest in the area through testing of coal sent to their laboratories and several field excursions in the early 1970s by A.N.M. staff. Samples tested in the laboratories are grab samples taken from outcrops and adits. Unfortunately, the identity of the seam from which the samples are taken is not recorded. This makes it difficult to correlate the analytical results to known coal seams at Crosswells Flat.

Table 1. ANALYSES OF COAL FROM MT LLOYD*

Seam Name	Seam Thickness (m)	Sample Thickness (m)	Moisture %	VCM %	FC %	Ash %	Sulphur %	Specific energy (MJ/kg)	SG	Sample Type	Recovery %
East 1	0.89	0.89	4.6	15.9	50.5	29.0	0.28	22.0	1.54	outcrop	full seam
East 1	0.99	0.99(?)	3.1	15.0	58.2	23.7	0.39	25.0	-	outcrop	?
East 2	1.37	0.46	3.3	19.0	55.5	22.2	0.50	25.4	1.50	outcrop	lower $\frac{1}{3}$ of outcrop
West 1	1.07	0.86	3.1	18.3	50.8	27.8	0.32	23.4	1.53	outcrop	base not sampled
West 1	1.14	0.53	3.3	13.7	55.0	28.0	0.34	23.5	-	cored+	46
West 2	0.51	0.33	2.9	14.3	60.2	22.6	0.45	25.5	-	cored+	64
West 2	0.51	0.51	8.0	29.9	39.1	23.0	0.34	20.7	-	?	?

* Adapted from C.A. Bacon, 1983.

+ From DOM 1

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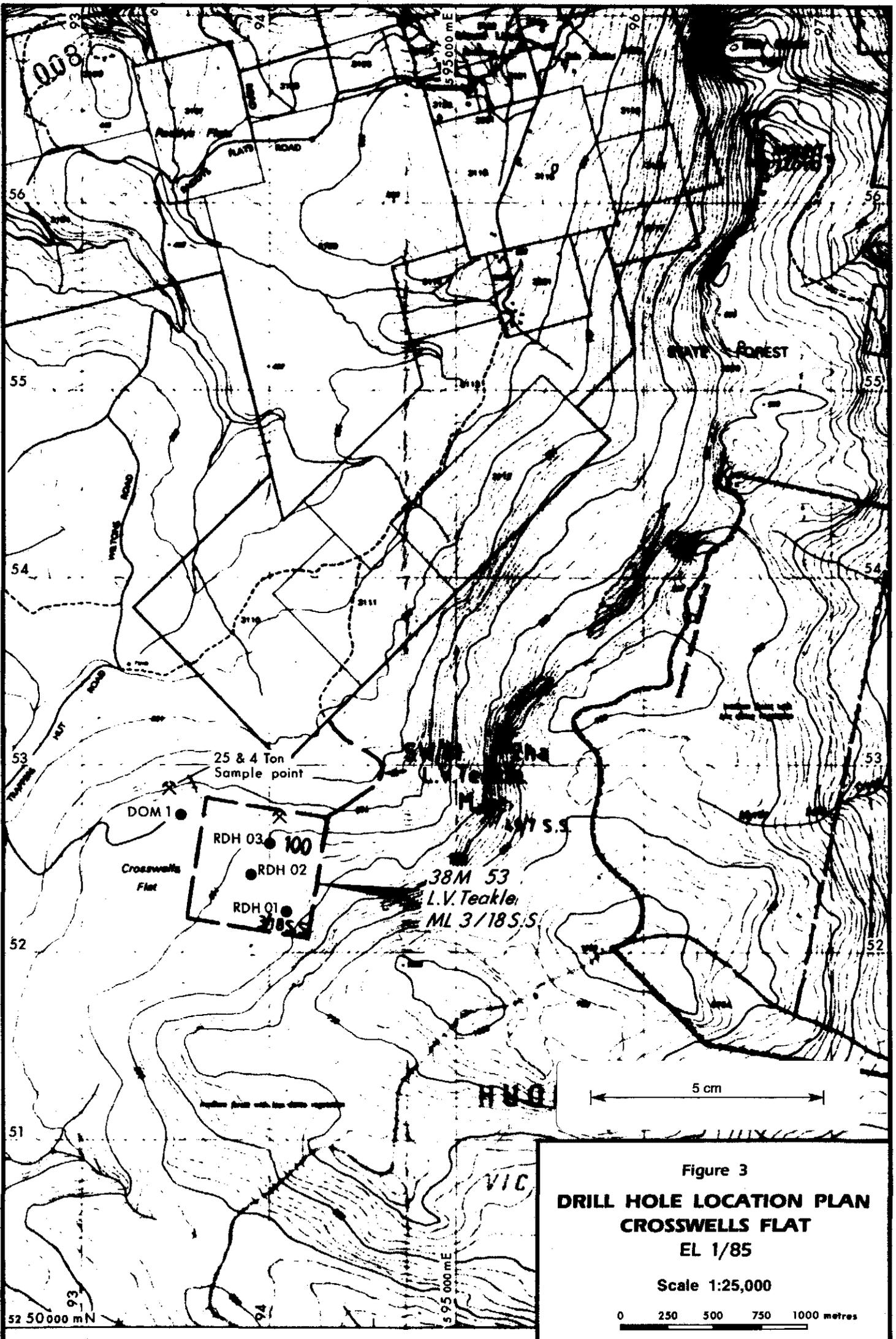


Figure 3
DRILL HOLE LOCATION PLAN
CROSSWELLS FLAT
 EL 1/85

Scale 1:25,000



Discussions with Lloyd Teakle (pers comm) indicate that the adit from which the 25 ton bulk samples was taken, was driven into the West 1 Seam (see Figure 4 and Table 2). Similarly, the 4 ton sample taken in 1957 is most likely taken from West 1 Seam.

