

000

Q48/23.

ROBERTSON RESEARCH (AUSTRALIA) PTY. LIMITED

187001

REPORT NO. 523

PROJECT NO. 1140

PRELIMINARY PROPOSAL FOR THE  
EXPLOITATION OF COAL RESERVES  
IN THE FINGAL COALFIELD, TASMANIA  
PART I - GEOLOGY

**MICROFILMED**

by

I.J. Salway, B.Sc., C.Eng., M.A.I.M.M. - Associate  
R.G. Hancock, A.C.S.M., M.I.M.M., A.M.A.I.M.M.  
P. Jago, B.Sc., M.Aus.I.M.M.

Prepared for:

The Commissioner,  
The Hydro-Electric Commission,  
4-16 Elizabeth Street,  
HOBART, TASMANIA.

June, 1979

**OPEN FILE**

## CONTENTS

001

	<u>Page</u>
1. INTRODUCTION	1
1.1 GENERAL	1
1.2 SCOPE	1
1.3 PROCEDURE	2
2. GEOLOGY	3
2.1 GENERAL	3
2.2 STRATIGRAPHY	3
2.2.1 Mathinna Beds	5
2.2.2 Parmeener Super Group	5
2.2.3 Tertiary	7
2.2.4 Quaternary	7
2.3 IGNEOUS GEOLOGY	8
2.4 STRUCTURE	9
2.4.1 General	9
2.4.2 Faulting	9
2.5 COAL SEAMS - UPPER PARMEENER SUPER GROUP	10
2.5.1 East Fingal Seam	11
2.5.2 Duncan Seam	12
2.6 ECONOMIC APPRAISAL OF COAL SEAMS	13
2.6.1 East Fingal Seam	13
2.6.2 Duncan Seam	14
2.6.3 General Comments	14
2.7 ROOF AND FLOOR STRATA	15
2.7.1 East Fingal Seam	15
2.7.2 Duncan Seam	15
2.8 COAL RESOURCES	16
BIBLIOGRAPHY	

002

## TABLES

1. SUMMARY OF BORE AND ANALYTICAL DATA - DEPARTMENT OF MINES  
SUMMARY OF BORE DATA - HYDRO ELECTRIC COMMISSION
2. EAST FINGAL SEAM - SUMMARY OF ANALYTICAL DATA - FINGAL AREA
3. DUNCAN SEAM - SUMMARY OF ANALYTICAL DATA - FINGAL AREA
4. COKING PROPERTIES

## FIGURES

- 2.1 SKETCH GEOLOGY
- 2.2 CROSS-SECTION A-B
- 2.3 CROSS-SECTION C-D
- 2.4 CROSS-SECTION E-F
- 2.5 STRUCTURE CONTOURS - ROOF OF DUNCAN SEAM
- 2.6 TERTIARY FAULT SYSTEM (*in text*)
- 2.7 ISOPACH MAP - EAST FINGAL SEAM
- 2.8 SEAM PROFILES - EAST FINGAL SEAM - SECTION LINE A-B
- 2.9 SEAM PROFILES - EAST FINGAL SEAM - SECTION C-D (*in text*)
- 2.10 ISOPACH MAP - DUNCAN SEAM
- 2.11 SEAM PROFILES - DUNCAN SEAM - SECTION LINE A-B (*in text*)
- 2.12 SEAM PROFILES - DUNCAN SEAM - SECTION LINE E-F (*in text*)
- 2.13 ISOASH MAP - DUNCAN SEAM
- 2.14 ROOF AND FLOOR STRUCTURE - EAST FINGAL SEAM - SECTION LINE A-B
- 2.15 ROOF AND FLOOR STRUCTURE - EAST FINGAL SEAM - SECTION LINE C-D
- 2.16 ROOF AND FLOOR STRUCTURE - DUNCAN SEAM - SECTION LINE A-B
- 2.17 ROOF AND FLOOR STRUCTURE - DUNCAN SEAM - SECTION LINE C-D
- 2.18 COAL RESERVES - EAST FINGAL SEAM
- 2.19 COAL RESERVES - DUNCAN SEAM

003

## 1. INTRODUCTION

### 1.1 GENERAL

The Hydro-Electric Commission of Tasmania commissioned Robertson Research (Australia) Pty. Ltd. to carry out a study relating to the possible development of a coal mine(s) in Tasmania. The purpose of the coal mining operation is to supply a 2 x 200 M.W. thermal power station with fuel.

The full Robertson Research report on the study consists of two parts. This Part I is solely concerned with geological aspects. Part II of the report is concerned with the mining concept and associated estimates of capital and production costs.

### 1.2 SCOPE

The objective of the study has differed from that originally intended by the Hydro-Electric Commission and as set down in the Invitation to Tender Document C.E. 1788 Section 3.

As a result of discussions regarding the sparsity of the base data which was available for study, it was decided that it would be inappropriate to attempt to make detailed plans at this stage. Nevertheless, it was agreed that preliminary consideration should be given to the aspects mentioned in the Tender Document and a series of assumptions made, which would be as realistic as possible in the circumstances and on which capital and production cost estimates would be based.

The objective of this study, therefore, has been to provide information which could be employed as a basis for developing a mining concept for the subject area.

004

1.3

## PROCEDURE

A field visit was made to the area by Mr. P. Jago who also inspected the adjoining Duncan Mine of Cornwall Coal Co. As much relevant information as possible was collected and studied. A geological interpretation was made of this information and in situ reserves of coal were calculated and categorised. At this time only a small part of the Exempt Area has been explored and it has therefore been necessary, in order to provide the required basis for Part II of this study, to make a number of assumptions. These assumptions are noted in the report.

Before a confident estimate of the coal reserves of the area can be arrived at, it will be necessary to carry out an exploration programme of drilling and analysis. The results of this programme could prove the assumptions made in this study to be incorrect and not until those results are available can serious consideration be given to developing a coal mine of the size required by the Hydro-Electric Commission in that environment.

005

SECTION 2. GEOLOGY

2.1 GENERAL

The Fingal State Coal Reserve Area is located on the southern side of the Break O'Day Valley (approximately 10km. south-east of Fingal) in the main coal mining district of St.Marys - Fingal - Avoca. It covers an area of 96km<sup>2</sup> and adjoins E.L. 5/61 (Industrial and Mining Investigations/Shell Co. joint venture) in the east, E.L. 16/77 (Investigator Coal Exploration Pty.Ltd.) in the west, and the Duncan Mine (Cornwall Coal Mining Co.Pty.Ltd.) in the north west. The Duncan Mine is the only operating coal mine in Tasmania and currently produces approximately 230,000 tonnes per annum.

The Tasmanian Department of Mines is presently carrying out a diamond drilling programme on a 0.8km x 0.8km grid pattern which covers parts of the Duncan Mine Lease and Coal Reserve Area. To date a total of 35 holes (including 9 Hydro-Electric Commission (H.E.C. holes) have been drilled, 8 of these being located in the north west corner of the Reserve area. The results of this drilling programme together with previous geological investigations undertaken by the Mines Department provide the basis for the present geological assessment.

It is understood from discussions with Mr. N. Kempton, of the Shell Company, that the exploration undertaken on E.L.5/61 has delineated an area of seam continuity over approximately 25km<sup>2</sup> in the Dalmayne region. The exploration results were not readily available, however, from general discussion it was felt that the results could not be extrapolated to the Coal Reserve Area because of the presence of massive intrusions and large scale faults (Cornwall Fault) between the two areas.

The 4 hole drilling programme undertaken by Investigator Coal Exploration Pty.Ltd. to the south west of the Reserve area, on E.L. 16/77, failed to delineate any promising coal areas, and it is impossible to draw any conclusions from these results that could be extrapolated to the Reserve Area.

2.2 STRATIGRAPHY

The stratigraphy of the Fingal Area has been summarised by Threader (1968) and is currently being updated by a Mines

006

Department Mapping programme. A plan of the preliminary results of the mapping is included as Figure 2.1.

The basement rocks in the area consist of the Early Palaeozoic Mathinna Beds and the Devonian Ben Lomond Granite. The Permian-Triassic Parmeener Super Group, deposited unconformably on the basement rocks, is divided into the Permian Lower Parmeener Super Group and Triassic Upper Parmeener Super Group. The boundary between the two is marked by a slight disconformity. Coal occurrences have been recorded in two horizons, namely the Mersey Coal Measures of Permian age, and the upper part of the Late Triassic sequence. The latter interval contains the main coal bearing strata in the region. The Cygnet Coal Measures, (Late Permian - Parmeener Super Group) also contain thin coal seams, however, its distribution is restricted to the western and southern parts of Tasmania.

Jurassic dolerite has intruded the Parmeener Super Group. It crops out extensively in the area and forms the Fingal Tier plateau.

A generalised stratigraphic section for the region is given below.

Quaternary	Alluvium and dolerite scree		
Tertiary	Basalt		
Jurassic	Dolerite		
Triassic	Parmeener Super Group	Upper Parmeener Super Group	
		- disconformity	
		Lower Parmeener Super Group	Ferntree Group Cascades Group Mersey Coal Measures
		Unconformity	
Devonian	Ben Lomond Granite		
Early Devonian - Late Ordovician	Mathinna Beds		

007

2.2.1

Mathinna Beds

The Mathinna Beds consist of slate, phyllite and siltstone, overlain by an interbedded sequence of sandstone and mudstone. The strata crop out in the South Esk and St. Paul's valleys on the east coast but are not exposed in the Break O'Day Valley except near the South Esk-Break O'Day confluence and east of the Cornwall Fault. (Threader 1968).

2.2.2

Parmeener Super Group

The Parmeener Super Group is divided into lower and upper sections of Permian and Triassic age respectively. The two sections are disconformable.

2.2.2.1 Lower Parmeener Super Group

The Lower Parmeener Super Group rests unconformably on the Mathinna Beds. In general the basal part of the Permian section consists of 6-10m. of conglomerate which appears to have been derived from the Mathinna Beds and Ben Lomond Granite.

The basal conglomerate is overlain by the Mersey Coal Measures which crops out in the Southern Esk and Break O'Day Valleys. Thickness of the measures varies from about 18m. at St. Pauls' Dome (near Avoca) to a maximum of 40m. in the Harefield bore hole near St. Mary's. The coal measures lense out towards the south in E.L. 16/77. The sediments consist of fine to medium grained quartz lithic sandstone, grey mudstone, carbonaceous mudstone, and very minor shaley coal.

The marine Cascades Group overlies the Mersey Coal Measures and consists of a sequence of mudstone and siltstone overlain by limestone. The strata are exposed in the Break O'Day Valley and between Fingal and St. Pauls Dome. The lower mudstone/siltstone unit is up to 40m. thick and the limestone unit ranges in thickness from 5 to 50m.

The Ferntree Group with the basal Risdon Sandstone unit conformably overlies the Cascades Group. The Ferntree Group, where penetrated in drilling varies from 20 to 60m. in thickness. Its thickness in the Duncan Mine Lease is 55m. (DDH4). The sediments comprise interbedded siltstone and mudstone with

008

occasional quartz grains and pebbles in the upper section. The basal Risdon Sandstone unit varies up to 20m. in thickness.

2.2.2.2 Upper Parmeener Super Group

The Upper Parmeener Super Group contains the main coal bearing interval in the St. Mary's - Fingal - Avoca region. Early workers had proposed various subdivisions of the Triassic sediments, however, recent investigations have deemed any breakdown of the Triassic strata as unnecessary.

The thickest section of Triassic strata encountered in drilling in the Fingal area is 321m. (DDH6). (Threader 1968) summarised the section as follows :

	<u>Thickness</u> (m)
Quartz Lithic Mica sandstone including coal seams	201
Mudstone, carbonaceous mudstone, coal seams and subordinate sandstone	36
Sandstone, mudstone and laminated mudstone.	61
Quartzose sandstone	23
	<hr style="width: 50px; margin-left: auto; margin-right: 0;"/> 321 <hr style="width: 50px; margin-left: auto; margin-right: 0;"/>

Coal seams are best developed in the upper 200m. of the Triassic sequence where as many as 10 seams have been intersected in drilling. Details of the main coal seams are discussed in more detail in Section 2.5.

The Upper Parmeener Super Group has been extensively intruded by dolerite sills. The sills tend to be discordant to the strata and disrupt the continuity of the upper seams as indicated in Cross Sections C-D and E-F (Figures 23 and 24). In DDH29, located 2km. west of the Reserve Area, only the basal 79m. of Triassic strata are present, the upper coal bearing having been intruded by dolerite.

Outcrop of the coal measures in the valley floors and valley slopes is generally poor due to alluvium and dolerite scree. Exposures of the coal measures and coal seams can occasionally be observed in creek beds.

009

2.2.3

Tertiary

Tertiary sediments and basalts occur in the St. Paul's and South Esk Valleys near Avoca as valley fillings.

2.2.4

Quaternary

The Quaternary sediments consist predominantly of silt and sand in the valley floors and their tributaries.

Dolerite scree is widespread along the dolerite cliff line and a maximum thickness of 116m. was recorded in H.E.C. C.1.

2.3

IGNEOUS GEOLOGY

010

The surface distribution of igneous rocks, as defined from Mines Department mapping and photo geological interpretation, is shown on Figure 2.1.

In the Duncan Mine/Coal Reserve Area, doleritic intrusions of Jurassic age occur predominantly as sills and to a lesser extent as dykes. The sills which have intruded the Upper Parmeener Super Group, cover approximately 75% of the Reserve area and form the plateau region known as the Fingal Tier. The thickness of the dolerite encountered in drilling varies from 200m. to 385m.

In the western part of the Reserve Area the basal contact of the dolerite is discordant to the strata and as a consequence coal seams in the upper coal bearing interval have been intrusively deleted in places. (Refer Cross Sections CD and EF included as Figures 2.3 and 2.4.) To the west of the Reserve Area the entire coal bearing interval of the Triassic sequence has been intruded such that only the barren basal, 79m. of Triassic sediments, were intersected in DDH29.

A major dolerite dyke was encountered in the Duncan Seam near the Mine portal. The trend of the dyke is in a north easterly direction. The remainder of the mine workings, however, are free of igneous intrusions.

A Gravity Survey of the Eastern Highlands, Central Eastern Tasmania was undertaken by the Department of Mines in 1978. An interpretation of this data suggests that major intrusions are likely to occur in the north east and south east parts of the Reserve Area as indicated on Figure 2.5.

Whilst the dolerite intrusives cover much of the Reserve Area it is impossible to predict the degree to which they have affected the main coal bearing horizon. Information on this aspect could only be acquired through a detailed exploration programme.

011

2.4 STRUCTURE

2.4.1 GENERAL

The Triassic Strata in the drilled area generally dip in an easterly direction at angles varying between  $1^{\circ}$  to  $2^{\circ}$ . Seam levels in the "Kitten" workings, located adjacent to the Fingal tunnel (Duncan Mine), indicate that localised steepening of the dip (up to  $20^{\circ}$ ) may occur in parts of the area. Structure contours plotted to the roof of the Duncan Seam are presented as Figure 2.5.

2.4.2 FAULTING

The main fault in the region is the Cornwall Fault which trends in a northerly direction north of St. Marys swinging away to the south west. It has a displacement of approximately 150m., upthrown on the east and passes to the east of the Reserve Area where it is associated with a major intrusion.

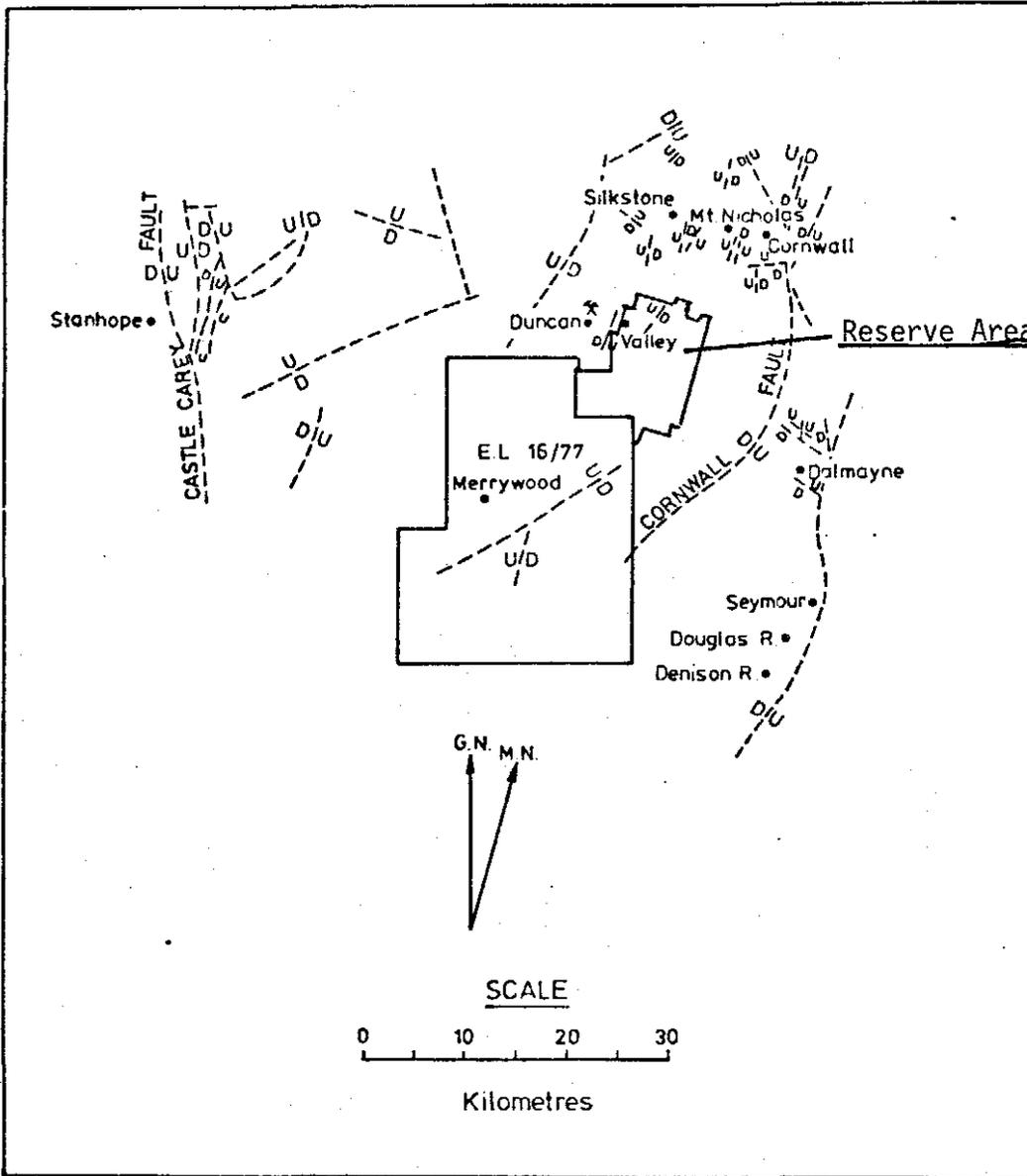
Faulting is also present in the Duncan Mine with displacements generally less than 2m. It is understood that Shell have undertaken a detailed mapping programme of the mine workings, however, the results were not available at the time of writing.