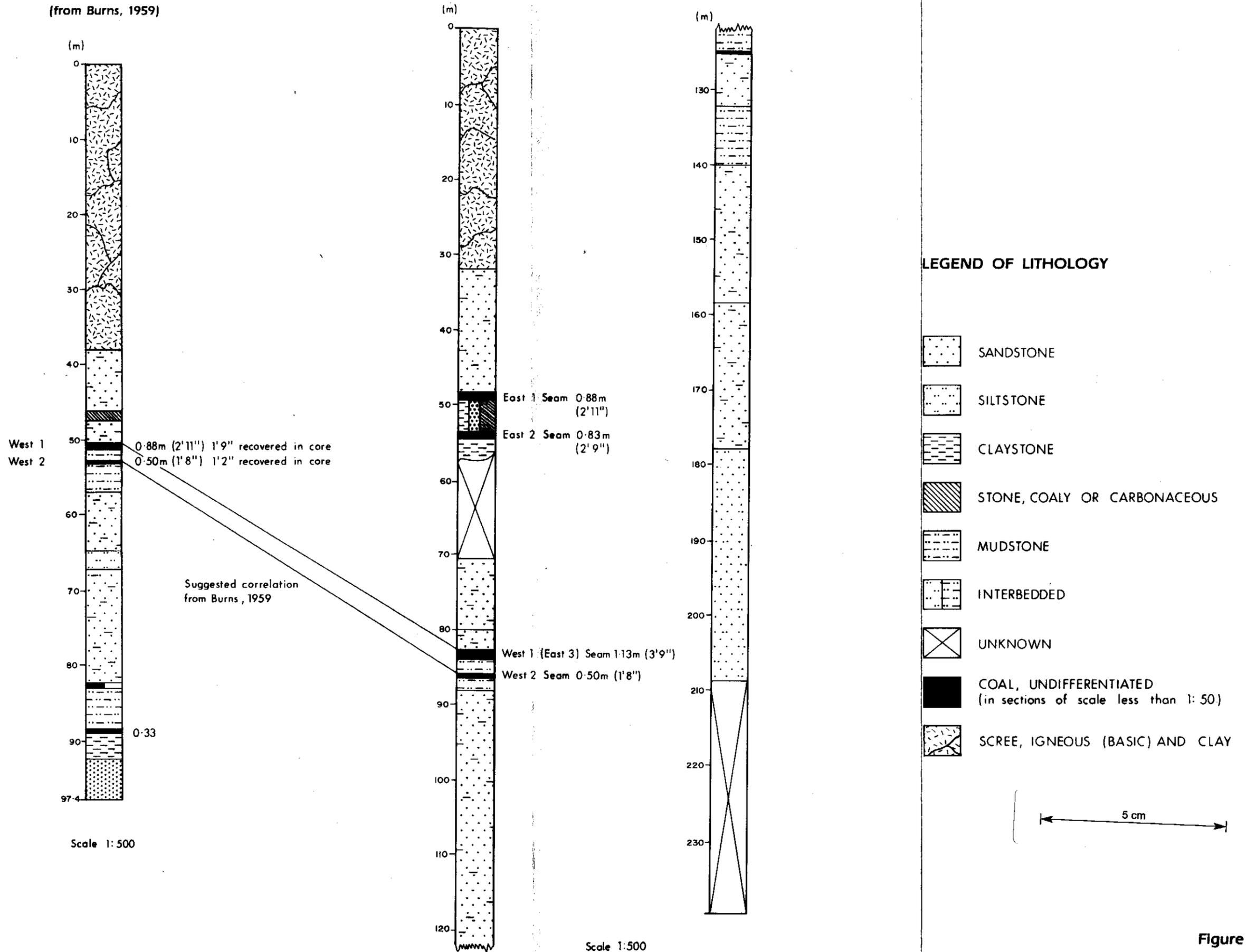
C.A. Bacon (1983), in the abstract of her report, refers to four thin coal seams, all less than one metre thick. The following extract from Bacon (1983) refers to the Mt Lloyd area. "The reserves are very small, the ground faulted and prospects for future exploration are limited."

SCHEMATIC STRATIGRAPHIC SECTION

Drawn from information from drillholes and known outcrops in Burns, 1959

MT LLOYD DOM 1

(from Burns, 1959)



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Figure 4

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TABLE 2*
 MF LLOYD - CROSSWELLS FLAT
 HISTORY AND BULK SAMPLE COAL ANALYSES

Sample Number	Date Collected	Sample Point	Amount	Ash	Sample Thickness	Tested By	Suspected Seam Name
CL225	21.10.1955	'Ex Mt Lloyd Colliery'	1 lb	30.0%	?	A.N.M.	?
CL361	12.8.1957	'Slack Coal Ex Mt Lloyd Colliery'	4 tons	27.8%	?	A.N.M.	West 1
CL392	26.2.1958	'Ex Mt Lloyd 2504 ft Seam'	?	24.1%		A.N.M.	East 1
CL396	6.3.1958	'Run of Mine Coal Ex Mt Lloyd Colliery'	25 tons	28.0%	?	A.N.M.	West 1
CL1525(1)	1.12.1970	Ex Mt Lloyd Colliery	?	11.1	4'	A.N.M.)	?
(2)	1.12.1970	Ex Mt Lloyd Colliery	?	7.4	4')	East 1 and 2
(3)	1.12.1970	Ex Mt Lloyd Colliery	?	12.4	4')	?
(4)	1.12.1970	100' below (1), (2) and (3)	?	28.3	?		Unnamed below West 2
?	Approx 5.6.1959	5'0" Seam 120ft addit	?	10.5	5'0"	Tas. Mines Dept.	?
CL1648	6.4.1972	Area 1 Coal Ex Mt Lloyd Coll.	?	6.7	2'	A.N.M.	?
CL1648	6.4.1972	Area 2 Coal Ex Mt Lloyd Coll.	?	8.0	3'	A.N.M.	?

* Data for this table has been collected from internal correspondence of A.N.M.

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SECTION 3. EXPLORATION IN EL 1/85 JANUARY 1985 TO JULY 1986

3.1 INTRODUCTION

Detailed geological mapping by Summons Geoservices as well as a small drilling programme supervised by McElroy Bryan & Associates constituted exploration work in EL 1/85. The study by Summons (see Appendix 2) highlighted Crosswells Flat as the real only possible source of coal. North Flat was mentioned but contained as a best case only 1.7×10^6 tonnes in situ (Summons, 1985 Appendix 2).

The objective of the drill holes at Crosswells Flat was to determine the stratigraphy of the area, define a potential open cut coal resource and to ascertain the quality of the various coal seams contained within the resource area. Three (3) drill holes were completed with a total meterage of 71.3 metres. There was extreme difficulty in penetrating the dolerite scree in two holes which necessitated drilling the third hole close to Lloyd Teakle's workings shown on Figure 3. The results of this third hole (Mt. Lloyd RDH 03) were poor and the hole had to be abandoned as the sample return was poor to non-existent. An estimate of the coal resources can therefore only be based on the work done since 1952 by Department of Mines Geologists and several field trips by A.N.M. staff.

3.2 RESULTS OF DRILLING AT CROSSWELLS FLAT

Even though the results of the drilling programme carried out in mid January 1985 were of little use, several salient points can be made about the coal resources of Crosswells Flat.

- (i) There are a number of seams known to exist at Crosswells Flat and most of them are less than 1.0m thick.
- (ii) It has been generally assumed that there are four main coal seams called East 1, East 2, West 1 and West 2 as shown in Figure 4.

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However, there is a possibility that there are only two seams and that West 1 and West 2 are the same as East 1 and East 2 - but at a different elevation due to faulting. The thicknesses and interburden of East 1 and East 2, and West 1 and West 2 are quite similar.