Seam correlation between boreholes 20, 24 and 16a has suggested the likely presence of a 30m. fault. (Refer Figure 2.4). This fault appears to be associated with the intrusion of the dolerite into the upper part of the coal measures.

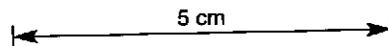
Both minor and major faulting are likely to be present in the Reserve Area. The small scale faults, with displacements generally less than 5m., are unlikely to be detected in a normal drilling programme. Larger faults, which may be present, are likely to be associated with the intrusion of the Jurassic dolerite into the upper part of the coal measures and Early Tertiary block movements. Figure 2.6 after Threader (1968) shows the Tertiary fault systems on the northeastern margin of the Tasman Basin.

012

# TERTIARY FAULT SYSTEM



( Modified After Threder 1968 )



## LEGEND

- γ Operating Coal Mine
- Closed Coal Mine

FIGURE 2.6

013

2.5

COAL SEAMS - UPPER PARMEENER SUPER GROUP

The Upper Parmeener Super Group consists of a lower part generally devoid of coal seams, and an upper coal bearing sequence. The thickest recorded section of the Upper Parmeener Super Group in the Fingal region was encountered in DDH4 where its thickness was 321m. The lower 121 metres consisted of interbedded sandstone, mudstone and siltstone with minor thin coal seams occurring towards the top.

The upper coal bearing sequence is about 200m. thick with the two main seams, the East Fingal Seam and the Duncan Seam, occurring near the base of the interval.

Drilling in the area has defined up to 10 coal seams (DDH25) with a seam thickness in excess of 0.5m. A summary of the coal intersections is included as Tables 1. With the exception of the Duncan and East Fingal Seams, correlation of the upper coal seams is difficult because of their lenticular nature or due to the presence of dolerite intrusions which obliterate seam continuity. Bore hole correlation along selected grid lines are presented as Figures 2.2, 2.3 and 2.4.

DDH's 16A, 20 and 31 located in the north west corner of the Reserve area intersected 3 coal seams in the upper part of the Triassic sequence. The 3 seams occur in a 50m. stratigraphic section about 80m. above the Duncan Seam. Average seam thicknesses for the 3 holes are (in ascending order): 5.4., 1.9., and 4.4m. Interseam thickness is generally in the order of 25m.

The two thicker seams consist of interbedded mudstone and coal. The proportion of coal plies in the seams decreases towards the south and increases towards the east. The 1.9m. thick seam consists predominantly of coal although the ratio of coal to stone decreases in an easterly direction. Variation in the percentage of coal plies present in the three seams is as follows:

014

D.D.H.	Average Seam Thickness		
	5.4m.	1.9m.	4.4m.
	Percent Coal Plies		
16A	26	100	17
24	60	75	27
31	81	66	76

The quality of the 5.4m. and 4.4m. thick seams appears to improve towards the east and together with the 1.9m. thick seam will be attractive target horizons in the Reserve Area. However, because of the close proximity of the dolerite sill, the 3 seams may be intruded over parts of the area as is already evident near the western margin of the Reserve Area (Refer DDH's 17 & 24).

2.5.1 EAST FINGAL SEAM

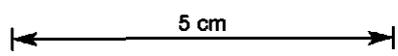
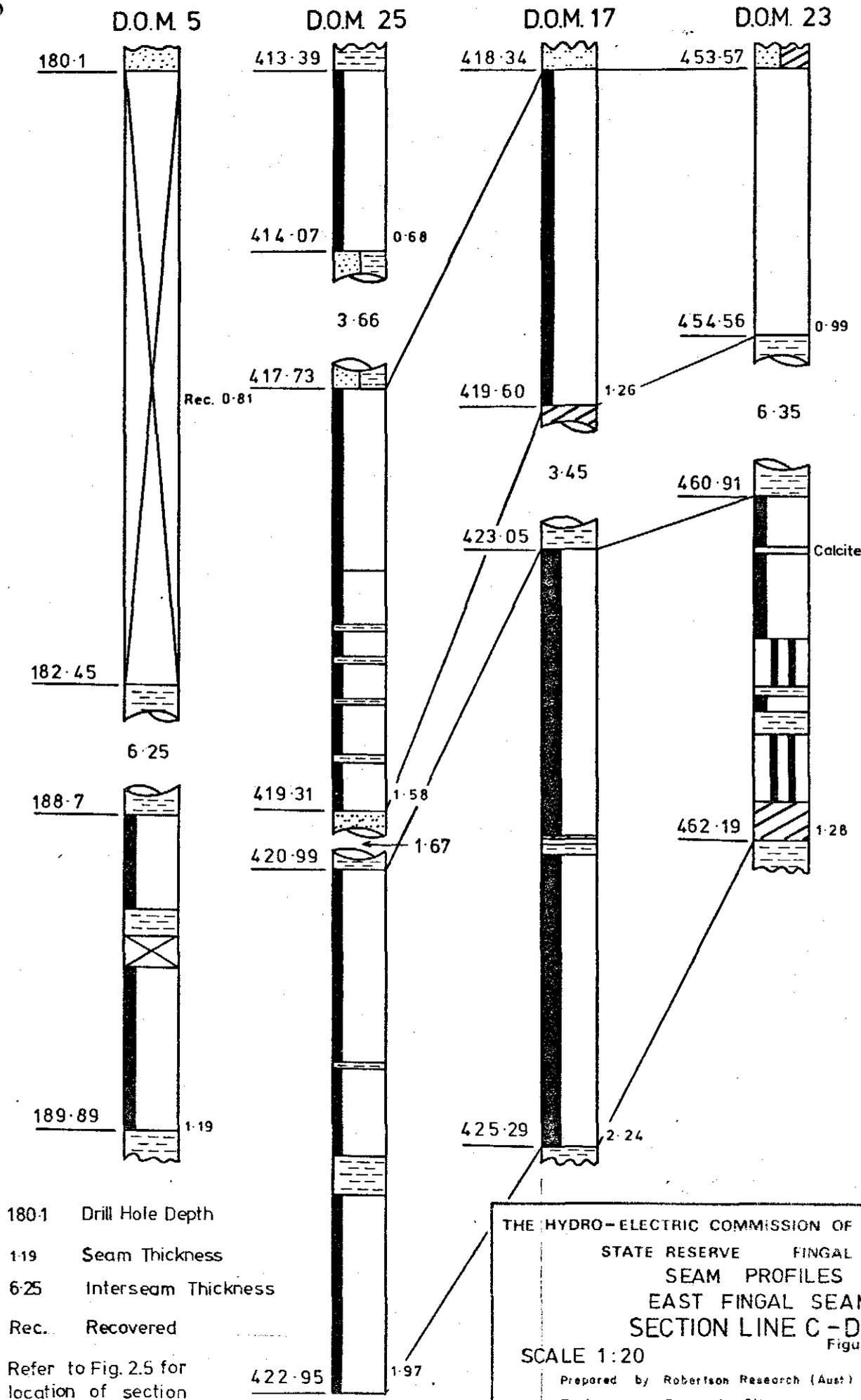
The East Fingal Seam occurs near the base of the coal bearing sequence. It varies in thickness from 1.28m. to 3.62m. and averages 2.25m. The seam is thickest along the eastern margin of the drilled area where intersections of 3.48m. and 3.62m. were recorded in H.E.C. C2 and DDH 31. In both holes the seam is split by a stone band with a thickness of 0.31m (H.E.C. C2) and 0.33m. (DDH 31). Further to the south east the thickness of the seam decreases.

Isopachs of the East Fingal Seam are shown on Figure 2.7.

Seam profiles have been prepared along Cross Section lines AB and CD and are shown as Figures 2.8 and 2.9.. The seam consists predominantly of dull coal with a prominent stone band occurring near the middle of the seam. It is possible that the seam is split in the drilled area with the upper split varying in thickness from 0.70m. to 1.47m (Refer Figure 2.8). The thickness of the strata between the splits varies from 0.33m. to 6.57m. and generally thins in a north easterly direction thus possibly accounting for the thicker seam intersections in DDH31 and H.E.C. C2.

Figure 2.7 shows the subcrop of the East Fingal Seam which has been delineated from the drilling results and extrapolated eastwards on the basis of an easterly dip of 1<sup>0</sup>-2<sup>0</sup>. The seam subcrop, as plotted, occurs north of the Reserve Area. Thus

015



016

to gain entry into the East Fingal Seam by means of an adit along the slopes of the Break O'Day Valley, it would be necessary to acquire an additional area to the north of the Reserve.

Towards the north east the East Fingal Seam may subcrop along the floor of the Break O'Day Valley. The Harefield Borehole, located approximately 4km. south of St.Marys (Refer Figure 2.18) encountered a 1.7m. thick seam at a depth of 10m. The reduced level of this seam is approximately 260m. and may well correlate with the East Fingal Seam based on the easterly extrapolation of that seam from the Duncan Mine (discussed above).

Whether the correlation proves correct or not, the area around Harefield is worthy of further investigations to determine the areal extent of the 1.7m. thick seam and its potential for strip mining.

Within the Reserve Area the interseam thickness between the East Fingal and Duncan Seams varies from 41.6m. to 52.6m. The interseam strata consists predominantly of sandstone with interbedded mudstone and minor siltstone and coal bands. The proportion of sandstone in the interseam strata and the overall thickness of the interseam sediments appear to increase towards the east.

#### 2.5.2

##### DUNCAN SEAM

The Duncan Seam has been intersected in 21 drill holes in the drilled area and is the seam currently worked at the Duncan Mine. Its thickness varies from 1.32m. to 2.74m. and averages 2.13m. Seam isopachs are shown on Figure 2.10.

The seam thickness is greatest in the vicinity of the Valley Mine where it contains a thick stone band (up to 0.9m. in H.E.C. C3). The seam thickness thins to a minimum of 1.32m. in DDH 17 and increases to 2.60m. further south.

The Duncan Seam was not encountered in drill holes H.E.C. C2 and DDH 31 located along the eastern margin of the drilled area. In both instances the lower East Fingal Seam and upper coal horizons were present and are considered to be continuous in the general region (Refer Cross Section A-B, Figure 2.2). Additionally massive sandstone was intersected at the Duncan Seam horizon

017

and consequently it is felt that the seam may have been washed out. Additional drilling to the east will determine whether the seam has been scoured by a channel or whether in fact the seam has been lensed out altogether.

Seam profiles have been plotted along section lines A-B and E-F and are included as Figures 2.11 and 2.12. The seam consists predominantly of dull coal with stone bands occurring in the centre and near the roof. A prominent stone band near the roof of the seam is termed the "Miners Roof" at the Duncan Mine. Its thickness varies from zero to approximately 0.25m. The seam subcrop has been inferred from the drilling data and is shown in Figure 2.10.

## 2.6 ECONOMIC APPRAISAL OF COAL SEAMS

A summary of the analytical data for all seams sampled is given in Table 1.

It is difficult to ascertain the sampling procedure in the exploration programme as many seams with appreciable thicknesses of coal have apparently not been analysed. Additionally many seams that were sampled for analyses did not include the stone bands. As a result, it is impossible to calculate weighted composites for the seam and consequently the analytical data for the seams can almost be treated as useless.

Washability data was sited for the Duncan and East Fingal Seams in DDH30 only. Unfortunately the seam composite subjected to the test and subsequent analysis of the float fraction at an S.G. of 1.60, did not include the stone bands. Thus it is impossible to make any valid comments on the yields or quality of the washed product.

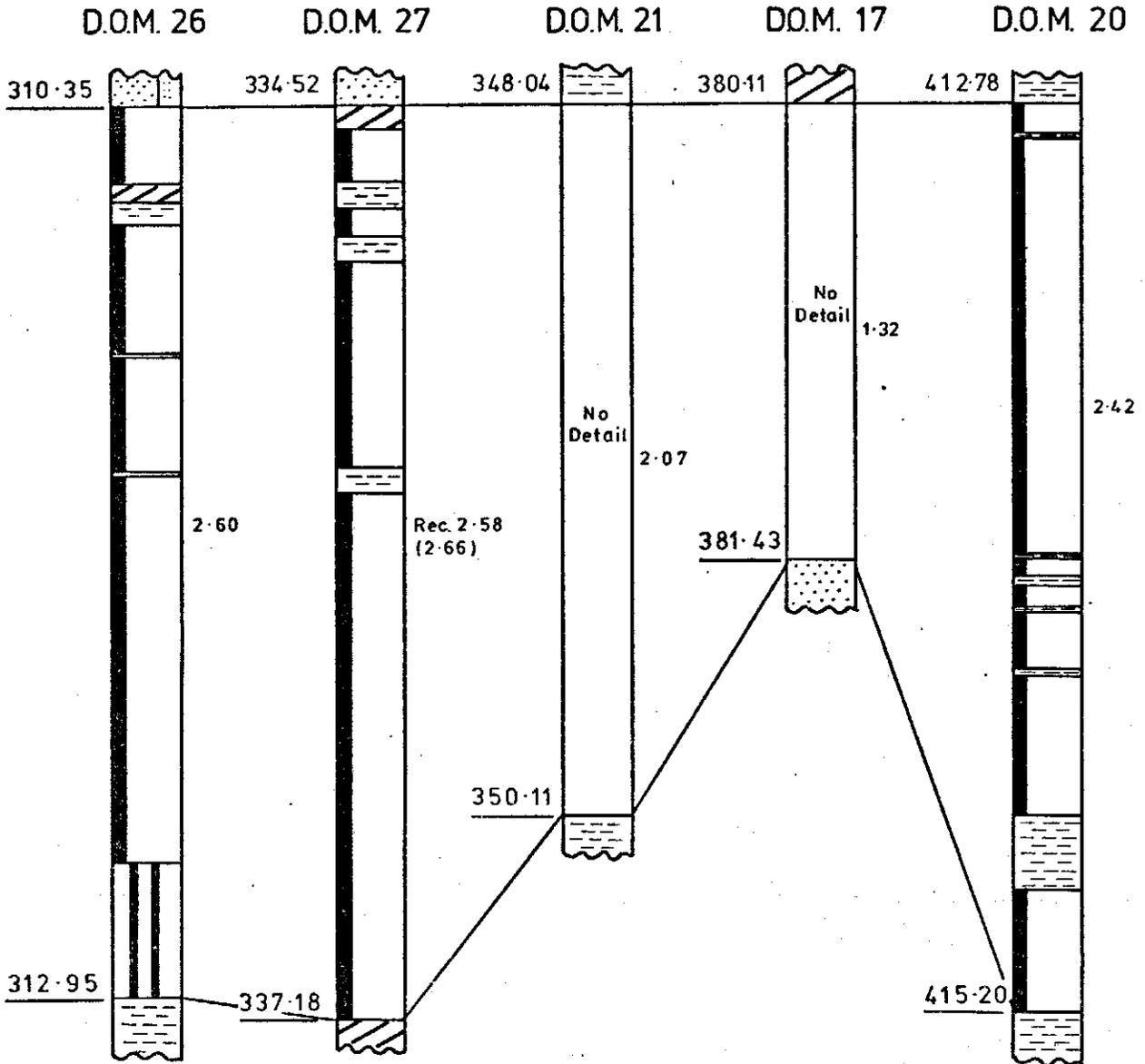
### 2.6.1 EAST FINGAL SEAM

A summary of the analytical data on composites of the East Fingal Seam is given in Table 2. Unfortunately only 5 seam composites could be calculated and these show the following

SOUTH WEST

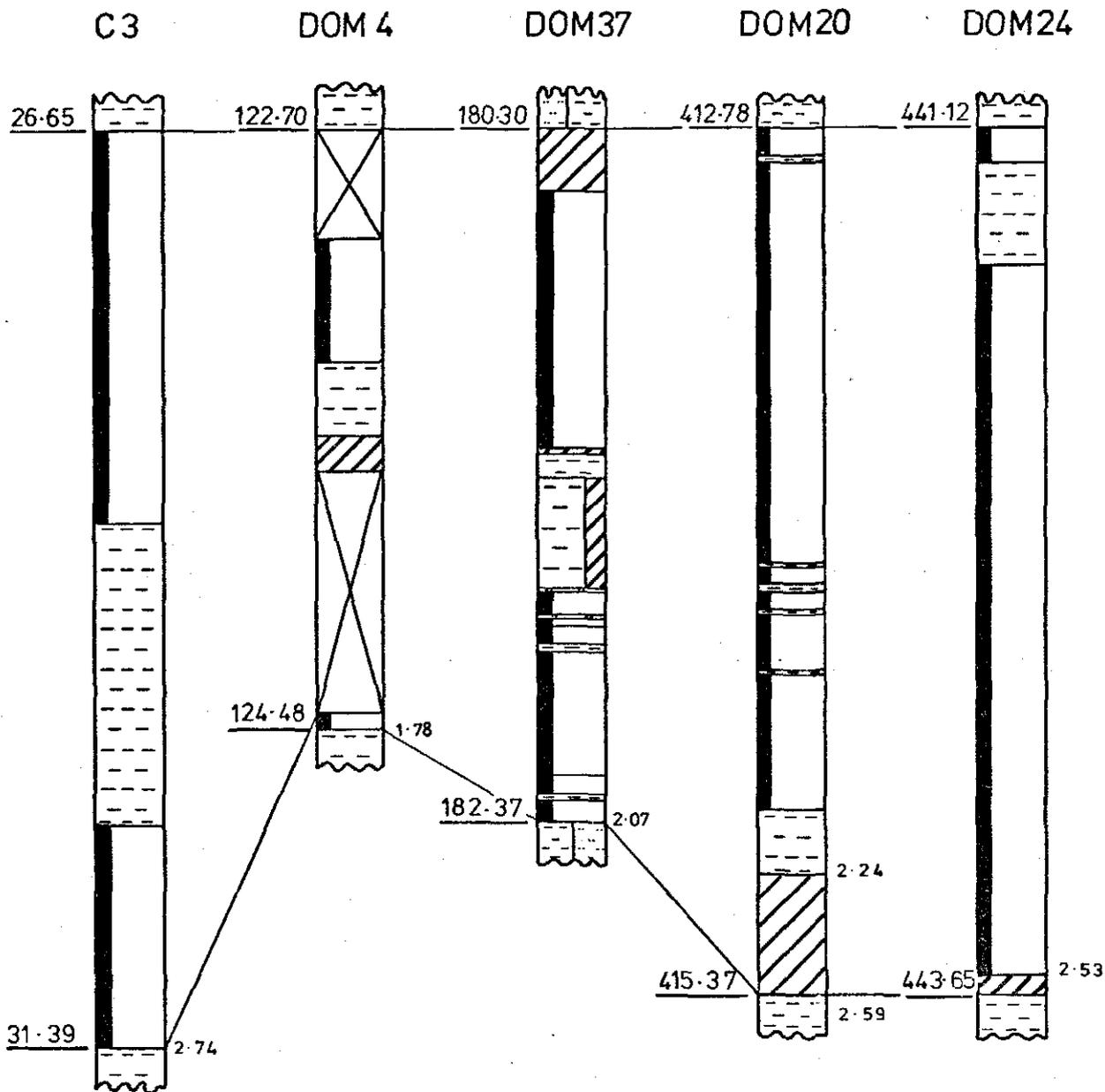
NORTH EAST

018



312.95 Drill Hole Depth  
 2.60 Seam Thickness  
 Refer Fig. 2.5 for location of section

THE HYDRO-ELECTRIC COMMISSION OF TASMANIA  
 STATE RESERVE FINGAL COALFIELD  
 SEAM PROFILES  
 DUNCAN SEAM  
 SECTION LINE A-B  
 SCALE 1:20  
 Prepared by Robertson Research (Aust) Pty Limited  
 To Accompany Report No. 511  
 Figure No. 2.11  
 May 1978



26.65 Drill Hole Depth

2.74 Seam Thickness

Refer Fig. 2.5 for location of section

THE HYDRO-ELECTRIC COMMISSION OF TASMANIA  
 STATE RESERVE FINGAL COALFIELD  
 SEAM PROFILES  
 DUNCAN SEAM  
 SECTION LINE E-F  
 SCALE 1:20  
 Prepared by Robertson Research (Aust) Pty Limited  
 To Accompany Report No. 511  
 May 1979

Figure No. 2.12

variations (Raw Coal).

187021

020

		<u>Range</u>	<u>Average</u>	<u>No. of Samples</u>
Moisture	%	3.2-4.5	3.7	4
Ash	%	25.6-39.4	32.7	5
Volatile Matter	%	22.3-23.6	22.9	4
Fixed Carbon	%	39.5-48.5	43.4	4
Sulphur	%	0.77	0.77	1
Calorific Value MJ/kg		21.8-24.3	22.7	3

Raw coal ash over the drilled area decreases in a south easterly direction, such that in the north west corner of the Reserve Area it is likely to be in the order of 25% - 28%.

2.6.2. DUNCAN SEAM

A summary of the analytical data for composites of the Duncan Seam is given in Table 3. Weighted composites were calculated for 11 seam intersections which show the following variations (Raw Coal).

		<u>Range</u>	<u>Average</u>	<u>No. of Samples</u>
Moisture	%	2.1-5.4	4.1	11
Ash	%	25.2-35.5	29.5	11
Volatile Matter	%	22.5-30.3	25.7	11
Fixed Carbon	%	36.2-46.3	41.6	11
Sulphur	%	0.25-0.31	0.29	3
Calorific Value MJ/kg		18.72-25.30	21.51	10

Isoash trendlines for the Duncan Seam are shown on Figure 2.13. The ash content appears to increase to the southwest (DDH30); it is variable over the remainder of the drilled area, reaching highs in DDH3 (35.5%) and DDH17 (32.9%). In the north west corner of the Reserve Area the ash content varies from 27.9% to 32.9%.

2.6.3 GENERAL COMMENTS

For an additional guide to the quality of the coal in the Duncan Mine, extracts from the publication by the Joint Coal Board and Queensland Coal Board titled "Australian Black Coals", are given in Table 4.

Overall the coal could be classified as non-coking, high ash, low sulphur, medium volatile and bituminous.

021

2.7 ROOF AND FLOOR STRATA

Graphic sections at a scale of 1:20 have been plotted for the 4m. of roof strata and 0.5m. of floor strata for the Duncan and East Fingal Seams in drill holes located along cross section lines A-B and C-D. These sections are included as Figures 2.14 - 2.17.

The sections are based solely on the descriptive log and do not take into consideration the distribution and spacing of : bedding plane partings; joints; slickensides and fractures.

2.7.1 EAST FINGAL SEAM (FIGURE 2.14 and 2.15)

The immediate roof strata is predominantly mudstone which is overlain by an interbedded sequence of sandstone, siltstone and mudstone. In DDH's 17, 20, 25 and 27, a coal seam, varying in thickness from 0.6m. to 1.58m., occurs between 1.7m. and 2.7m. above the roof.

The overall trends evident in the drilled area is an increase in arenaceous sediments towards the east and a decrease towards the south.

The floor strata consists predominantly of mudstone with only minor sandstone and siltstone phases.

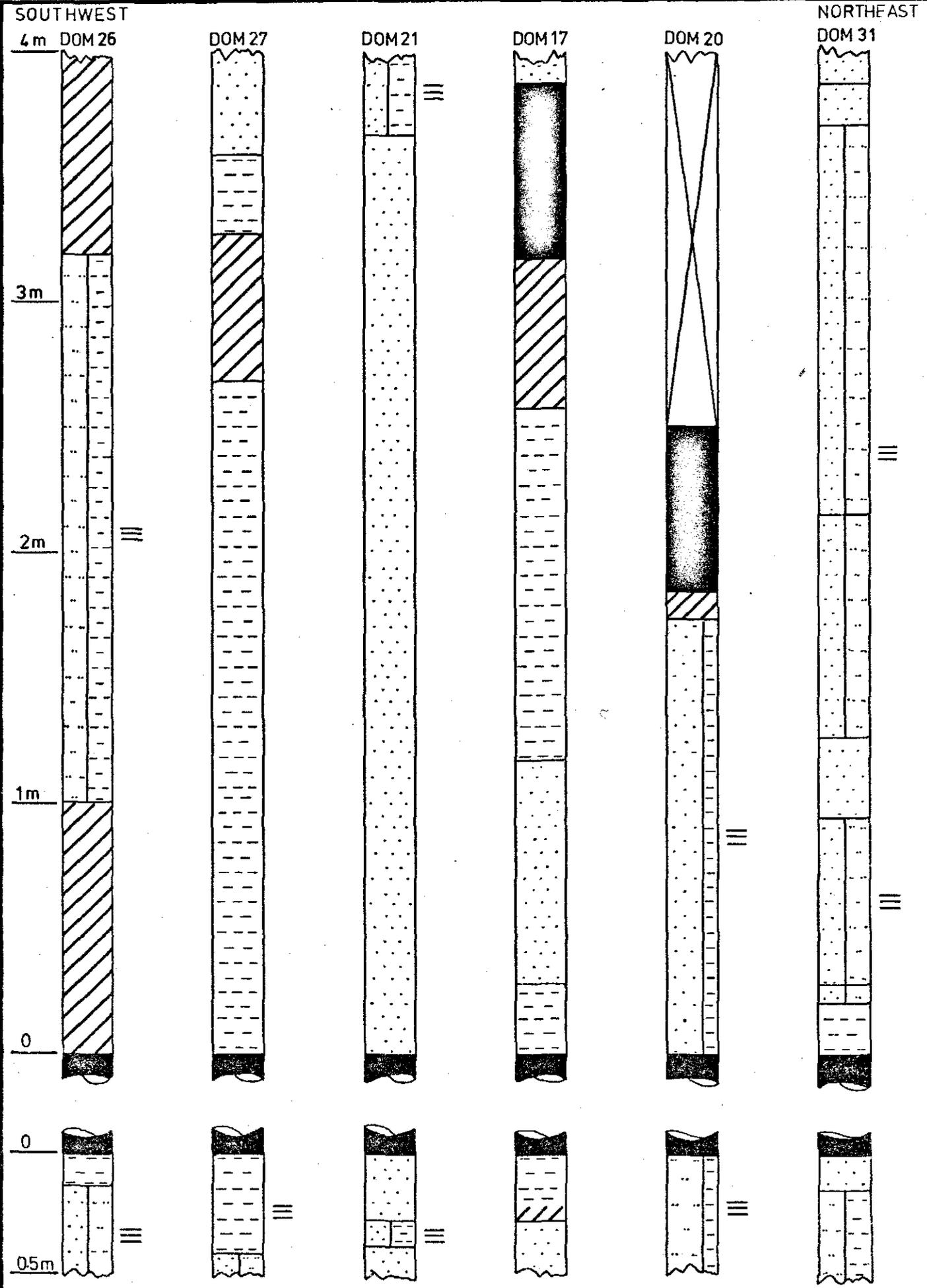
2.7.2 DUNCAN SEAM (FIGURE 2.16 and 2.17)

The roof and floor strata along Section lines A-B and C-D, consist almost entirely of mudstone with only very minor siltstone and sandstone. A coal seam varying in thickness from 0.1m. to 1.2m. occurs between 1.2m. and 2.6m. above the roof in DDH's 5,17,20, 23, 26 and 27.

In the Duncan mine the following general observations were noted for the roof and floor strata of the Duncan Seam.

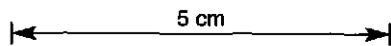
(1) Where the roof strata consisted of sandstone the conditions were good.