- (iii) In general, the quality of the coal seams at Crosswells Flat is consistent with other Tasmanian Triassic coals; i.e. moderate to high ash and low specific energy. The analytical results that are available are unreliable as the actual geographic location as well as the geological sample point is poorly documented. It is difficult to identify accurately from which part of the coal seams the samples were taken.
- (iv) Sampling techniques are not documented and some low ash analyses recorded are likely to be the result of grab sampling from outcropping coals. The samples may have come from better looking (lower ash) sections of the coal seam.
- (v) The coal seams at Crosswells Flat most probably represent the lower part of the coal bearing Triassic Strata. There are coal seams higher up in the valley of the Plenty River. However, Lloyd Teakle, who has been prospecting in the valley for over twenty five years has not mentioned a coal seam occurrence of substantial thickness; i.e. greater than 1.5 m. It is therefore considered unlikely that seams of mineable coal will be found in the vicinity of Mt Lloyd.

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3.3 COAL RESOURCE POTENTIAL AT CROSSWELLS FLAT

An estimate of the open-cut coal resource potential at Crosswells Flat has been made in spite of the lack of drillhole data and reliable coal quality results. If there are 4 coal seams in the area it is possible that the total amount of saleable coal at Crosswells Flat (as shown in Figure 5) could be as much as 3.3 million tonnes. This figure includes coal that exists in Teakle's mining lease. Saleable coal at Crosswells Flat, excluding the mining lease, could be as much as 2.04 million. However, if there are only two seams in the area then the maximum resources could be up to 1.65 million tonnes (including mining lease) or 1.02 million tonnes (excluding mining lease). The saleable coal resource estimates are documented in Table 3. The estimates are based on data that has been collected from field observations since 1952, one Department of Mines drillhole (DOM1) and assumptions that are detailed below.

- (i) The coal seams dip towards the south and would have an approximate subcrop pattern as shown in Figure 5.
- (ii) It is assumed that the thickness of the coal seams in Teakle's lease is constant throughout the Crosswells Flat area.
- (iii) Saleable coal reserves are calculated for coal seams greater than 0.5 m in thickness.
- (iv) The southern and eastern reserve boundaries are based on the limitations of mining open-cut in steep terrain. The boundaries are shown in Figure 5.

COAL RESOURCE POTENTIAL AT CROSSWELLS FLAT

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AREA I *		
ASSUMED SEAM NAME (refer to Fig. 4)	ASSUMED THICKNESS	POTENTIAL SALEABLE COAL x 10 (tonnes)
East 1	0.90	0.70
East 2	1.20	<u>0.94</u> 1.64
West 1	1.10	1.14
West 2	0.50	<u>0.52</u> 1.66
POSSIBILITY A	TOTAL FOUR SEAMS	3.30
POSSIBILITY B	AV. TOTAL TWO SEAMS	1.65

* Area I includes possible coal resources that are located within Lloyd Teakle's mining lease

AREA II **		
ASSUMED SEAM NAME (refer to Fig. 4)	ASSUMED THICKNESS (m)	POTENTIAL SALEABLE COAL x 10 (tonnes)
East 1	0.90	0.42
East 2	1.20	<u>0.56</u> 0.98
West 1	1.10	0.73
West 2	0.50	<u>0.33</u> 1.06
POSSIBILITY A	TOTAL FOUR SEAMS	2.04
POSSIBILITY B	AV. TOTAL TWO SEAMS	1.02

** Area II excludes Lloyd Teakle's mining lease

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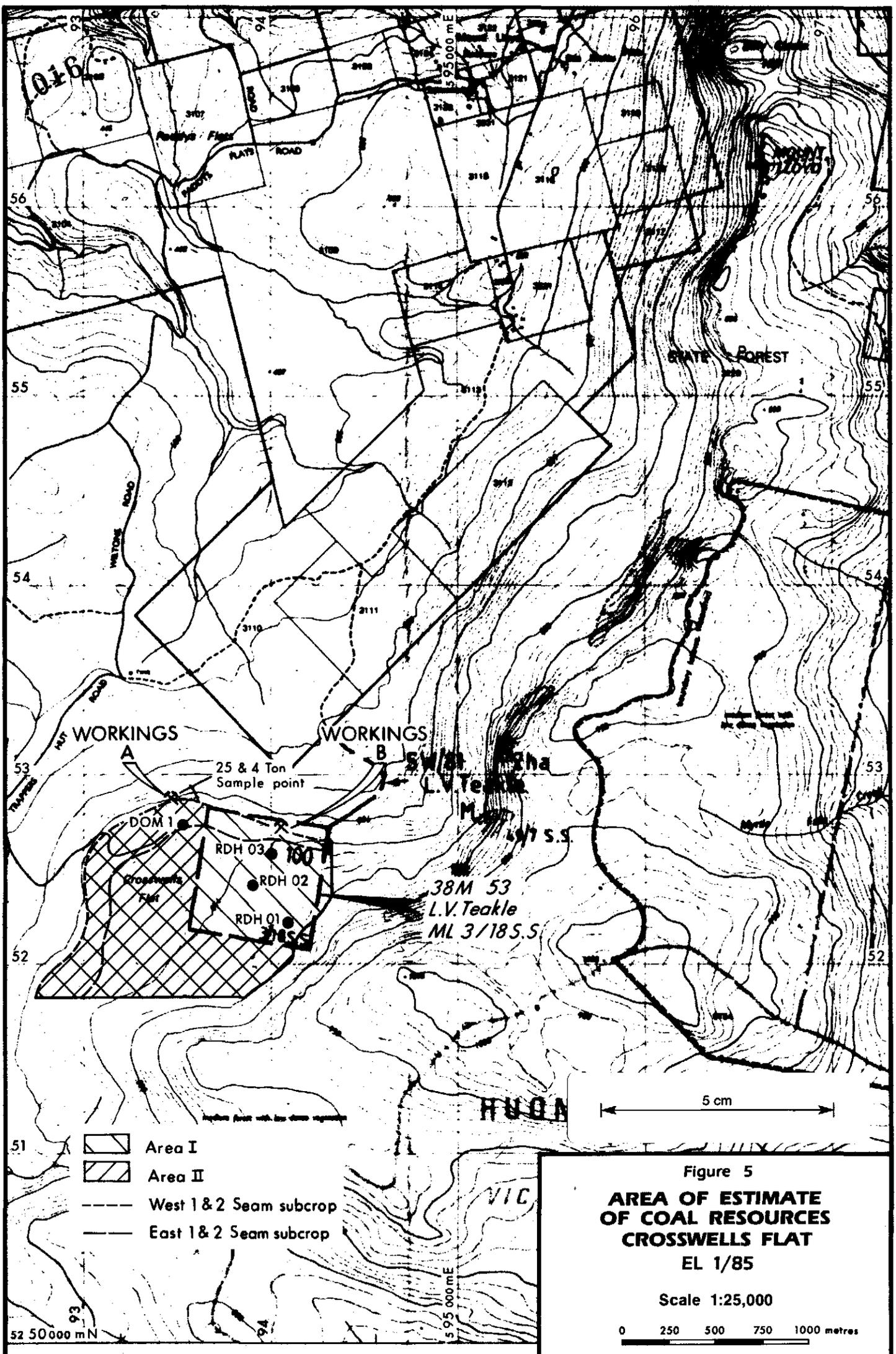


Figure 5
**AREA OF ESTIMATE
 OF COAL RESOURCES
 CROSSWELLS FLAT**
 EL 1/85

Scale 1:25,000



52 50 000 m N

5 95 000 m E

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- (v) A mining recovery of 85% of *in-situ* resources is assumed for each coal seam.
- (vi) A washery recovery yield of 70% of run-of-mine is assumed for each coal seam.
- (vii) A specific gravity (S.G.) of 1.5 is assumed for *in-situ* coal and is consistent with the test results from DOM 1.