022



Refer Fig. 2.5 for location of section

SCALE 1:20

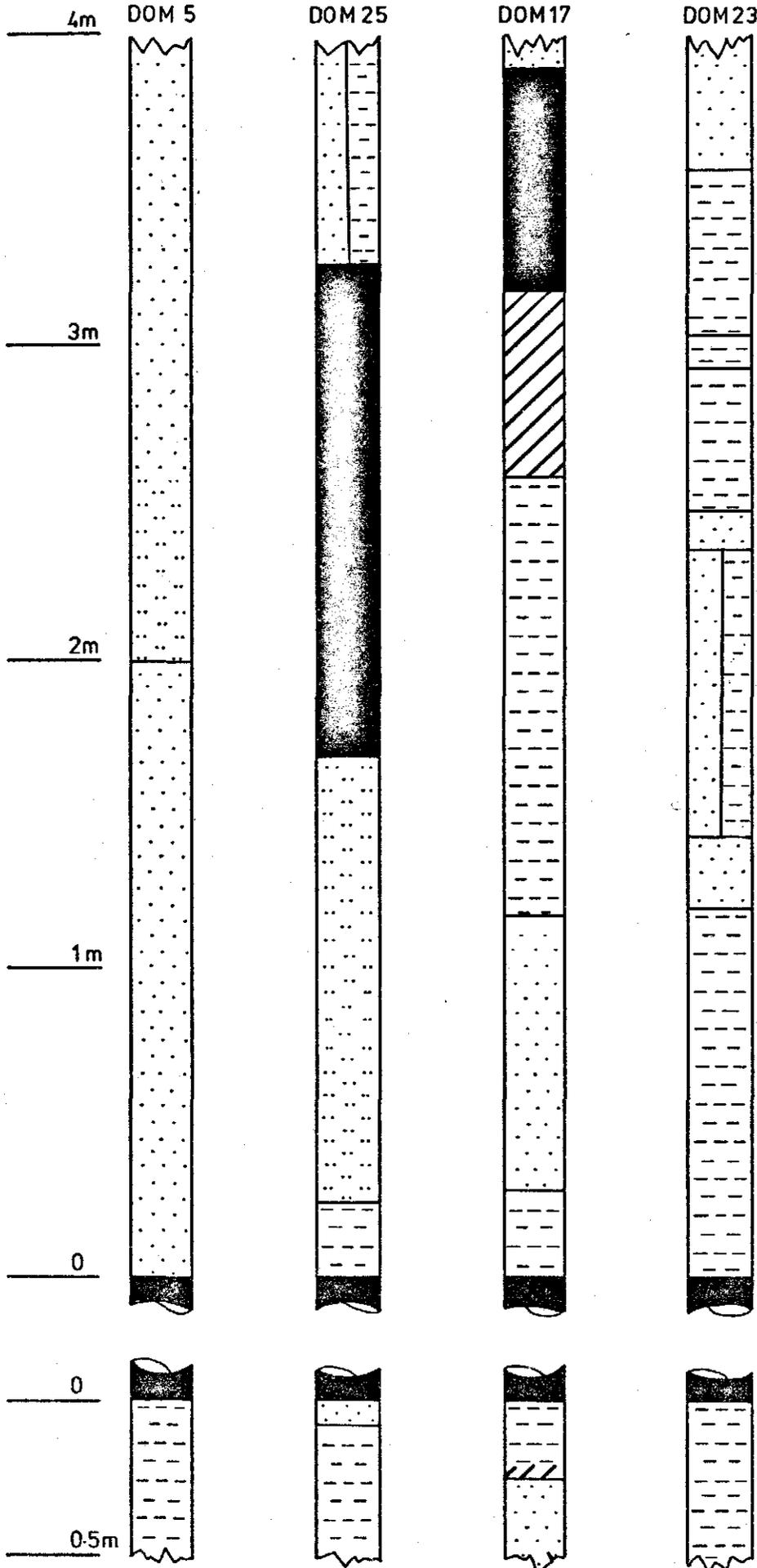


ROOF AND FLOOR STRATA  
 EAST FINGAL SEAM  
 SECTION LINE A-B

023

NORTH WEST

SOUTH EAST



Refer Fig. 2.5 for location of section

SCALE 1:20

ROOF AND FLOOR STRATA  
EAST FINGAL SEAM  
SECTION LINE C-D

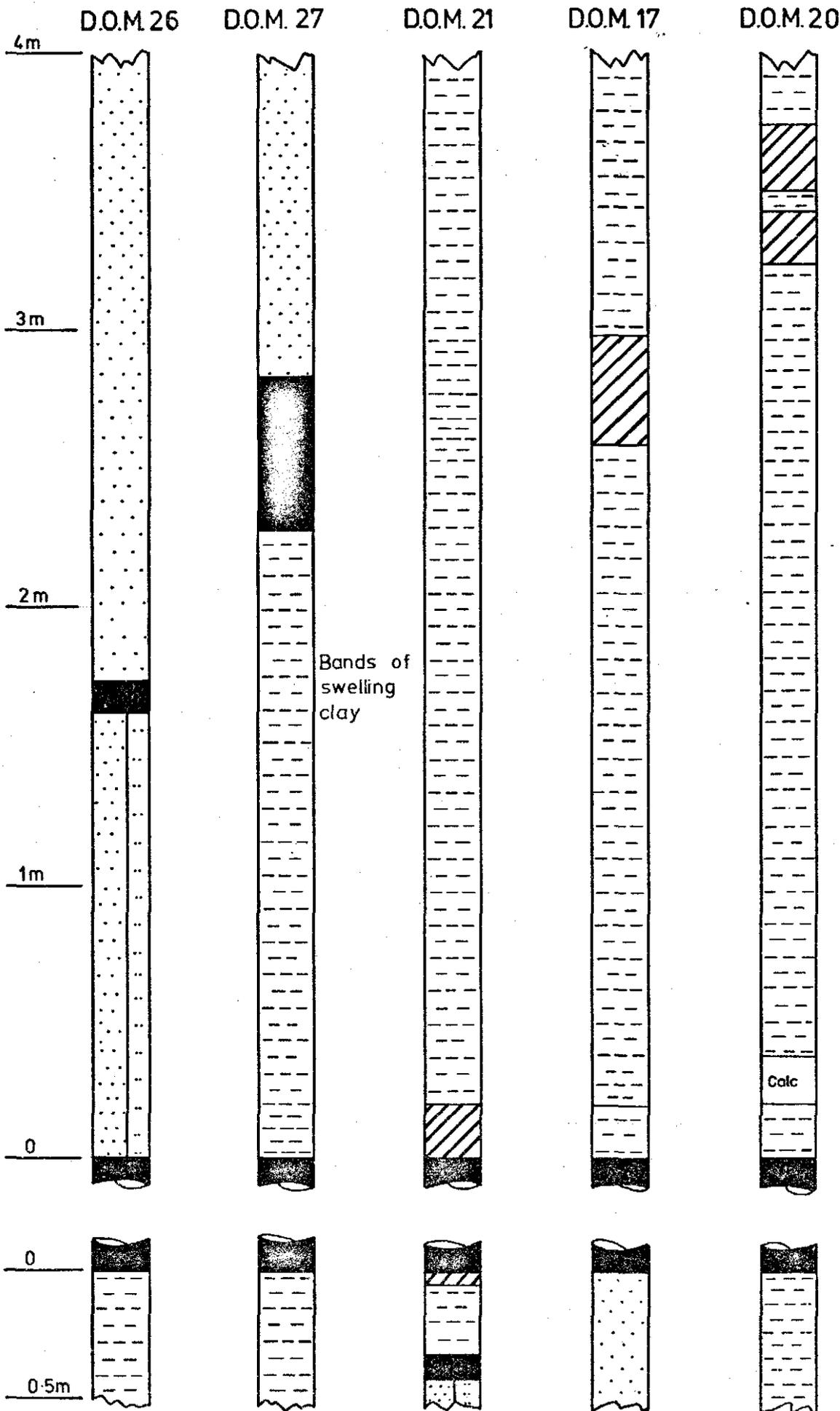
FIG 2.15

SOUTHWEST

187025

NORTHEAST

024



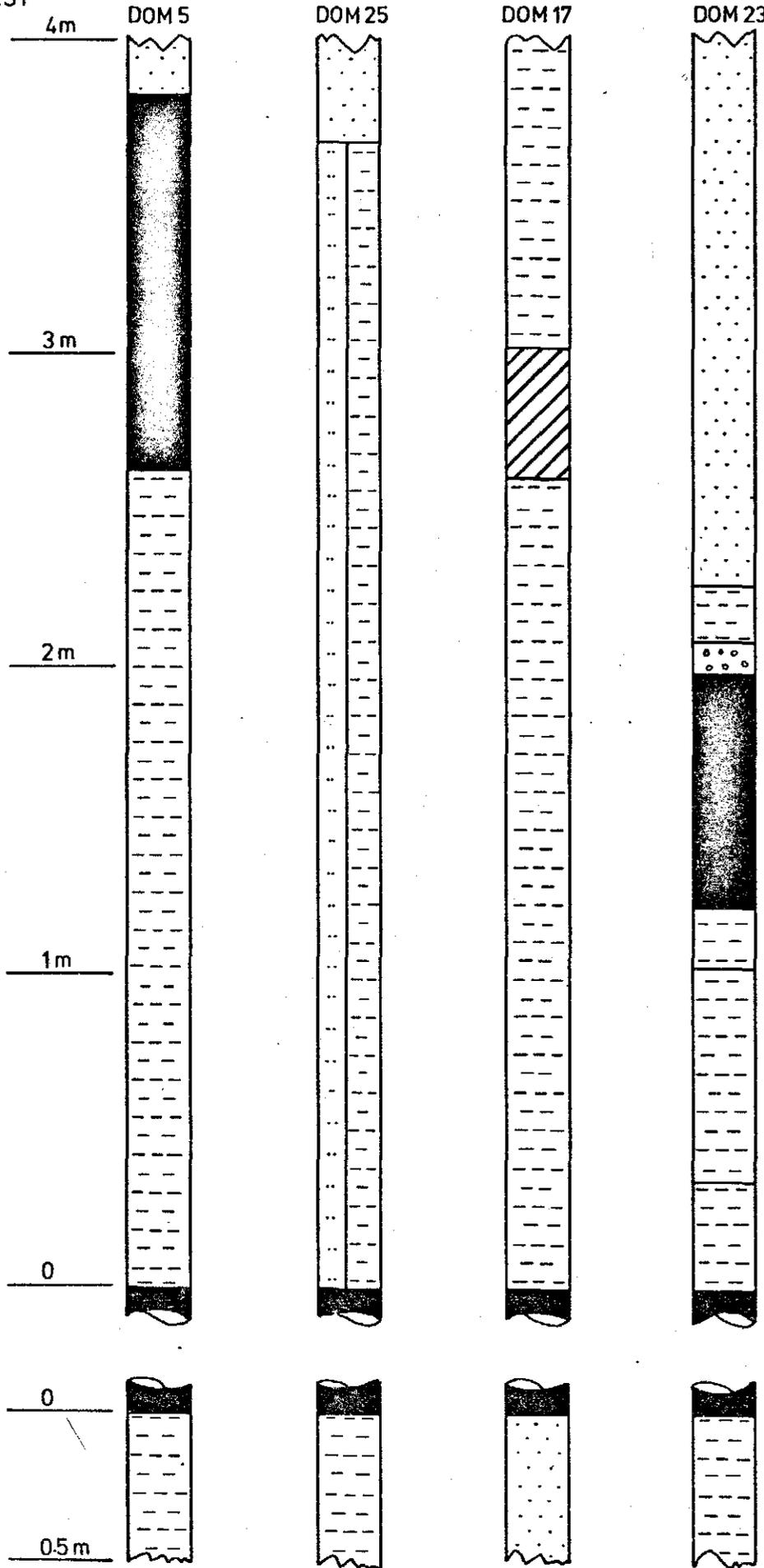
Refer Fig. 2.5 for location of section  
SCALE 1:20

025

NORTHWEST

SOUTHEAST

187026



Refer Fig. 2.5 for location of Section

SCALE 1:20

5 cm

ROOF AND FLOOR STRATA  
DUNCAN SEAM  
SECTION LINE A-B

FIG 2.17

026

- (2) In areas where mudstone formed the immediate roof together with a coal seam occurring at a height generally > 0.5m. above the roof, problems were encountered with the roof stability.
- (3) In a zone surrounding the transition from a mudstone/coal roof to a sandstone roof, sporadic falls, generally in the order of 1m. to 2m. would occur in the sandstone roof.
- (4) The mine generally worked to a coal floor to avoid breakdown of the mudstone underlying the coal upon exposure to air and water.

2.8

COAL RESOURCES

In situ coal reserves have been calculated using the seam isopach maps at a scale of 1:40,000. Each small area, generally bounded by seam thickness contours, was determined by planimeter.

Estimation of the mean coal thickness within each area enabled the volume of coal to be derived and using an average density of 1.60, the quantity of in situ coal within each area was determined. Reserves of coal have been calculated on the basis of a minimum working section of 1.5m.

Reserves of in situ coal have been quoted in the following categories :

- (a) Measured
- (b) Indicated Class I.

The criteria on which these categories are based are reported in "Parameters for the Calculation and Reporting of Coal Reserves, Queensland" which was prepared by the Queensland Department of Mines in 1968. Extracts of the metric modification of the original publication follow.

Measured Reserves. Measured coal is that for which tonnage is computed from dimensions revealed in outcrops, trenches, mine workings, and drill holes and for which the grade is computed from the results of detailed sampling. The points of observations, measurement, and sampling are so closely spaced and the thickness, extent, and grade of the coal are so well defined that the computed tonnage and grade are judged to be accurate within 20 per cent of the true tonnage and grade. The limits of accuracy of the estimate or the maximum distance between points of observation should be stated.

Although the spacing of the points of observation necessary to demonstrate continuity of coal will vary in different regions according to the habit of the coal seams, the points of observation are no more than 1km apart. The outer limit of a block measured coal, therefore, shall not be more than 0.5km from the last point of positive information (i.e. about half the distance between points of observation.)

The standards Association of Australia considers that, where a point of observation is a drill hole, core only is to be regarded as a true sample. Consequently only core shall be used as a drill hole sample in computing measured reserves. Minimum core recovery at any point of observation, which should exceed 90 per cent, should be stated.

Indicated Reserves. Indicated coal is that for which tonnage and grade are computed partly from specific measurements and samples, and partly from projection of visible data for a reasonable distance on geologic evidence. In general, the points of observation are no more than 2km apart. Indicated reserves exclude contained measured coal.

Where measurements and sampling, on which computations of tonnage and grade are based, are of coal in situ or of core from a drill hole, the indicated reserves shall be designated first class. If the tonnage and grade are computed from drill hole samples other than cores, the indicated reserves shall be designated second class. Second class indicated reserves shall not be used in computing recoverable reserves.

Inferred Reserves. Inferred coal is coal for which quantitative estimates are based largely on broad knowledge of the geologic character of the bed or region and for which there are few, if any, measurements or samples. The estimates are based on an assumed continuity for which there is geologic evidence.

028

In general, inferred coal is coal lying in areas more than 1km from points of sampling, or observation used in computing reserves of higher status.

A quantitative value is not allocated to inferred reserves other than to indicate its value within the following ranges.

- (a) Very large - in excess of 10 000 000 000 tonnes
- (b) Large - 100 000 000 tonnes to 10 000 000 000 tonnes
- (c) Small - 20 000 000 tonnes to 100 000 000 tonnes
- (d) Very small - less than 20 000 000 tonnes.

Recoverable Reserves are that coal in the ground at the date of appraisal that can be produced and utilised as coal. These reserves are calculated by subtracting estimated future losses in mining from reserves in the ground at the date of appraisal. Where the coal is to be produced to a specified grade, allowance is also made for losses in beneficiation.

Desirably for the purposes of this calculation, account should be taken of measured coal only, but it must be accepted, that for some time to come, indicated coal first class must be included in the calculations. Indicated coal second class and inferred coal should not be included.

Reserves computed in the above categories are also to be classified according to the thickness of the coal and according to the thickness of overburden.

No attempt has been made to calculate Inferred Reserves because of the unknown and variable parameters of faulting, intrusions and seam continuity.

Recoverable coal reserves have been calculated on the basis of a 50% mining recovery. Beneficiation of the coal will be required to produce the desired product of 20% ash. In view of the lack of

washability data, a very rough figure of 65% has been used for the washing recovery factor, (assuming raw coal ash of the Duncan and East Fingal Seams will vary between 28% - 35%).

The Blocked areas for reserve calculation on both the Duncan and East Fingal Seams are shown on Figures 2.18 and 2.19 respectively. In calculating reserves of the East Fingal Seam, the thickness of the lower split in DDH31 and H.E.C. C2 has been used in preparing the necessary isopachs.

The total measured plus indicated in situ reserves in the north west corner of the Reserve Area is 33.38 million tonnes. Clean coal reserves have been crudely estimated at 10.85 million tonnes. Details of the coal reserves are indicated below.

COAL RESERVES

Seam	In Situ		Run of Mine		Clean Coal	
	*M	*I	*M	*I	*M	*I
Duncan	11.20	7.01	5.60	3.51	3.64	2.28
East Fingal	6.64	8.53	3.32	4.27	2.16	2.77
Total	17.84	15.54	8.92	7.78	5.80	5.05
Total (M & I)		33.38		16.70		10.85

\*M = Measured Reserves (tonnes  $\times 10^6$ )

\*I = Indicated Reserves (tonnes  $\times 10^6$ )

Proven clean coal reserves required for the power station have been put at 36 million tonnes. Thus an additional tonnage of 25 million tonnes (clean coal) will need to be proven to meet these requirements.

Figures 2.18 and 2.19 show an area over which 2m. thickness of coal in the Duncan and East Fingal Seams would need to be proven to obtain the required clean coal tonnage assuming 50% mining and 65% wash recovery factors. (Duncan Seam - 10m.t.,

030

East Fingal Seam - 15m.t.) Additional reserves of coal may also be present in some upper seams of the Triassic sequence (Refer Section 2.5).

Open cut coal resources may occur in the Break O'Day Valley in the Harefield region (Refer Figure 2.18 and Section 2.5.1) Unfortunately this area is presently covered by E.L. 5/67 held by Industrial and Mining Investigations.

In order to more fully appraise the coal resources present, it is strongly recommended that a detailed drilling programme be undertaken.

TABLE 1

## SUMMARY OF BORE AND ANALYTICAL DATA

## DEPARTMENT OF MINES

031

Bore No.	Collar R.L. (m)	Total Depth (m)	Seam	Depth to Roof (m)	Seam Thickness (m)	Comments	R.L. Seam Roof (m)	Thickness Analysed (m)	Proximate Analysis (Raw Coal)				Sulphur %	Cal. Value MJ/kg
									Moist. %	Ash %	Vol. Matter %	Fixed Carbon %		
1	525.5	217.9	Duncan	71.7	1.68		454.4							
				116.0	0.76		409.5	0.76	6.3	31.2	21.0	41.5	0.28	20.12
2	608.7	184.0	Duncan	69.1	1.80		539.6							
				155.3	0.59		453.4							
3	641.9	216.7	Duncan	176.7	2.39		432.0	2.39	4.8	28.3	26.2	40.7	0.31	22.03
				128.8	0.86		513.1							
4	546.5	330.1	Duncan	142.2	1.40	Shaly	499.7							
				156.3	0.61		485.6	0.61	4.7	24.5	27.5	43.5	0.40	23.48
4	546.5	330.1	Duncan	187.5	1.04	Shaly	454.4							
				210.2	2.34		431.7	2.34	3.8	35.5	24.3	36.4	0.31	18.72
4	546.5	330.1	Duncan	20.73	1.12	Shaly	525.8							
				43.08	1.45		503.4							
4	546.5	330.1	Duncan	72.70	1.30		473.8	1.30						
				113.70	0.76		432.8	0.76	4.9	18.5	30.7	45.9	0.50	25.12
4	546.5	330.1	Duncan	122.70	1.78	Poor Rec.	423.8							
				142.5	2.84	Shaly 58%	404.0							
4	546.5	330.1	East Fingal	165.5	0.61	Insufficient detail in log	381.0	0.61	3.5	28.3	23.4	44.8	0.77	22.20
				99.7	1.22		476.2	1.22	4.9	25.0	27.3	42.8	0.39	22.92
5	575.9	269.6	Duncan	103.9	0.46		472.0							
				143.0	1.22		432.9							
5	575.9	269.6	East Fingal	146.9	2.03		429.0	2.03						
				180.1	2.90	Poor Rec.	395.8	2.90	3.2	34.7	22.6	39.5	-	-
5	575.9	269.6	East Fingal	188.7	1.02		387.2	1.02	3.7	46.4	18.9	31.0	-	-
				206.1	0.91		369.8							
6	739.7	457.8	Duncan	165.2	6.04	Clyst/Coal	574.5							
				219.9	1.80	Shaly	519.8							
6	739.7	457.8	Duncan	248.6	0.76		491.1							
				281.2	0.81		458.5							
6	739.7	457.8	East Fingal	305.1	2.74	Rec. 2.07	434.6	2.07	3.4	28.2	25.2	43.2	-	21.72
				343.2	1.52		396.5	1.52						
7B	619.7	351.7	Duncan	100.0	2.08	Thick Stone Band	519.7							
				130.7	1.17		489.0							
7B	619.7	351.7	Duncan	162.3	1.27		457.4							
				183.3	2.49		436.4	2.13	4.3	29.2	30.3	36.2	-	21.5
7B	619.7	351.7	Duncan	255.2	0.81		364.5							

187032

Bore No.	Collar R.L. (m)	Total Depth (m)	Seam	Depth to Roof (m)	Seam Thickness (m)	Comments	R.L. Seam Roof (m)	Thickness Analysed (m)	Proximate Analysis (Raw Coal)				Sulphur %	Cal. Value MJ/kg
									Moist. %	Ash %	Vol. Matter %	Fixed Carbon %		
8	573.3	250.7	Mt. Nicholas	31.8	0.56		541.5							
				45.1	0.69		528.2							
				124.1	1.83	Stoney	449.2	1.83	4.9	41.8	25.8	27.5	-	-
				126.6	2.59		446.7	2.29	5.9	30.7	27.9	35.5	-	-
				152.7	0.71		420.6	0.71	6.8	44.7	23.6	24.9	-	-
				156.1	1.68		417.2	1.68	4.7	61.6	19.9	13.8	-	-
			161.4	1.37		411.9	1.37	4.4	68.5	18.2	8.9	-	-	
9	448.9	236.5	Nicholas Range	22.2	1.62		426.7	-						
10	-	-												
11	498.5	139.6	Nicholas Range	66.98	1.14		431.5	1.14	2.8	23.4	27.9	45.9	0.63	25.59
12	575.01	223.93	Nicholas Range	88.19	0.84		486.8							
				123.95	1.45		451.1							
				149.25	1.52		425.8	1.52	-	27.2	31.5	-	-	22.0
13	536.4	228.50	Huntsmap Cap	1.52	5.95	?Driller's	534.9							
				37.01	6.47	Log. Mudst/	499.4							
				73.84	0.95	coal	462.6							
				83.79	0.50		452.6							
				85.50	2.18		450.9	2.18	-	17.0	33.4	-	-	27.60
				162.65	3.29		373.75	3.29	5.5	35.1	18.2	41.2	-	18.00
			180.61	2.32	Coal/Mudst.	355.8								
14	-	-												
15	-	-												
16A	837.0	364.25		303.11	4.87	Mudst/Coal	533.89							
				328.80	2.10		508.2	2.10	1.4	42.0	16.4	40.1	-	-
				352.19	5.84	Mudst/Coal	484.8							
17	777.5	505.29		323.46	2.13		454.0							
				348.98	1.34	Mudst/Coal	428.5	1.34	4.5	23.7	26.1	45.7	-	24.9
				354.34	0.80		423.2	0.80	4.1	27.5	26.0	42.4	-	24.3
				380.11	1.32	Duncan	397.4	1.32	4.1	32.9	24.7	38.3	-	18.8
				418.90	0.70		359.2	0.70	3.7	37.4	20.6	38.3	-	17.2
				422.78	2.24	East Fingal	354.5	1.85	3.6	25.6	22.3	48.5	-	24.3
18	664.5	424.80	Royal George											
19	847.2	455.0		313.29	0.98		533.9							
				324.15	1.33		523.1							
				350.33	2.37	63% Rec.	496.9							
				377.64	1.12	Mudst/Coal	469.6							
				383.53	0.75	"	463.7							
				388.77	0.93		458.4							
				421.44	0.70		425.8							
				428.10	1.60	Duncan	419.1	1.55	5.3	25.2	23.8	45.7	-	-

032

187033

Bore No.	Collar R.L. (m)	Total Depth (m)	Seam	Depth to Roof (m)	Seam Thickness (m)	Comments	R.L. Seam Roof (m)	Thickness Analysed (m)	Proximate Analysis (Raw Coal)				Sulphur %	Cal. Value MJ/kg				
									Moist. %	Ash %	Vol. Matter %	Fixed Carbon %						
20.	811.0	465.54	Duncan	279.10	4.31	Mudst/Coal	531.9											
				308.20	2.06		502.8											
				334.43	4.54	Mudst/Coal	476.6											
				364.72	1.05		446.3	1.05	6.6	20.7	32.2	47.1	-	29.4				
				412.78	2.42	Prox. Anal.	398.2	2.42	5.4	31.9	24.4	43.6	-	22.46				
				454.64	0.88	Incorrect	356.4	0.88	5.0	33.5	21.3	45.2	-	21.5				
				East Fingal	458.24	1.79		352.8										
21.	758.5	502.40	Duncan	295.87	0.93		462.6											
				325.85	0.70		432.7											
				341.81	0.50		416.6											
				348.04	2.07	Prox. Anal.	410.5	2.07	4.9	26.7	27.1	46.3	-	25.3				
				386.32	0.86	Incorrect	362.8	1.70	4.2	27.2	23.9	48.9	-	23.7				
				East Fingal	414.46	0.82		344.0	0.82	4.5	35.6	23.6	40.8	-	21.8			
22.	407.4	228.56	George	155.19	1.49		242.2	1.49	2.4	21.0	26.3	50.3	-	25.6				
				"Lochaber", Royal	188.59	0.68		218.8	0.68	2.1	15.6	30.1	52.2	-	27.2			
					199.30	0.85		208.1	0.85	3.2	44.8	19.0	33.0	-	-			
				East Fingal	374.90	0.95		429.7	0.95	2.7	28.9	28.2	40.2	-	21.5			
23.	804.6	553.63	Duncan	373.13	1.02	0.75m. stone band	431.5	1.02	2.5	35.2	27.5	34.8	-	19.5				
					410.33	0.75		394.3	0.75	2.7	28.3	26.1	42.9	-	22.3			
					412.30	2.56		392.3	2.56	2.4	27.9	27.3	42.4	-	21.89			
					453.57	0.94		351.0										
				East Fingal	460.91	1.28		343.7										
				24.	830.8	523.26	Duncan	397.04	1.17		433.8							
									401.44	1.04		429.4						
	441.12	2.53						389.7	2.13	2.1	29.7	27.4	40.8	-	21.40			
East Fingal	496.22	1.54						334.6										
25.	784.1	525.93	Duncan	242.23	0.83	Mudst/Coal	541.9											
					244.12	2.33		540.0										
					270.59	1.62		513.5										
					294.24	3.19		489.9										
					326.32	0.99		457.8										
					350.35	1.02		433.8										
					376.07	1.78		408.0										
					413.39	0.67		370.7										
					417.73	1.58		366.4										
					East Fingal	420.98	1.97		363.1									
26.	733.8	459.22	Duncan	310.35	2.60		423.5											
					354.60	2.15		379.2										
				East Fingal	380.45	1.37		353.4										

033

187034

Bore No.	Collar R.L. (m)	Total Depth (m)	Seam	Depth to Roof (m)	Seam Thickness (m)	Comments	R.L. Seam Roof (m)	Thickness Analysed (m)	Proximate Analysis (Raw Coal)				Sulphur %	Cal. Value MJ/kg		
									Moist. %	Ash %	Vol. Matter %	Fixed Carbon %				
27	745.7	487.96	Duncan	313.09	0.89	Poor Rec.	432.6									
				334.52	2.58		411.2								Stone Bands Excluded	
				372.71	1.97		372.9								Stone Bands Excluded	
				377.17	1.06		368.5								Stone Bands Excluded	
				395.12	0.96		350.6									
28	442.0	160.48	Duncan	51.75	1.41		467.7									
				71.49	2.25		447.9								Stone Bands Excluded: Wash on Seam incl.bands S.G.1.60 Yield 68.8% Ash 33.5%	
29	686.4	431.43	Duncan	74.90	0.83		444.5									
				115.50	0.67		403.9									
30	519.4	254.85	East Fingal	118.71	2.03	Carb Mudst?	400.7									
				171.40	1.65		348.0								Stone Bands Excluded : Wash on Seam incl.bands S.G.1.60 Yield 45.5% Ash 31.1%	
31	828.9	575.98	Duncan	309.92	4.04	Mudst/Coal 81% Rec. Mudst/Coal	519.0									
				335.71	2.90		493.2									Stone Bands Excluded
				339.42	1.44		489.5									Stone Bands Excluded
				358.28	5.69		470.6									
				385.40	1.32		443.5									
				389.03	0.98		439.9									
				431.67	0.50		397.2									
				481.84	3.62		347.1									
32	533.3	274.67	East Fingal	500.07	0.99		328.8									
				64.07	1.24		469.2									
33	509.30 (West of Cornwall)	199.56	Duncan	82.24	1.63		451.1	1.36								
				184.69	1.36		348.6								Stone Bands Excluded 3.4 23.5 32.4 44.1 - -	
34A	478.0	65.32	East Fingal	15.84	0.75	0.48m Stone Band	493.5									
				43.27	5.21		466.0									Stone Bands Excluded
				55.66	1.32		453.6									
				73.22	3.24		435.1									Stone Bands Excluded
				119.29	1.30		390.0									
				122.98	2.02		386.3									
142.16	1.60	367.1														

034

187035

Bore No.	Collar R.L. (m)	Total Depth (m)	Seam	Depth to Roof (m)	Seam Thickness (m)	Comments	R.L. Seam Roof (m)	Thickness Analysed (m)	Proximate Analysis (Raw Coal)				Sulphur %	Cal. Value MJ/kg				
									Moist. %	Ash %	Vol. Matter %	Fixed Carbon %						
348	466.4	47.18	East Fingal	29.09	3.09		437.3											
35	630.8	94.60	Abandoned															
36	436.2 (West of Cornwall)	133.26		25.04	3.74		411.2											
37	596.3	311.72	Duncan	77.05	0.86		519.3											
				78.71	1.19		517.6											
				105.14	2.14		491.2											
				131.37	0.85		464.9											
				180.30	2.07		416.0											
				186.22	0.54		410.1											
37	596.3	311.72	East Fingal	219.71	0.91		376.6											
				222.23	1.43		374.1											

035

- Notes : (1) Where stone bands in the seam have been excluded from analyses it is impossible to calculate weighted seam composites.
- (2) Where a name accompanies the bore no. the hole has been drilled in that area which is outside the Duncan Mine/Coal Reserve Area.

187036

036

TABLE 1 (Cont'd)

187037

SUMMARY OF BORE DATAHYDRO ELECTRIC COMMISSION

Bore No.	Collar R.L. (m)	Total Depth (m)	Seam	Depth to Roof (m)	Seam Thickness (m)	Comments	R.L. Seam Roof (m)
C1	638.3	265.8	Duncan	160.35	1.09		477.9
				190.27	1.24		448.0
				216.31	0.71		422.0
				238.37	2.64		399.9
C2	508.7	250.2	East Fingal	20.29	1.65		488.4
				40.18	4.93		468.5
				62.23	0.56		446.5
				66.52	0.74		442.2
				83.46	0.59		425.2
				159.05	3.48		349.7
C3	455.4	162.69	Duncan	28.65	2.74	Thick stone band (0.9m)	426.8
				34.59	0.46		420.8
				65.61	0.91		389.7
			East Fingal	69.80	2.44		385.6
				78.51	0.99		376.0
				82.55	0.61		372.9
				85.64	0.69		369.8
				91.29	0.76		364.1
C4	404.8	121.08		97.84	1.83		357.0
				16.31	1.22		388.5
C5	400.5	100.56		23.65	0.76		381.2
				26.97	1.73		373.7
C6	394.4	104.24		16.61	0.91		377.8
				24.59	0.53		369.8
				28.78	1.09		365.6
				33.68	0.76		360.7

037

2.

187038

Bore No.	Collar R.L. (m)	Total Depth (m)	Seam	Depth to Roof (m)	Seam Thickness (m)	Comments	R.L. Seam Roof (m)
C7	401.4	117.73	East Fingal	17.68	2.44		383.7
				22.15	1.62		379.3
				31.09	0.91		370.3
				42.98	1.22		358.4
C8	?	159.05		-			
C9	392.5	117.42		40.23	2.13	Weathered	352.3
				48.46	2.13		344.0
				54.79	2.26		

TABLE 2

## EAST FINGAL SEAM

## SUMMARY OF ANALYTICAL DATA

## FINGAL AREA

Bore No.	Depth to Roof (m)	Thickness Analysed (m)	Proximate Analysis				Sulphur	Cal. Value MJ/kg
			Moist. %	Ash %	Vol. Matter %	Fixed Carbon %		
4	165.5	0.61	3.5	28.3	23.4	44.8	0.77	22.0
5	180.1	2.90	3.2	34.7	22.6	39.5	-	-
6	343.2	1.52		39.4				
17	422.78	1.85	3.6	25.6	22.3	48.5	-	24.3
20	458.24		Stone Bands Excluded					
21	395.75	1.70	4.2		23.9	48.9	-	23.7
23	460.91		Stone Bands Excluded					
24	496.22		"	"	"			
25	420.98		"	"	"			
26	354.60		"	"	"			
27	372.71		"	"	"			
30	118.71		"	"	"	Wash on Seam Incl. Bands S.G.1.60, Yield 45.5%, Ash 31.1%		
31	481.84							
34A	40.29	3.43	"	"	"			
C2	159.05	3.48	*N/A					
C3	69.80	2.44	*N/A					
C7	17.68	2.44	*N/A					

\*N/A = Not Available

TABLE 3

## DUNCAN SEAM

## SUMMARY OF ANALYTICAL DATA

## FINGAL AREA

Bore No.	Depth to Roof (m)	Thickness Analysed (m)	Proximate Analysis				Sulphur %	Cal. Value MJ/kg
			Moist. %	Ash %	Vol. Matter %	Fixed Carbon %		
2	176.7	2.39	4.8	28.3	26.2	40.7	0.31	22.03
3	210.2	2.34	3.8	35.5	24.3	36.4	0.31	18.72
4	122.70		Stone Bands Excluded					
5	146.9	2.03	4.3	29.4	22.5	43.8	0.25	21.27
6	305.1	2.07	3.4	28.2	25.2	43.2	-	21.72
7B	183.3	2.13	4.3	29.2	30.3	36.2	-	21.5
17	380.11	1.32	4.1	32.9	24.7	38.3	-	18.8
19	428.10	1.55	5.3	25.2	23.8	45.7	-	-
20	412.78	2.42	5.4	31.9	24.4	43.6	-	22.46
21	348.04	2.07	4.9	26.7	27.1	46.3	-	25.3
23	412.30	2.56	2.4	27.9	27.3	42.4	-	21.89
24	441.12	2.13	2.1	29.7	27.4	40.8	-	21.40
25	376.07		Stone Bands Excluded					
26	310.35		"	"	"			
27	334.52		"	"	"			
30	71.49		Stone Bands Excluded: Wash on Seam Incl. Bands S.G.1.60, Yield 68.8%, Ash 33.5%					
32	82.24		Stone Bands Excluded					
C1	238.37	2.64	*N/A					
C3	162.69	2.74	*N/A					

\*N/A = Not Available.

TABLE 4  
COKING PROPERTIES

187041

0.10

Index No.	Seam name(s) Coal Measures Area or Colliery	Proximate analysis %					Coking properties							
		Inherent moisture (a.d.)	Ash (d.b.)	Volatile matter (d.b.)	Volatile matter (d.a.f.)	Fixed carbon (d.b.)	Caking indices			Gieseler plastometer values				
							Crucible Swelling Number	Gray-King coke type	Roga Index	Initial softening temp. (°C)	Max. fluidity. Dial divisions per minute (ddm)	Max. fluidity temp. (°C)	Solidification temp. (°C)	Temp. range soften to solidification (°C)
D10-1	Fingal . . . . .	6.0	20.2	25.3	31.7	54.5	½	B	0	..	..	..	..	..

Coking properties											Seam name(s) Coal Measures, Area or Colliery	Index No.			
Audibert Arnu dilatometer values					Petrographic parameters					% Mean max. reflectance of vitrinite					
Initial softening temp. (°C)	Temp. of maximum contraction (°C)	Temp. of maximum dilatation (°C)	Maximum contraction %	Maximum dilatation %	Maceral analysis % by volume								Reactivities: Inerts ratio		
					..	..	..	..	..	% Vitrinite	% Exinite	% Microinite		% Semi fusinite	% Fusinite

CLASSIFICATION AND CHEMICAL PROPERTIES

Index No.	Seam name(s) Coal measures Area or Colliery	Classification					Ultimate analysis %					Phosphorus (d.b.)	Chlorine (d.b.)	
		Australian	International	N.C.B.	A.S.T.M. No.	A.S.T.M. description	Sealyer's description	Carbon (d.a.f.)	Hydrogen (d.a.f.)	Nitrogen (d.a.f.)	Oxygen (d.a.f.)			Carbonates (a.d.)
D10-1	Fingal	50115	401	801	113	High vol. A bitum	Paraff. (sublv'd)	83.3	4.79	1.5	10.0	0.1	0.003	Trace

Total (d.b.)	Sulphur %	Gray King carbonization assay at 600°C yield per 100g of dry coal						Fischer assay			Seam name(s) Coal measures Area or Colliery	Index No.	
		Pyritic (d.b.)	Sulphate (d.b.)	Organic (d.b.)	Coke %	Tar %	Liquor %	Gas ml	Coke %	Tar %			Water %
0.36	0.10	..	0.26	80.67	7.36	5.50	9.200	86.9	5.7	3.0	4.4	Fingal	D10-1

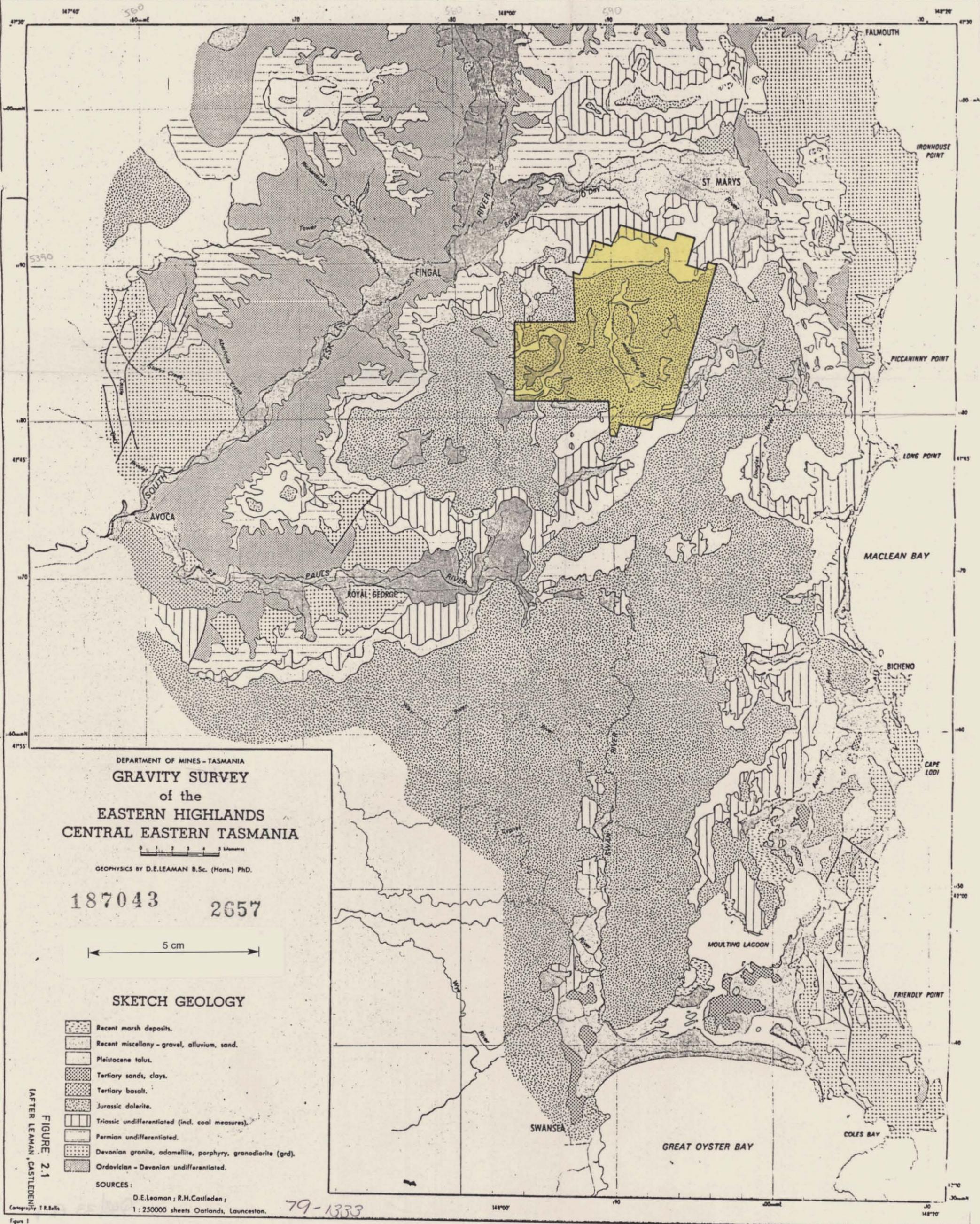
COMBUSTION AND ASH PROPERTIES

Index No.	Seam name(s) Coal measures Area or Colliery	Hardgrove Grindability Index	Gross Specific Energy						Mineral matter % (d.b.)	Ash fusion temperature °C (reducing atmosphere)		
			Air dried		Dry		Dry ash free			Deformation	Hemisphere	Flow
			Btu/lb	MJ/kg	Btu/lb	MJ/kg	Btu/lb	MJ/kg				
D10-1	Fingal . . . . .	56	10 680	24.84	11 360	26.42	14 240	33.12	22.2	1 520	1 560	1 560

Analysis of ash constituents %											Seam name(s) Coal measures Area or Colliery	Index No.	
SiO <sub>2</sub>	Al <sub>2</sub> O <sub>3</sub>	Fe <sub>2</sub> O <sub>3</sub>	TiO <sub>2</sub>	CaO	MgO	Na <sub>2</sub> O	K <sub>2</sub> O	P <sub>2</sub> O <sub>5</sub>	Mn <sub>2</sub> O <sub>4</sub>	SO <sub>3</sub>			SiO <sub>2</sub> :Al <sub>2</sub> O <sub>3</sub> ratio
62.9	28.2	5.48	0.78	0.17	1.02	0.60	0.67	0.02	0.08	0.10	2.23	Fingal	D10-1

## BIBLIOGRAPHY

- BAIRD, J., 1960. Proposed drilling on the Fingal Coalfield. Technical Report, Department of Mines Tasmania, No. 5, p. 188-193.
- NOLDART, A.J., 1975. Permian Coal in Tasmania, p. 264-265 in Economic Geology of Australia and Papua New Guinea, Part II, Coal Monograph No. 6, Aus.I.M.M. 1975.
- NOLDART, A.J., 1975. Triassic Coal in Tasmania, p. 300-301 in Economic Geology of Australia and Papua New Guinea, Part II, Coal Monograph No. 6, Aus.I.M.M. 1975.
- HALE, G., 1962. Triassic System in "The Geology of Tasmania", Journal of the Geological Society of Australia, Volume 9, p. 218-231.
- THREADER, V.M., 1964. The easterly extension of the Fingal Coalfield Technical Report, Department of Mines Tasmania, No. 9, p. 89-95.
- THREADER, V.M., 1968. Interim report on the Geology and Coal Resources of the Northeast Coalfields of Tasmania, Department of Mines Tasmania Report.
- THREADER, V.M., 1976. Diamond Drilling for Coal in the Fingal Area, Department of Mines Tasmania Unpublished Report 1976/14.