In estimating the coal resources of the area there are several factors which could significantly reduce the amount of saleable coal.

- (i) The estimate does not take into account the erosional boundary between the base of the Cainozoic dolerite scree and the Triassic Coal Measures. This boundary is not known and could easily remove significant portions of the coal seams.

The delineation of the Cainozoic dolerite scree and Triassic Coal Measure boundary could be further complicated by debris flows and landslides of unknown dimensions. The existence of such flows is discussed in Summons (Appendix 2).

- (ii) The possibility of there being a fault between the two known working areas of Mr Lloyd Teakle, (Workings A and B, Figure 5) would create a corridor of no coal extraction, therefore reducing reserves.
- (iii) The overburden to coal seam strip ratio is not known and there would be severe limitations as to where the coal seams can be economically mined as the overburden probably increases sharply in a southerly direction.
- (iv) A very large proportion of the coal resources is covered by an A.N.M. pine plantation which by the nature of this known economic resource may sterilise underlying unknown coal resources.

SECTION 4. CONCLUSIONS AND RECOMMENDATIONS

Detailed field mapping in the Plenty River Valley has indicated only two localities as having any open cut coal resource potential. The two areas are Crosswells Flat and North Flat. North Flat has an estimated in situ maximum open cut coal resource of 1.7×10^6 tonnes (Summons, Appendix 2) and Crosswells Flat has a maximum best case of 3.30×10^6 tonnes saleable coal (open cut). However, given that there are several factors which could significantly reduce the amount of saleable coal as outlined in Section 3.3 it is recommended that further work in the EL 1/85 is not warranted and that the area be relinquished.

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SECTION 5 EXPENDITURE

The following is a summary of expenditure on exploration in EL 1/85 for the period January 1985 to July 1986.

(i)	Drilling	\$5,335.00
(ii)	Geological Consulting Services McElroy Bryan & Associates - Travel, Accommodation, drilling supervision, telephone	6,174.00
	Summons Geoservices Pty.Ltd.	7,900.00
(iii)	Lease rent fee, bank guarantee	1,110.00
	TOTAL	20,519.00

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SECTION 6. REFERENCES

- Bacon, C.A. 1983 The Mount Lloyd Coalfield
Unpubl. Rep. Dep. Mines Tasmania 1983/6
- Burns, K.L. 1959 Coal Exploration - Mt Lloyd
Tech. Rep. Dep. Mines Tasmania
3:92-102
- Hughes, T.D. 1952 Coal Near Mt Lloyd
Unpubl. Rep. Dep. Mines Tasmania
1952:17-19
- Hughes, T.D. 1955 Coal Near Mt Lloyd (2nd Report)
Unpubl. Rep. Dep. Mines Tasmania
1955:17-20

021

APPENDIX 1

DRILLHOLE LOGS AND GRAPHICS
A.N.M. MT LLOYD RDHS 01 - 03

022

A.N.M. MT LLOYD R.D.H. 01Location: Crosswells FlatMap: Lloyd 1:25 000AMG Co-ordinates: E 494 080 mDrilled by: Stacpoole Drilling

N 5252 200 m

Logged by: C.F.R. ParburyCollar R.L.: 785 m approx.Commenced: 22.1.85Total Depth: 12.3 mCompleted: 23.1.85

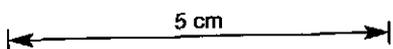
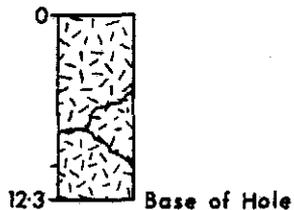
	<u>Estimated Thickness (m)</u>	<u>Estimated Depth to Base of Stratum (m)</u>	<u>Remarks</u>
DOLERITE SCREE, CLAY AND DOLERITE, ratio 70:30. Clay, red, iron- stained; dolerite cobbles and boulders	12.30	12.30	

HOLE ABANDONED

A.N.M. Mt Lloyd

023

RDH 01



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A.N.M. MT LLOYD R.D.H 02Location: Crosswells FlatMap: Lloyd 1:25 000AMG Co-ordinates: E 493 900Drilled by: Stacpoole Drilling

N 5252 420

Logged by: C.F.R. ParburyCollar R.L.: 760 m approx.Commenced: 24.1.85Total Depth: 32.0 mCompleted: 24.1.85

	<u>Estimated Thickness (m)</u>	<u>Estimated Depth to Base of Stratum (m)</u>	<u>Remarks</u>
DOLERITE SCREE, CLAY AND DOLERITE INTERMIXED	32.00	32.00	
			HOLE ABANDONED IN SCREE

025

A.N.M. MT LLOYD R.D.H. 03

Location: Crosswells Flat
AMG Co-ordinates: E 494 000
 N 5252 580
Collar R.L.: 750 m approx.
Total Depth: 27.00 m

Map: Lloyd 1:25 000
Drilled by: Stacpoole Drilling
Logged by: C.F.R. Parbury
Commenced: 24.1.85
Completed: 25.1.85

	<u>Estimated Thickness (m)</u>	<u>Estimated Depth to Base of Stratum (m)</u>	<u>Remarks</u>
DOLERITE SCREE, dolerite and clay intermixed	12.00	12.00	
SEDIMENT ?, no return	4.50	16.50	
MUDSTONE AND COAL INTERMIXED, ratio 60:40. Mudstone, dark grey, carbonaceous; coal, dull	1.50	18.00	
MUDSTONE, dark grey	1.00	19.00	
SANDSTONE, mid grey, fine to medium, lithic	1.00	20.00	
MUDSTONE AND COAL INTERMIXED, ratio 80:20. Mudstone, grey; coal, dull	1.00	21.00	
CLAYSTONE AND MUDSTONE	6.00	27.00	

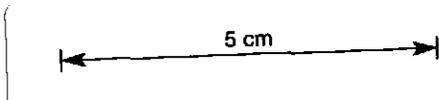
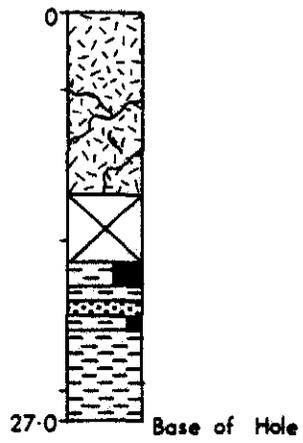
HOLE ABANDONED

026

A.N.M. Mt Lloyd

983027

RDH 03



027

APPENDIX 2

GEOLOGY AND COAL POTENTIAL
OF PART OF
EXPLORATION LICENCE 1/85
(NORTH WEST BAY COY. PTY. LTD.)
MT LLOYD AREA
SOUTHERN TASMANIA

BY

T.G. SUMMONS
SUMMONS GEOSERVICES PTY. LTD.
MAY, 1985

GEOLOGY AND COAL POTENTIAL
OF PART OF
EXPLORATION LICENCE 1/85
(NORTH WEST BAY COY. PTY. LTD.)