DEPARTMENT OF MINES - TASMANIA  
**GRAVITY SURVEY**  
 of the  
**EASTERN HIGHLANDS**  
**CENTRAL EASTERN TASMANIA**

GEOPHYSICS BY D.E. LEAMAN B.Sc. (Hons.) Ph.D.

187043      2657

5 cm

**SKETCH GEOLOGY**

- Recent marsh deposits.
- Recent miscellany - gravel, alluvium, sand.
- Pleistocene talus.
- Tertiary sands, clays.
- Tertiary basalt.
- Jurassic dolerite.
- Triassic undifferentiated (incl. coal measures).
- Permian undifferentiated.
- Devonian granite, adamellite, porphyry, granodiorite (grd).
- Ordovician - Devonian undifferentiated.

**SOURCES:**

D.E. Leaman; R.H. Castleden;  
 1: 250000 sheets Oatlands, Launceston.

FIGURE 2.1  
 (AFTER LEAMAN, CASTLEDEN)

79-1333

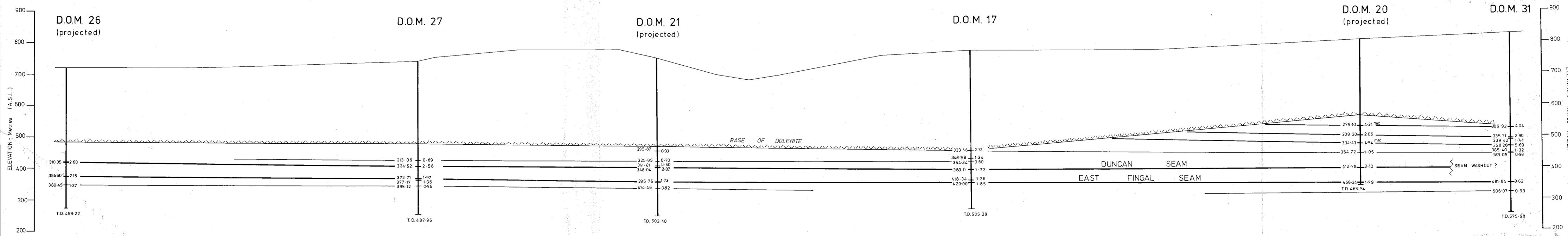
A

SOUTH WEST

Reserve Area  
Western Boundary

B

NORTH EAST

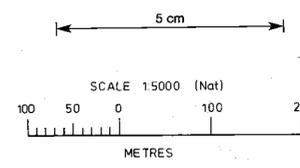


REFERENCE

412.78 | 2.42 | Depth to roof of seam and seam thickness.

T. D. | Total Depth.

Refer to Fig 2.5 for location of cross section.



187044

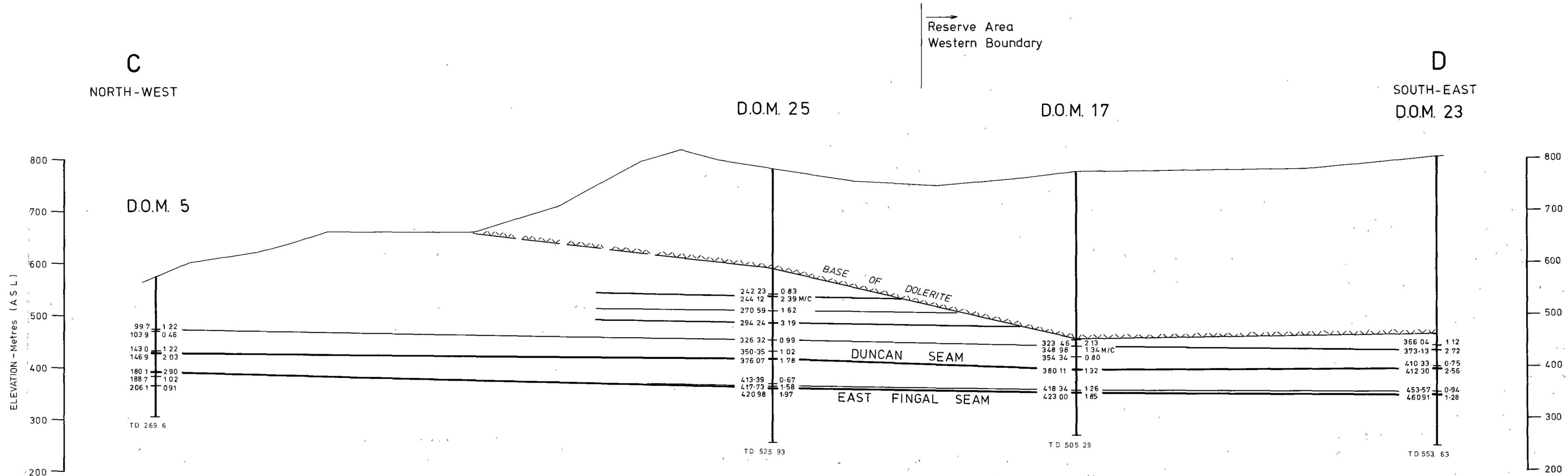
79-1332

THE HYDRO-ELECTRIC COMMISSION OF TASMANIA  
STATE RESERVE FINGAL COALFIELD

CROSS-SECTION A-B

Figure No. 2.2

Prepared by Robertson Research (Aust) Pty Limited  
To Accompany Report No. 511 May 1979

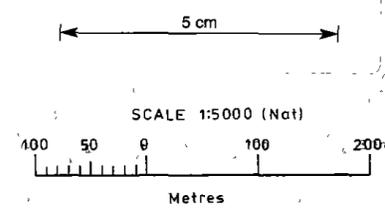


REFERENCE

412 78 | 2 42      Depth to roof of seam and seam thickness

T D                  Total Depth

Refer to Fig 2.5 for location of cross section



187045

79-1333      2659

THE HYDRO-ELECTRIC COMMISSION OF TASMANIA  
 STATE RESERVE      FINGAL COALFIELD

**CROSS-SECTION C-D**

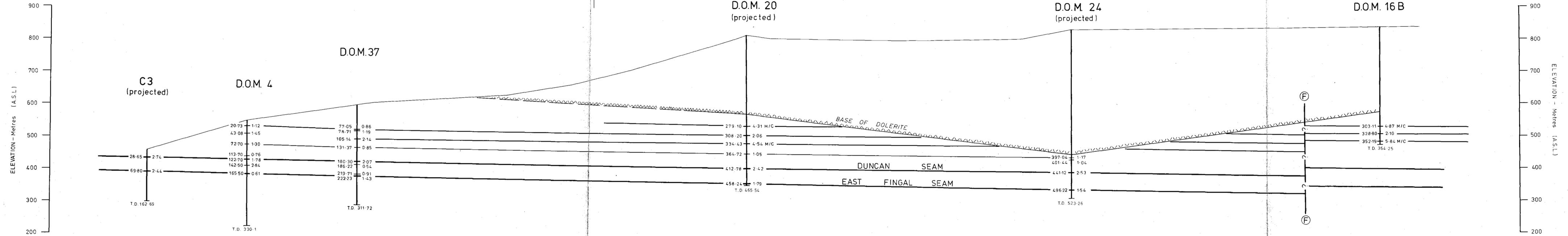
Figure No. 2.3

Prepared by Robertson Research (Australia) Limited  
 To Accompany Report No. 1511      May 1973

E  
NORTH WEST

Reserve Area  
Western Boundary

F  
SOUTH EAST

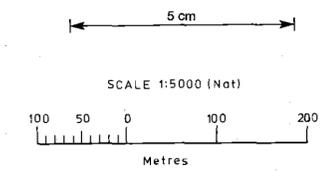


REFERENCE

412.78 | 2.42 Depth to roof of seam and seam thickness

T.D. Total Depth

Refer to Fig 2.5 for location of cross section



187046

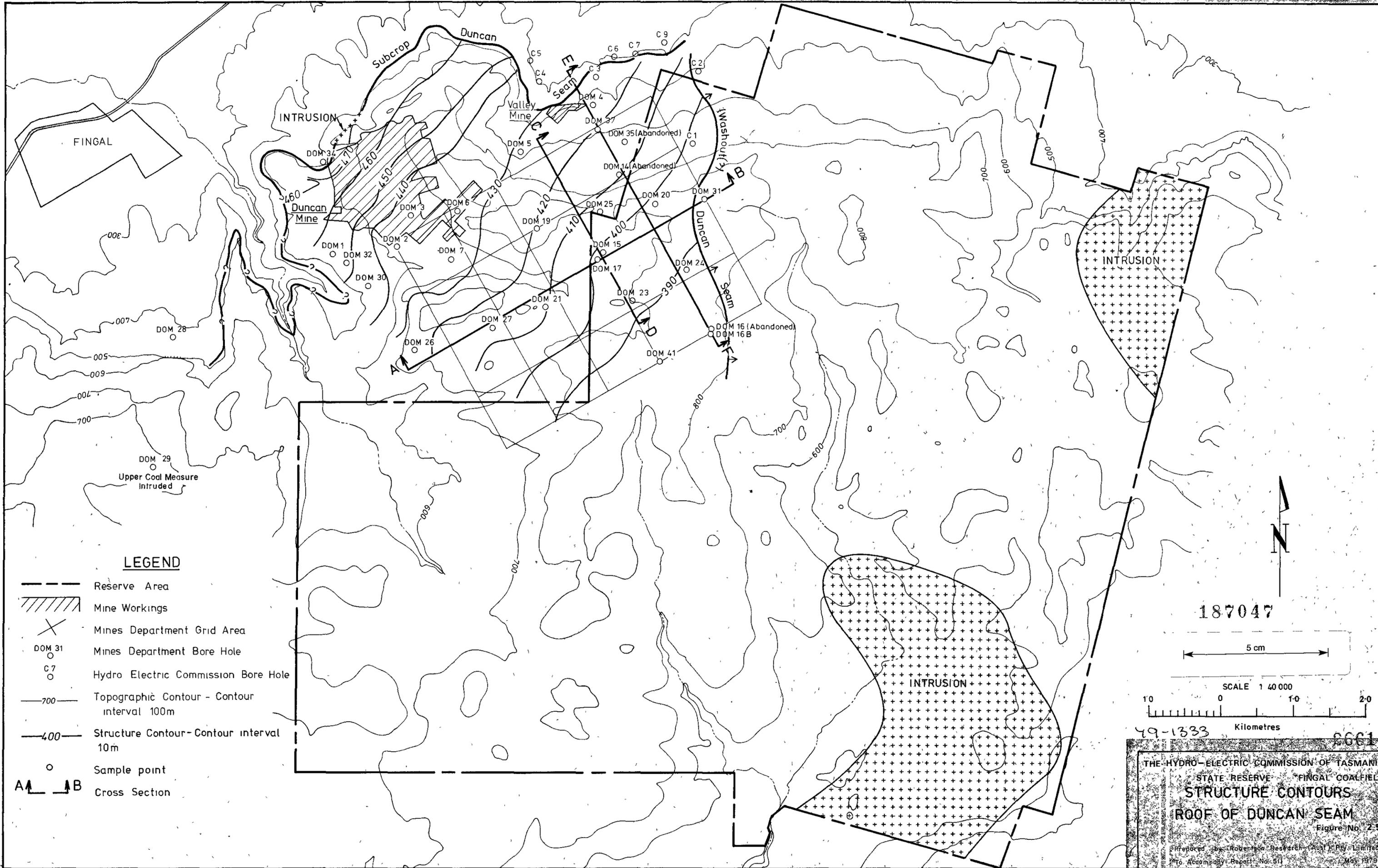
79-1333 2660

THE HYDRO-ELECTRIC COMMISSION OF TASMANIA  
STATE RESERVE FINGAL COALFIELD

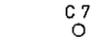
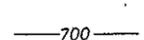
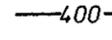
CROSS-SECTION E-F

Figure No. 2.4

Prepared by Robertson Research (Aust) Pty Limited  
To Accompany Report No. 511 May 1979



**LEGEND**

-  Reserve Area
-  Mine Workings
-  Mines Department Grid Area
-  Mines Department Bore Hole
-  Hydro Electric Commission Bore Hole
-  Topographic Contour - Contour interval 100m
-  Structure Contour - Contour interval 10m
-  Sample point
-  Cross Section

187047

5 cm

SCALE 1:40 000

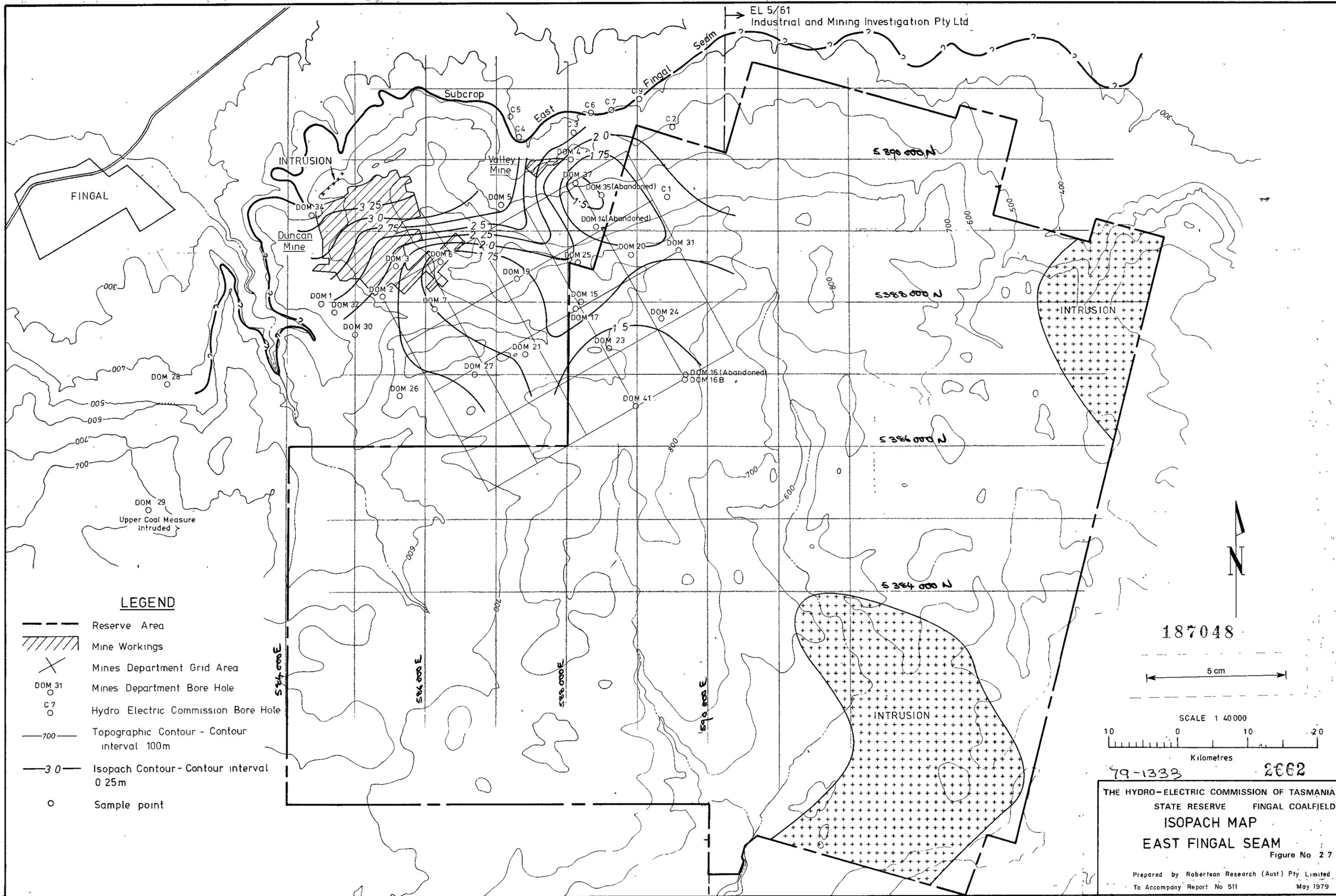


10 0 10 20 Kilometres

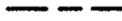
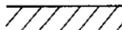
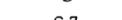
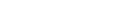
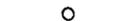
49-1333 2061