MT. LLOYD AREA
SOUTHERN TASMANIA

T. G. SUMMONS
Summons Geoservices Pty. Ltd.
May, 1985.

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1. INTRODUCTION

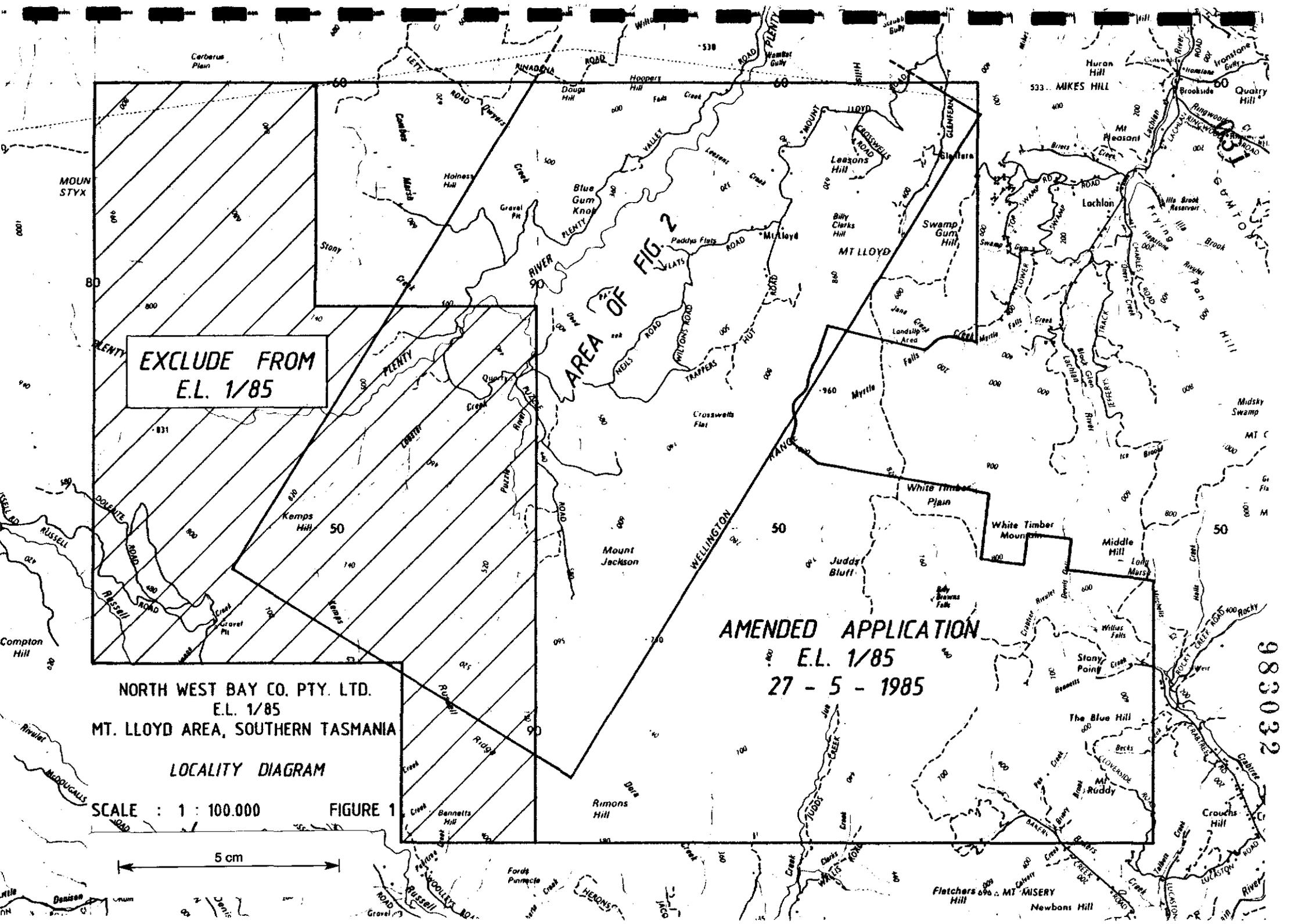
Exploration Licence (EL) 1/85 originally covered an area of 326 sqr km over a region extending from the Plenty River valley eastward to the Wellington Range south of New Norfolk. *

The area covered in this report is bounded by the north west end of the Wellington Range as defined by Mt. Lloyd, Mt. Jackson, Russell Ridge and Kemps Hill, and by a north east trending western margin located 1.5km east of the northeast flowing Plenty River, as shown on Figure 1.

The portion of EL 1/85 selected for detailed geological mapping was influenced by previous mapping by the Geological Survey of Tasmania, and by the known occurrences of black coal. This area mapped in detail totals 35 sqr km, and was done in April and May 1985, using aerial photographs, 1:10 000 scale topographic sheets and field traverses.

The physiography of the area varies from elevated plateaux (800-1000 m ASL) with alpine vegetation, to the NE-SW aligned parallel sided valley of the Plenty River, the orientation of which is structurally controlled. Within this valley the topography is mainly terraced (reflecting the flat lying bedrocks), with slope deposits of mainly dolerite talus, and scree flanking the high (dolerite) plateaux which enclose the valley.

* Following a meeting between the author and Mr. M. C. Forster in late May 1985, the area of EL 1/85 (then under application) was reduced to 209 sqr km as shown in figure 1.



**EXCLUDE FROM
E.L. 1/85**

AREA OF FIG. 2

**AMENDED APPLICATION
E.L. 1/85
27 - 5 - 1985**

**NORTH WEST BAY CO. PTY. LTD.
E.L. 1/85
MT. LLOYD AREA, SOUTHERN TASMANIA
LOCALITY DIAGRAM**

SCALE : 1 : 100.000 FIGURE 1

5 cm

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2. OBJECTIVES

Previous correspondence between the author and Mr. B. L. Stafford of ANM Ltd., resulted in three main objectives for the work, namely:

- 2.1. To map the extent of the various sedimentary rock units in the upper (freshwater) division of the Parmeener Super Group;
- 2.2. To record the position of faults in the area;
- 2.3. To map areas of scree/talus cover.

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3.

3. RESULTS

3.1. INTRODUCTION

The results of the mapping are shown in Figure 2, which is a combination of outcrop distribution, and the interpretation of the likely extent of the rock units.

Outcrop over much of the area is non-existent, particularly the southern and eastern portions above an elevation of 600m ASL, where a 1 to 1.5 km band of dolerite talus and scree parallels the edge of the dolerite plateaux, and obscures the underlying lithologies.

For this reason, objective 3 was modified so as to portray the outcrop areas, with the implication that the intervening areas are dolerite scree covered.

3.2. SEDIMENTARY UNITS

The late Palaeozoic and early Mesozoic sedimentary rocks in Tasmania are subdivided on a lithostratigraphical basis, and comprise the Parmeener Super Group. This group ranges in age from late Carboniferous to Triassic, with two divisions as follows:

3.2.1. Lower - glacial and glacio marine sediments, with minor coal measures;

3.2.2. Upper - freshwater sediments, with coal measures at two main horizons, one of Permian, and one of Triassic age.

The Permian age coal seams are exemplified by the Cygnet Coal Measures, and the younger coal seams by the "Midlands - Fingal" coal measures.

Within the area mapped, the present floor of the Plenty River valley is composed of sedimentary rocks of Permian age (Lower division of the Parmeener Super Group).

Above this floor, litho-correlates of both the Cygnet and "Midlands-Fingal" Coal Measures were located in the valley.

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Most attention was given to the upper division (freshwater) sediments, and at least six sequences have been recognized, as follows:

- Sequence 1 and 2: Lithic arenite, mudstone and coal measures;
- Sequence 3: Quartz arenite, mudstone and carbonaceous beds, (including coal);
- Sequence 4: Quartz rich lithic arenite, mudstone, with a basal quartz arenite;
- Sequence 5: Micaceous mudstone, and feldspathic quartz arenite;
- Sequence 6: Quartz arenite, variably feldspathic;
- Sequence 7: Cygnet Coal Measures correlate.

These sedimentary sequences are lithocorrelates of sedimentary units elsewhere in southern and eastern Tasmania, and although detailed biostratigraphical correlation may indicate subtle age variations across the state, Sequences 1 to 5 are regarded as Triassic in age, Sequence 6 as Triassic (and ?Permian at the base), and Sequence 7 as Permian age.

Detailed division of Sequences 1 and 2 may be possible with better exposures, but in the absence of such data, these sequences have been combined as one unit.

Sequence 2 is usually a mudstone dominated unit, and may be a facies variant of Sequence 1; elsewhere in the state Sequence 2 can be seen to show a diachronous relation with Sequence 3, which in turn can be seen to interdigitate with Sequence 4.

Sequence 1 and 2: this is very limited in exposure, outcropping mainly around Crosswells Flat; rock types include lithic arenite, siltstone, mudstone (grey and carbonaceous) and coal. The preserved (remnant) thickness of the combined sequence ranges from 90m to 150m, depending on the level of dolerite intrusion.

Sequence 3: this has an extremely limited exposure, but has been cut in drill core (Dept. of Mines No. 1 Bore), and has been reported below Teakles workings (in ML 38m/53).

It consists of quartz arenite (±feldspar), khaki siltstone, pale brown silty

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shale, and at least one coal seam.

The thickness of this sequence is approx. 30m.

Sequence 4: these rocks were recognized in several places, and consist of lithic to quartz rich lithic arenite, grey/khaki siltstone, grey/green mudstone, coaly debris and tuff fragments. West of Mt. Jackson a basal horizon of quartz sandstone was recognized in this sequence. Thickness of the sequence varies, but averages 80m.

Sequence 5: these rocks are distinctive, usually showing a green/brown/red/purple colouration; they consist of siltstone, silty shale and micaceous mudstone in excess of feldspathic quartz arenite, which is frequently micaceous and graphitic, and may have a muddy matrix. The sequence is generally iron rich, probably reflecting an original arid climate.

Thickness of the sequence averages 30m.

Sequence 6: this sequence is popularly referred to as the "Ross Sandstone", and in the area mapped consists mainly of quartz (+feldspar/clay) arenite, with very minor cream/pink/pale brown shales, often present as mud pellets in the sandstone. The arenites are frequently micaceous and graphite bearing, and resemble parts of Sequence 5.

Areally, Sequence 6 sandstones comprise the bulk of the region mapped, and form distinctive terraces and cliffs.

The sequence is apparently 200 to 230m thick, although no complete (and unfaulted) section was seen during the field work.

Sequence 7: the Cygnet Coal Measures correlates in the area of mapping consist of feldspathic micaceous quartz arenite (and rarely sublithic arenite), siltstone, silty shale and shale (grey/brown/black and fossiliferous).

The only carbonaceous material seen was near Lobster Creek in the SW corner of the area mapped, but consisted only of carbonised plant remains.

The thickness ranges from 50 to 60m.

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3.3. INTRUSIVE ROCKS

The only known intrusive rocks seen in the area were dolerite of Jurassic age; this rock comprises the high country of the Wellington Range, and its distribution, particularly the location of its margins, is of paramount importance in assessing the coal potential of an area.

In broad terms, two main forms have been recognized, the areally extensive sill-like bodies, and the volumetrically smaller dykes of dolerite.

However, the classification of most of the dolerite as being concordant intrusive bodies is in some cases a simplification; in the vicinity of Mt. Lloyd, the base of the dolerite ranges from Sequence 1 to Sequence 6, suggestive of either a discordant lower contact, or that step-like emplacement of the dolerite has occurred. In addition, the bases of the dolerite drops sharply between Mt. Lloyd and Leasons Hill to the north, with an elevation span of 510m to 660m ASL within Sequence 6.

Elsewhere, between Mt. Jackson and the eastern end of Kemps Hill, the base of the dolerite sheet ranges from Sequence 3 to Sequence 6, while to the NNW of Kemps Hill, an inferred sill may intrude Sequence 7 rocks.

The existence of more than one dolerite sheet (sill) in the Plenty River valley cannot be discounted; the base of the dolerite rim to this valley ranges in elevation from 650m to 850m ASL between Mt. Lloyd and the Puzzle River, and along the north flank of Kemps Hill.

However, the inferred sill NNW of Kemps Hill has a base at \pm 500m ASL, and in the vicinity of Russell Ridge the base of the dolerite is between 500 and 550m ASL, and rests on Sequence 6 rocks. This latter dolerite is probably a lower sill, since the only thermally metamorphosed sedimentary rocks of Triassic age located during the mapping were situated between the Russell Ridge and the Puzzle River, (and in the latter).

The dolerite sheet in Glenfern Creek is assumed to be concordant, and was not studied in detail.