THE HYDRO-ELECTRIC COMMISSION OF TASMANIA  
 STATE RESERVE FINGAL COALFIELD  
**STRUCTURE CONTOURS**  
**ROOF OF DUNCAN SEAM**  
 Figure No. 2.5

Prepared by Robertson Research (Aust) Pty. Limited  
 To Accompany Report No. 511 May 1979



**LEGEND**

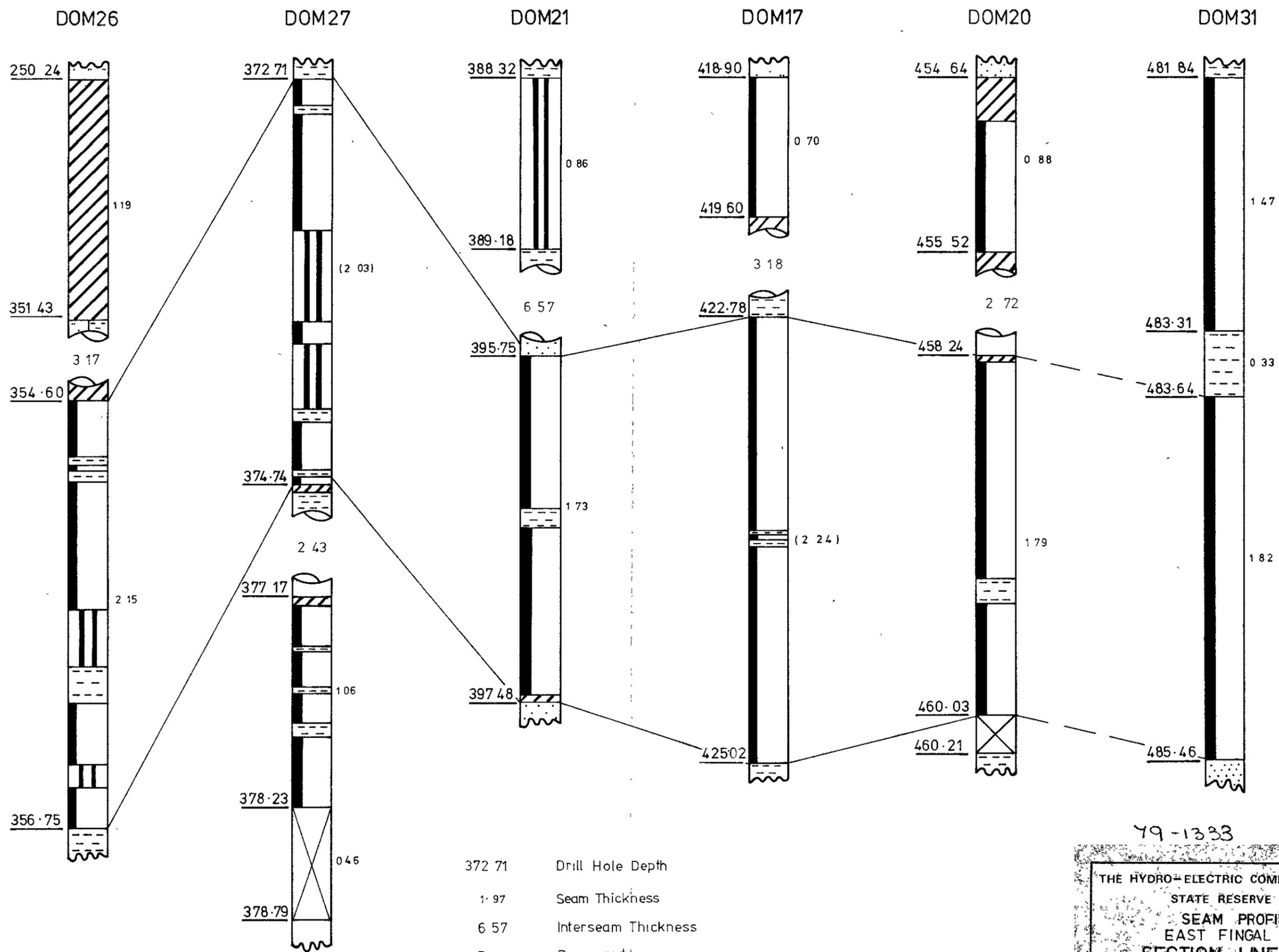
-  Reserve Area
-  Mine Workings
-  Mines Department Grid Area
-  Mines Department Bore Hole
-  Hydro Electric Commission Bore Hole
-  Topographic Contour - Contour interval 100m
-  Isopach Contour - Contour interval 0 25m
-  Sample point

THE HYDRO-ELECTRIC COMMISSION OF TASMANIA  
STATE RESERVE FINGAL COALFIELD  
ISOPACH MAP  
EAST FINGAL SEAM  
Figure No 27

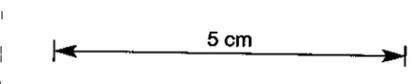
Prepared by Robertson Research (Aust) Pty Limited  
To Accompany Report No 511 May 1979

SOUTH WEST

NORTH EAST



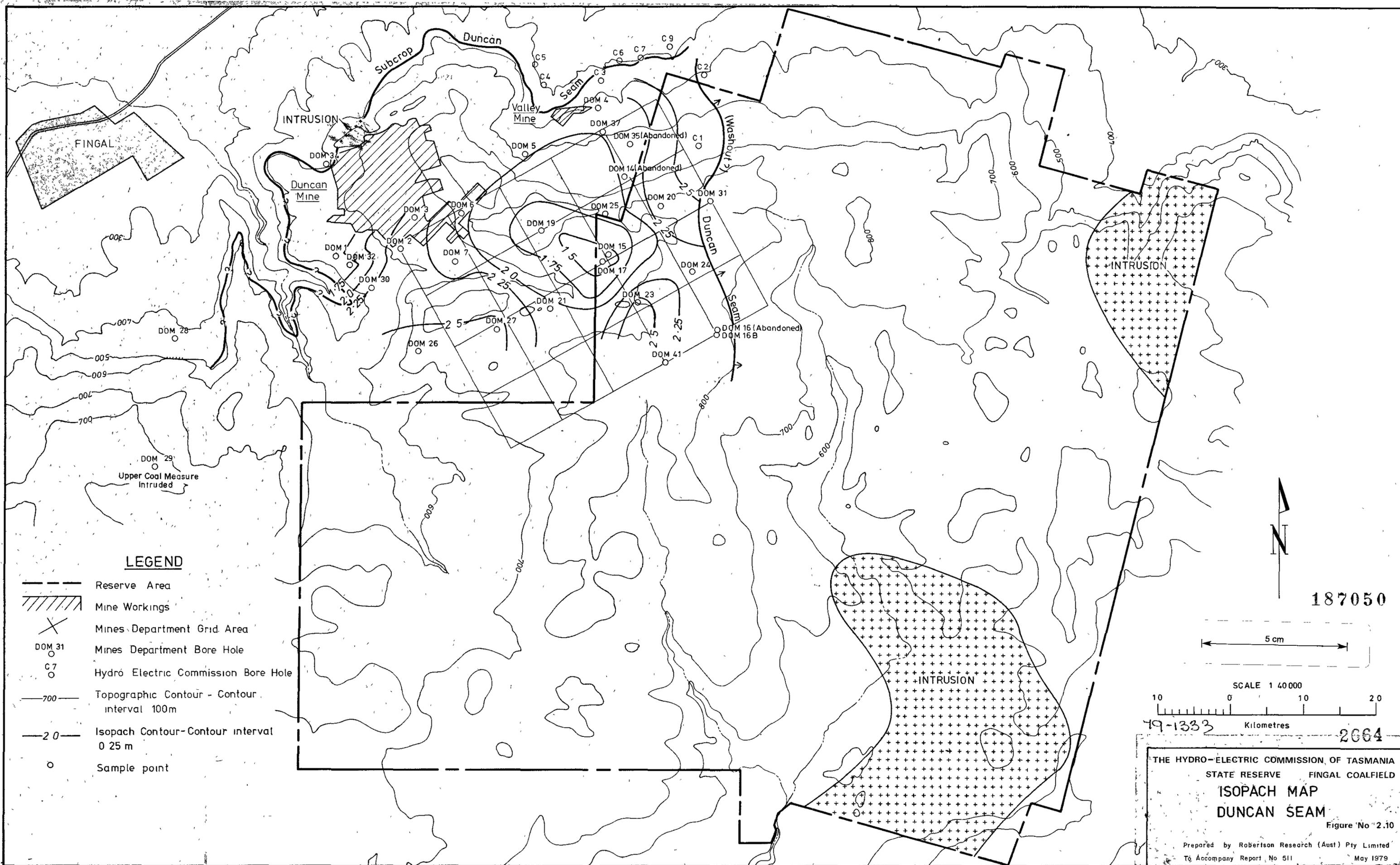
372 71 Drill Hole Depth  
 1 97 Seam Thickness  
 6 57 Interseam Thickness  
 Rec Recovered  
 Refer Fig 2 5 for location of section



79-1333

187049

THE HYDRO-ELECTRIC COMMISSION OF TASMANIA  
 STATE RESERVE FINGAL COALFIELD  
 SEAM PROFILES  
 EAST FINGAL SEAM  
 SECTION LINE A-B  
 Figure No 2.8  
 SCALE 1:20  
 Prepared by Robertson Research (Aust) Pty Limited  
 To Accompany Report No 511 May 1970



**LEGEND**

- Reserve Area
- Mine Workings
- Mines Department Grid Area
- DOM 31 Mines Department Bore Hole
- C 7 Hydro Electric Commission Bore Hole
- 700 Topographic Contour - Contour interval 100m
- 2.0 Isopach Contour - Contour interval 0.25 m
- Sample point

187050

5 cm

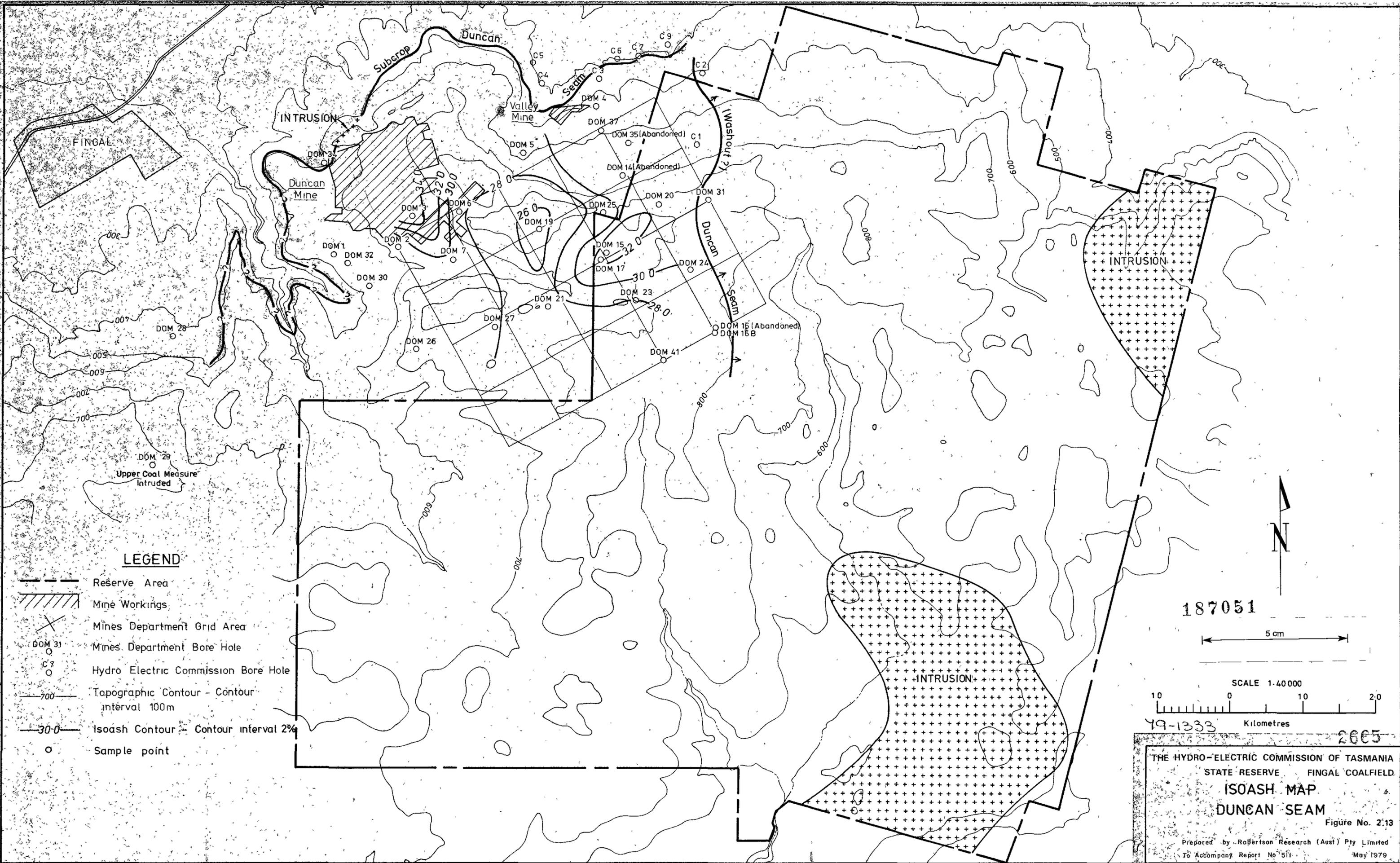
SCALE 1:40000

10 0 10 20

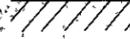
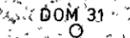
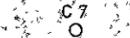
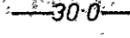
Kilometres

19-1333 2064

**THE HYDRO-ELECTRIC COMMISSION OF TASMANIA**  
 STATE RESERVE FINGAL COALFIELD  
**ISOPACH MAP**  
**DUNCAN SEAM**  
 Figure No 2.10  
 Prepared by Robertson Research (Aust) Pty Limited  
 To Accompany Report No 511 May 1979



**LEGEND**

-  Reserve Area
-  Mine Workings
-  Mines Department Grid Area
-  Mines Department Bore Hole
-  Hydro Electric Commission Bore Hole
-  Topographic Contour - Contour interval 100m
-  Isoash Contour - Contour interval 2%
-  Sample point

187051

5 cm

SCALE 1:40 000

10 0 10 20

49-1333 Kilometres

2665

THE HYDRO-ELECTRIC COMMISSION OF TASMANIA  
 STATE RESERVE FINGAL COALFIELD  
**ISOASH MAP**  
**DUNCAN SEAM**  
 Figure No. 2/13  
 Prepared by Robertson Research (Aust) Pty Limited  
 To Accompany Report No 511 May 1979



EL 5/61  
Industrial and Mining  
Investigation Pty Ltd

Harefield Bore Hole  
Located in this Region  
(1.7m Coal Seam at 10m)

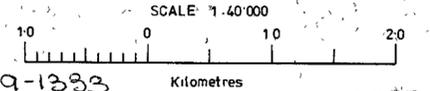
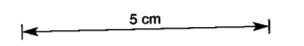
Area for further investigation  
to assess the open cut  
potential

Indicated Reserves  
In Situ 8.53 mt  
Clean 2.77 mt

Measured Reserves  
In Situ 6.64 mt  
Clean 2.16 mt

Reserves of 15 mt. Clean Coal  
Assuming 1. Continuity of a 2m thick coal seam  
2. 50% Mining Recovery  
3. 65% Wash Recovery

- LEGEND**
- Reserve Area
  - Mine Workings
  - Mines Department Grid Area
  - Mines Department Bore Hole
  - Hydro Electric Commission Bore Hole
  - Topographic Contour - Contour interval 100m