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Dolerite dykes occur at several scales, the largest of which is the arcuate dyke extending NE from the head waters of the Plenty River, trending east across the lower Puzzle River toward Neils Road, where it turns south toward Mt. Jackson along a major fault (the "Jackson Fault").

This dyke is 200 to 400 m wide, and is presumed to be steep sided; south of the Neils Road - Trappers Hut Road junction it apparently thickens to 800m but this may be either a composite intrusion, or a result of fault displacement.

This dolerite body resembles part of a ring dyke, and it may have been the feeder for the high level sill(s).

South of "Coal Creek" (where L. V. Teakle first discovered coal in 1952), the Jackson Fault has been intruded by a 100m wide dyke of dolerite which transects the NE flank of Mt. Jackson, and which may continue south to where the Puzzle Road crosses the Puzzle River.

In the bed of "Jackson Creek" (east of Mt. Jackson), numerous granophyric and very fine grained dykes of dolerite cut massive medium grained dolerite. These small dykes are ≥ 100 mm wide, and are aligned en echelon with strikes of 300° to 320° .

3.4. STRUCTURAL ASPECTS

3.4.1. BEDDING

The dip of the various sedimentary rocks ranges from 2° to 10° generally orientated in the E to SSE sector.

Strike directions other than these N to ENE azimuths are not uncommon, and are considered to reflect either a proximity to faults, or to be measurements of cross beds in some areas of poor outcrop.

These flat dips are confirmed by the terraced morphology of the Plenty River valley where mapped.

3.4.2. FAULTING

A study of aerial photographs of the region revealed several trends of the linear structures; subsequent field mapping interpretation of rock unit

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distribution, and of the geomorphology in conjunction with these photo linears indicated the presence of faults within all of the groups of linears; these groups are aligned NW to NNW, N, NE, and ENE to E.

Although not statistically processed, it is considered that these groups approximate major sets of faults. The data in Figure 2 incorporates three categories of photolinears:

- 3.4.2.1. Those considered to be faults (good exposures etc.)
- 3.4.2.2. Those inferred as faults (poor exposure, data etc.)
- 3.4.2.3. Those depicted simply as linears (?non fault linears).

Most if not all of the observed linears may be explained as reflecting structural trends in basement rocks in southern Tasmania. Post-Devonian faulting may be inferred at several times:

- 3.4.2.4. Triassic - possible growth faults associated with basin development;
- 3.4.2.5. Jurassic - tensional faults, both predating and syntectonic with dolerite emplacement;
- 3.4.2.6. Tertiary - tensional faults indicative of the Gondwanaland break up.

Most of the faults seen (or inferred) in the area mapped have had dip slip movements, although some transcurrent offset along the "Jackson Fault" is indicated by the en echelon alignment of narrow dolerite dykes in "Jackson Creek."

This observation may be complemented to the north, where the 400m wide "ring dyke" of dolerite has a wedge like form, suggestive of sinistral offset post dating dolerite intrusion.

Vertical displacement across most of the faults is in the range 20 to 50m, although the Jackson Fault appears to have a throw of >150m (east block down) near the southern end of Crosswells Flat.

Comparitively smaller scale faulting was observed in Teakles open cut coal

workings on the northern edge of Crosswells Flat, where numerous close spaced faults dislocate the top seam (East seam). Out of a total of ten faults, seven showed dip slip offset across a strike range of 155° - 185° , with a dip range of 42° to 70° E; the other three faults displayed reverse offsets across a strike range of 120° to 160° , with a dip range of 53° to 80° to the SW and W.

These strike values, averaging 150° , give credence to the faults depicted with NNW strikes in the general vicinity.

3.4.3. LANDSLIDES

The steep terrain characteristic of the margins of most dolerite sheets is well represented in the area mapped, and such terrain usually has an apron of dolerite talus.

Although not depicted directly on Figure 2, the deposits of dolerite talus and scree may be inferred by the limited exposures of the sedimentary units. However, not all the scree deposits in the area are of dolerite, and the western margins of Crosswells and North flats consist of debris flows, which have transported sandstone, mudstone, coal and dolerite talus downslope.

Burns (1957) recognized the presence of large landslipped blocks to the west of North Flat, and considered the steep slope between this flat and Crosswells Flat to be particularly prone to soil mass failure, sliding on a mudstone base.

Drill investigations of Crosswells Flat have indicated the "dolerite scree" to be up to 35m thick; interestingly, the overburden in the Dept. of Mines bore No. 1 was described as "talus", while less than 200m to the SW there occurs a debris flow of lithic arenite, mudstone, coal and dolerite.

The collar positions of the five drill holes put down on Crosswells Flat are shown on Figure 2; all of these holes (except Dept. of Mines No 2), can be seen to lie in areas of circular failure of the combined soil and rock masses.

The extent, and depth of these debris flows is not known in any detail, although the base of such mass movements appears to lie at 660m ASL on the

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ANM road to Crosswells Flat, rising to 670m and eventually to 690m ASL around the NW end of this flat.

The western flank of the same flat appears to be less prone to landslides.

Resolution of the origin of these debris flows is clearly of importance in assessing the coal potential of both Crosswells and North Flats, and these topographic features also require an explanation of their origins.

The age of both the topographic flats and their cover of debris flow deposits may be as old as the Tertiary period for the following reasons:

3.4.1. The dolerite content of these deposits is $\approx 90\%$, of which $\approx 75\%$ is extremely weathered (EW), the remainder being fresh (F) in geotechnical weathering status. The EW dolerite has a distinct lateritic red colour, and this type of deep chemical weathering may have taken place during a time of known lateritic weathering in mid Tertiary time in Tasmania. The F dolerite is considered to represent younger scree, possibly shed during glacial phases in the later Quaternary period.

3.4.2. Initiation of these major soil mass failures may have required more than a wet climate interacting with a mudstone substrate; tensional faulting during the Tertiary period, along the NW, NE and ENE orientated faults bounding the north west corner of Crosswells Flat, is considered a likely mechanism to start such soil mass motion.

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4. COAL POTENTIAL

The results of the mapping indicate that only two localities have any coal potential, namely the tract of ground incorporating both Crosswells and North flats, and the region located to the east of the Jackson Fault.

4.1. CROSSWELLS FLAT

The coal seams discovered, prospected, tunnelled and excavated by Mr. L. V. Teakle, have been adequately described in the literature (Bacon, 1983, Burns 1957, 1959, Gulline 1959 and Hughes 1952, 1955).

The present program of mapping has not changed any of the published data, except to suggest that the section in Coal Creek (where two seams 0.3 and 0.9m thick, plus several 0.1m seams were located), is broadly similar to the East Seam - West Seam section in Teakles open cut workings. Accordingly, these two localities have been correlated, as shown in Figure 2.

On this basis, therefore, an inferred resource of coal has been estimated as follows:

4.1.1. Average seam widths of: East -1 0.9m
 East -2 0.8m
 West -1 1.0m
 West -2 0.5m

4.1.2. Relative density of all coal seams of 1.5;

4.1.3. Coal seam continuity (and hence area etc.) as defined below.

CASE A

Maximum tonnage of coal (i.e. no erosional loss of coal due to fault offset, or mass flow loss of coal as part of circular failure of the soil mass);

Maximum area of East 1 and 2 seams	=	$1.38 \times 10^6 \text{ m}^2$
" mass of " " " " "	=	$3.5 \times 10^6 \text{ tonnes}$
Maximum area of West 1 and 2 seams	=	$1.63 \times 10^6 \text{ m}^2$
" mas of " " " " "	=	$3.7 \times 10^6 \text{ tonnes.}$
i.e. <u>total in situ coal = $7.2 \times 10^6 \text{ tonnes}$</u>		

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These seams are the East 1, East 2 and West 1 seams respectively.

Assuming that both East and West seams are present beneath North Flat, then;

the maximum area of North Flat = $0.36 \times 10^6 \text{ m}^2$, and
 " " mass of coal = 1.7×10^6 tonnes.

However, if fault repetition has occurred, there may be 1.5m of coal in this area, and the (?minimum) mass of coal = 0.80×10^6 tonnes.

4.3. PUZZLE RIVER SOURCE (EAST OF JACKSON FAULT)

The head waters of the Puzzle River originate from a swamp/lake formed on the down thrown (east) side of the Jackson Fault.

The region has not been investigate in detail as it falls outside the designated area of mapping as described in section 1.

However, stratigraphic and structural considerations combine to indicate a moderate potential for Sequence 1 rocks to be preserved in this area.

The 0.56m coal seam recorded by Gulline (1959) was not relocated, although a coaly mudstone in the lower reaches of Coal Creek, (west of Jackson Fault) occurs in a likely area, (Gulline stated the coal seam to be 50 yards from this fault).

It is also of interest to note that the lowest (0.34m) coal seam found in the Dept. of Mines bore No. 1 is situated in Sequence 3 rocks, and that such rocks are present to the SE of Mt. Jackson.

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5. CONCLUSIONS

5.1. Six sedimentary rock sequences have been recognized in the area of mapping, and can be correlated on a lithological basis with sedimentary units of Triassic age elsewhere in Tasmania.

5.2. Coal is present in only two of these sequences - the combined Sequence 1 and 2, and in Sequence 3. The other sequences (including the Cygnet Coal Measures correlate) are unprospective.

5.3. The early mapping and definition of Triassic coal measures by the Department of Mines has been shown to incorporate Sequences 1, 2, 3, 4, 5 and possibly Sequence 7.

5.4. The extent of sedimentary rocks with maximum coal potential (i.e. Sequence 1 and 2) is considerably less than originally estimated by the previous mapping.

5.5. The dolerite free area of such prospective rocks totals approximately 2 sq. km. over North and Crosswells Flats, and an unknown area east of the Jackson Fault.

5.6. Several coal seams occur in the North Flat - Crosswells Flat vicinity, the principal of which are apparently present as two split seams, (the East 1 and 2, and the West 1 and 2).

5.7. The lateral extent of these seams beneath these topographic flats is not known in detail; major unresolved factors influencing this continuity centre on the removal of coal resulting from one or all of the following;

- 5.7.1. Faulting (including fault repetition)
- 5.7.2. Debris flowage (circular failure of soil/rock masses)
- 5.7.3. Aqueous erosion.

2.2?

5.8. The in situ inferred resources of coal range from 1.5 to 7.2 million tonnes beneath Crosswells Flat and from 0.8 to 1.7 million tonnes beneath North Flat.

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6. COMMENTS/RECOMMENDATIONS

6.1. As indicated in the introduction, the original area covered by EL 1/85 (then pending) of 326 sqr km was reduced to 200 sqr km to incorporate both the results of the mapping, and discussions between the author and M. C. Forster.

This action was taken because the excluded area of 117 sqr km was considered unprospective for coal, and particularly any coal present that would be amenable to open pit extraction.

6.2. Limited reconnaissance traverses in to the eastern portion of EL 1/85 (east of the area mapped) were made as follows:

6.2.1. Judbury: traverse along Jacobsons Rd., logging tracks, fire tracks and Dora Creek; in the latter, quartz arenite float at 491 850E, 5 244 930N was interpreted as Sequence 3 and is similar to that seen in Jackson Creek to the north.

6.2.2. Crab-tree: traverse along White Timber Trail, Judds Creek Rd. and Myrtle Falls Creek; Sequence 6 arenites were found on the track to Billy Browns Falls between 499 400E and 500 000E.

6.2.3. Lachlan/Glenfern: traverse along Swamp Gum Hill track and upper reaches of Jane Creek; Sequence 6 arenites were seen and inferred between 497 600E and 499 000E.

Although not comprehensively covered, the eastern portion of EL 1/85 appears to have a low coal potential, mainly because of the extensive thick dolerite sills, and because these sills have intruded into Sequence 6 sediments.

6.3. If it is assumed that the minimum inferred resource of coal beneath Crosswells and North Flats is 2.3×10^6 tonnes (say 1.5×10^6 tonnes after open cut extraction and 70% washery yield) then the perceived target of 2.0×10^6 tonnes of coal (mined and washed, .. B.L. Stafford, pers. comm.) may not exist.

However, this minimum inferred tonnage is based on the assumptions that the East seam is a fault repetition of the West seam (or vice versa), and that erosion by either water or rock has removed the bulk of the coal from the vicinity.

These factors require verification, as to both the actual authenticity, and as to extent.

Consequently, it is recommended that further investigation of Crosswells and North Flats be undertaken.

Depending on coal resource targets, exploration budget considerations etc. these detailed investigations could include the following:

- 6.3.1. Surveying - establishment of a 100 x 100m grid
- 6.3.2. Geophysics - seismic and electrical techniques
- 6.3.3. Costeaming - depth of scree/debris, exposure of coal seams
- 6.3.4. Drilling - both open and cored holes
- 6.3.5. Wireline logging of drill holes.

REFERENCES

- BACON, C.A. 1983: The Mt. Lloyd Coalfield; Unpub. Rep. Dept. Mines Tas. '83.
- BURNS, K.L. 1957: The distribution of coal at Mt. Lloyd; Tech. Rep. Tas. Dept. Mines 1:31-34.
- BURNS, K.L. 1959: Coal exploration at Mt. Lloyd, Tech. Rep. Dept. Mines Tas. 3:92-103.
- GULLINE, A.B. 1959: Mt. Lloyd and Upper Plenty Coal Prospects; Tech. Rep. Dept. Mines Tas. 3: 104-108.
- HUGHES, T.D. 1952: Coal near Mt. Lloyd. Unpub. Rep. Dept. Mines Tas, 1952, 17-19.
- HUGHES, T.D. 1955: Coal near Mt. Lloyd (second report); Unpub. Rep. Dept. Mines. Tas. 1955, 17-20.