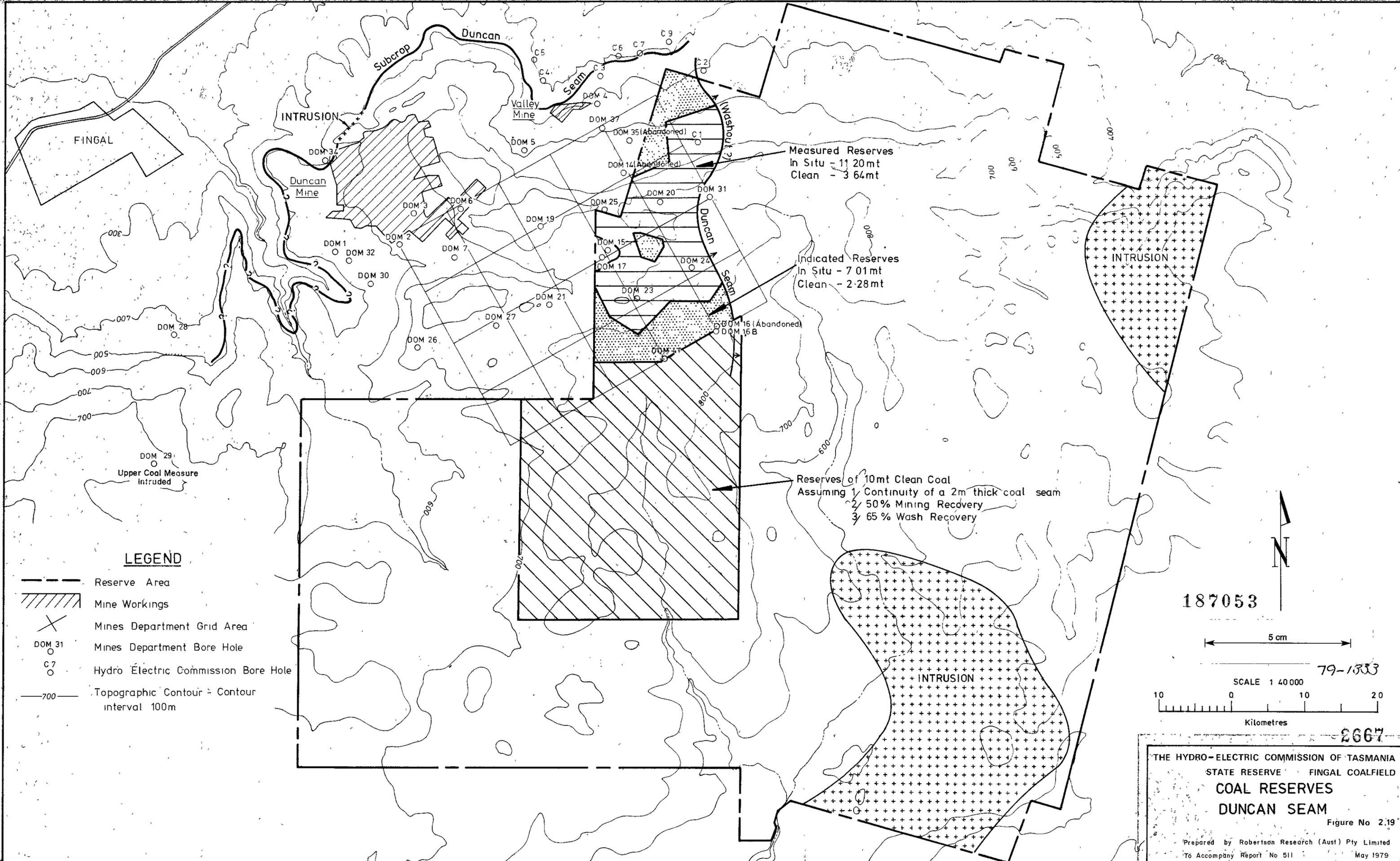


19-1333

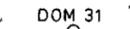
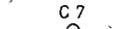
187052

THE HYDRO-ELECTRIC COMMISSION OF TASMANIA  
STATE RESERVE FINGAL COALFIELD  
**COAL RESERVES  
EAST FINGAL SEAM**  
Figure No. 2.18  
Prepared by Robertson Research (Aus) Pty. Limited  
To Accompany Report No. 611 May 1979

Q48/23 Pt 1



**LEGEND**

-  Reserve Area
-  Mine Workings
-  Mines Department Grid Area
-  Mines Department Bore Hole
-  Hydro Electric Commission Bore Hole
-  Topographic Contour - Contour interval 100m

Measured Reserves  
In Situ - 11 20 mt  
Clean - 3 64 mt

Indicated Reserves  
In Situ - 7 01 mt  
Clean - 2 28 mt

Reserves of 10 mt Clean Coal  
Assuming 1/ Continuity of a 2m thick coal seam  
2/ 50% Mining Recovery  
3/ 65% Wash Recovery

187053

5 cm

SCALE 1:40 000  
10 0 10 20  
Kilometres

79-1333  
2667  
THE HYDRO-ELECTRIC COMMISSION OF TASMANIA  
STATE RESERVE FINGAL COALFIELD  
**COAL RESERVES  
DUNCAN SEAM**  
Figure No 2.19  
Prepared by Robertson Research (Aust) Pty Limited  
To Accompany Report No 511 May 1979

042  
ROBERTSON RESEARCH (AUSTRALIA) PTY. LIMITED

REPORT NO. 523

PROJECT NO. 1140

PRELIMINARY PROPOSAL FOR THE  
EXPLOITATION OF COAL RESERVES  
IN THE FINGAL COALFIELD, TASMANIA  
PART II - MINING CONCEPT AND  
ASSOCIATED COSTS

by

I.J. Salway, B.Sc., C.Eng., M.A.I.M.M. - Associate  
R.G. Hancock, A.C.S.M., M.I.M.M., A.M.A.I.M.M.  
P. Jago, B.Sc., M.Aus.I.M.M.

Prepared for:

The Commissioner,  
The Hydro-Electric Commission,  
4-16 Elizabeth Street,  
HOBART, TASMANIA.

June, 1979

**OPEN FILE**

SUMMARY AND COMMENT

This is the second part of a study commissioned by the Hydro-Electric Commission of Tasmania in order to examine the possibility of developing a coal mine(s) in the N.E. of Tasmania. The purpose of the mine being to supply coal to a 2 x 200 M.W. thermal power station.

Geological aspects of the study are dealt with in Part I of this report. This Part II considers the mining, treatment and transport of coal and the associated capital requirements and costs. The study differs from that originally intended and as outlined in Invitation to Tender document C.E. 1788 Section 3, because it was found that after examination of the data available there was insufficient information available to develop a detailed mine plan as specified in the tender document.

Because of the sparcity of information concerning the subject area, due either to the lack of exploration drilling or insufficient analysis of drilling carried out, it has been necessary to base the mining concept employed on a number of assumptions. Although these assumptions are in our opinion well founded and reasonable, future exploration and investigation could prove them to be incorrect, in which case, the concept and basis for capital and operating costs estimates given in this report would require revision.

The major design criteria employed in arriving at a mining concept were as follows:-

- \* There are only two mineable seams in the Exempt Area; these are the Duncan Seam and the East Fingal Seam (assumed).

044

- \* The present in-situ reserves in both seams amount to 17.84 million tonnes classified as measured and 15.54 million tonnes classified as indicated giving a total of 33.38 million tonnes of measured and indicated reserves.
- \* The seam thickness that would be encountered when mining would be 2.13m in the Duncan Seam and 3m in the East Fingal Seam (assumed).
- \* The ash content of the Duncan Seam in-situ would be 28% and that of the East Fingal Seam would be 30%; their respective calorific values would be 21 MJ/Kg and 22MJ/Kg (assumed).
- \* The Duncan Seam would have a mudstone roof and the East Fingal Seam would have a sandstone roof. Both seams would have a moderately soft floor (assumed).
- \* The Dip of both seams would be  $1^{\circ}$  -  $2^{\circ}$  (assumed).
- \* The average mining recovery over the life of the mine would be 60%, i.e. mining operations would be successful in removing 60% of the in-situ reserves (assumed).
- \* The washery recovery would be 85% and the resultant product would meet the H.E.C. specifications (assumed).

The estimated fuel requirement for the power station was supplied by the H.E.C., this amounts to a total of 33 million tonnes of coal with a calorific value of 23 MJ/Kg over the 30 year life of the power station and a maximum annual requirement of 1.26 million tonnes. This fuel requirement was employed together with the above assumptions and known geological and technical facts to devise a project concept and to estimate capital requirements and direct costs of production.

The concept envisages that two mines would be necessary to provide the required production. One mine would be in the Duncan Seam and the other in the East Fingal Seam. Each mine would produce 3700 tonnes per day of run-of-mine coal.

Both mines would obtain the majority of their production from different parts of the Exempt Area, but mine entries would be close together and in the region of the 400m contour. The mine entries would be sited in the seam which would be exposed by excavation and the mines would then be developed in the coal seam starting from the surface.

Three entries would be driven for each mine, one entry for coal conveying, one entry for machine and personnel access and one entry as a ventilation return with mine fans installed on the surface.

Both seams would be developed by a multiple entry system. In the Duncan Seam Coal Boring Jumbos and Load Haul Dump machines would be employed loading onto conveyor belts and in the East Fingal Seam, Continuous Miners loading into Shuttle Cars onto conveyor belts.

The method of underground coal transportation would be by conveyor belt and belt feeder breakers would be used.

Personnel and materials would be transported underground by diesel powered prime movers with special trailer units for personnel and materials.

The mine workshops, mine baths, offices, stores, etc. would be sited on the flatter ground below the 300m contour in the Break O'Day Valley close to the workshop area.

The washing plant would consist of a Bradford Breaker, raw coal bin, jigs, and cyclones, washed coal bin and washery reject bin.

046

The coal from the washery would be either transported directly by belt conveyor to a truck loading bin with 1000 tonnes live capacity, onto a stockpile with 100,000 tonnes capacity and trainloading facility rated at 2500 tonnes per hour, or directly to the power station stockpile which would have a capacity of about 750,000 tonnes. The type of ex-washery handling facility chosen would depend on the siting of the power station. Capital cost estimates have been given for three alternatives.

The initial capital requirement for developing the above concept would depend on the final selection of power station site. A full breakdown of capital estimates is given in Appendix 1 of this report. Four different capital alternatives are given below.

Case 1 - A supply of raw coal by belt conveyor to a power station sited adjacent to the mine, i.e. no washery, rail loop or mine stockpile required and the power station designed to burn raw coal. The total initial capital requirement in this case would be \$46,226,000.

Case 2 - A supply of washed coal by belt conveyor to a power station sited adjacent to the mine. The total initial capital requirement in this case would be \$49,064,000.

Case 3 - A supply of raw coal to a power station sited say at Bell Bay. Rail loop and stockpiling facilities would be needed and the total initial capital requirement in this case would be \$50,237,000.

Case 4 - A supply of washed coal to a power station sited say at Bell Bay. Total initial capital required - \$53,077,000.

047

The personnel requirement for the mine when in full production would be 433. It has been assumed when estimating capital that accommodation in the form of caravan parks (50), single quarters (80) and houses (163) would have to be provided by the H.E.C.

The total initial capital expenditure would be spread over a period of 11 years. The first expenditure would be on carrying out an exploration programme. This expenditure would amount to \$2,300,000 and the programme would take 2 years to complete.

Following this detailed planning and environmental studies would be required before the decision could be made to go ahead with the project. This work would take 1 year to complete and would cost \$600,000.

Following this there would be two years of mine development before the mine would be developed sufficiently to confidently provide fuel for a power station.

In addition to the initial capital requirement a further \$20,000,000 capital expenditure would be required for replacement of mining equipment during the life of the mine.

The direct costs of production have been synthesised on the basis of the mining concept. The costs arrived at are as follows:-

	\$
Raw Coal Ex-Mine	11.64
Washed Coal Ex-Washery	15.04

048

These costs do not include any allowance for depreciation or head office administration. The costs are slightly higher than the average that would be expected in N.S.W., but are in keeping with the assumed mining conditions.

The results of this study indicate that, if the assumptions made in this report are correct, there is a good possibility of establishing a coal mine in the Exempt Area. Obviously before any decision can be made to use coal from this area as fuel for a thermal power station, it will be necessary to firstly prove that there is sufficient coal there to support the project, and secondly that it can be produced at a price competitive with other forms of fuel.

If the power station is to go on line in 1989 and there is a possibility that power station is to be coal fired from Tasmanian coal, then there is little time to lose and an exploration programme should be started as soon as possible. This programme should determine the reserves present in the Exempt Area and should also determine the quality and washability of the coal and if possible, the seam conditions. At the moment there are 17.84 million tonnes of measured reserves in the Exempt Area. It is necessary to convert the indicated reserves of 15.4 million tonnes to the measured category and to increase the total measured reserves by a further 32 million tonnes. This latter figure assumes that the ash content, and washery recovery used in this report are correct.

In addition to reserves, more information is required with regard to ash content, calorific value, washability and seam conditions, in fact, the majority of the assumptions which have been used in this report have to be proven or disproven before a confident decision can be made.

049

This can only be achieved by carrying out a properly planned and conducted exploration programme in the Exempt Area. If this is unsuccessful, then other areas could possibly be considered.

CONTENTSPAGE NO.

1.	INTRODUCTION	1
	1.1 General	
	1.2 Scope	
	1.3 Procedure	
2.	DESIGN CRITERIA	4
	2.1 Introduction	
	2.2 Mineable Seams	
	2.3 Geological Reserves	
	2.4 Seam Conditions	
	2.5 Seam Outcrops	
	2.6 Mining Recovery	
	2.7 Washery Recovery	
3.	PRODUCTION PROGRAMME	12
4.	MINING CONCEPT	14
	4.1 Introduction	
	4.2 Number of Mines	
	4.3 Mine Entries	
	4.4 Mining Methods	
	4.4.1 Selection of Methods	
	4.4.2 Duncan Seam (LHD Method)	
	4.4.3 East Fingal Seam (CM & SC)	
	4.5 Underground Coal Transportation	
	4.6 Personnel & Material Transportation	
	4.7 Machine Maintenance	
	4.8 Surface Facilities	
	4.9 Mine Ventilation	
	4.10 Washing Plant	
	4.11 Stockpiling and Transport to Power Station	
	4.12 Infrastructure	
5.	CAPITAL REQUIREMENT	31
	5.1 Introduction	
	5.2 Summary of Initial Capital Requirement	
	5.3 Initial Capital Phasing	
	5.4 Replacement Capital and Phasing	
6.	DIRECT COSTS OF PRODUCTION	35
	6.1 Introduction	
	6.2 Labour Requirements and Cost	
	6.3 Other Costs	
	6.4 Summary Direct Production Costs	
	6.5 Transport Costs	

APPENDIX - 1

## CAPITAL REQUIREMENTS

1. PRE-DEVELOPMENT COSTS
2. LAND ACQUISITION
3. INFRASTRUCTURE
4. SURFACE FACILITIES
5. MINE VENTILATION FANS
6. UNDERGROUND MINING EQUIPMENT
7. SURFACE CONVEYOR
8. COAL WASHING PLANT
9. STOCKPILING FACILITIES
10. HOUSING REQUIREMENTS
11. REPLACEMENT CAPITAL

APPENDIX - 2

## PRODUCTION COSTS

1. PERSONNEL REQUIREMENTS AND LABOUR COST
  - 1.1 Summary
  - 1.2 Duncan Mine - Underground
  - 1.3 East Fingal Mine - Underground
  - 1.4 Surface - Combined Mines
2. ROOF SUPPORTS
3. PROVISION FOR OVERHAUL
4. POWER COSTS
  - 4.1 Power Requirements
  - 4.2 Power Costs
5. MAINTENANCE MATERIALS & SPARES
6. MINE STORES
7. WASHING COSTS AND STOCKPILING COST
8. HOUSING MAINTENANCE

## FIGURES

1. RESERVE AREAS - DUNCAN AND EAST FINGAL SEAMS
2. CONCEPTIONAL LAY-OUT
3. GENERAL MINING PLAN - BOTH SEAMS
4. DUNCAN SEAM - PROPOSED NORMAL MINING SECTION LAY-OUT
5. PROPOSED SHOTFIRING PATTERN - DUNCAN SEAM
6. PROPOSED PILLAR EXTRACTION SEQUENCE - DUNCAN SEAM
7. PROPOSED TIMBERING PLAN - DUNCAN SEAM

053

1.

INTRODUCTION1.1 GENERAL

The Hydro-Electric Commission of Tasmania commissioned Robertson Research (Australia) Pty. Ltd. to carry out a study relating to the possible development of a coal mine(s) in Tasmania. The purpose of the coal mining operation being to supply a 2 x 200 M.W. thermal power station with fuel.

The full Robertson Research report on the study consists of two parts. Part I is solely concerned with the geological aspects of the study and is presented under a separate cover. This Part II of the report is concerned with the mining concept and associated capital requirement and production cost estimates.

The mining area which has been considered as a possible site for coal mining operations is an Exempt Area which is reserved for the H.E.C. The Exempt Area is in the N.E. part of Tasmania and is to the south of the Break O'Day Valley between Fingal and St. Marys.

The area can be reached by road from Launceston, a distance of approximately 115Km, or from Hobart which is 195Km away. The main road access is from the west along the Esk Main Road which runs along the South Esk River to Fingal and then continues along the Break O'Day river towards St. Marys. The property can also be reached via the Esk Main Road via the East Coast route.

Railway access to the area is via the Fingal line which runs to the north of the Esk Main Road and passes within about 3Km of the Exempt Area.

The known coal seams sub-crop on the south side of the Break O'Day Valley at about the 400 metre contour and extend to the south. A massive basalt cap, which is mountainous and wooded, covers the known coal seams and also the Exempt Area. There is limited access to the northern and north western edge of the Exempt Area, but the majority of the area is presently inaccessible by road.

Main electricity supply also follows the same route as the road and railway and after some amplification of existing facilities can be supplied to the mine site.

The surface area of the Exempt Area is 94 square kilometers.

The Exempt Area adjoins an existing mining lease which is held by the Cornwall Coal Co. and which is being mined by them at their Duncan Mine.

## 1.2

### SCOPE

The objective of the study has differed from that originally intended by the H.E.C. and as set down in the Invitation to Tender Document C.E. 1788 Section 3. That invitation called for detailed plans of underground layouts, surface layout, coal handling facilities, process flow sheets etc.

As a result of discussions regarding the sparcity of the base data which was available for study, it was decided that it would be inappropriate to attempt to make detailed plans at this stage. Nevertheless, it was agreed that preliminary consideration should be given to the aspects mentioned in the Tender Document and a series of assumptions made, which would be as realistic as possible in the circumstances and on which capital and production cost estimates would be based. This cost analysis

would then be employed by H.E.C. as input to the overall study analysis which would be carried out by them and in which they would apply their own economic evaluation. The figures to be supplied would be in 1979 dollars.

Since it has not yet been decided where the power station would be located, cost would be given which would relate to transportation of run-of-mine coal and washed coal to various alternative sites.

## 1.3

PROCEDURE

A visit was made to Tasmania by Mr. R. G. Hancock (Mining Engineer) and Mr. P. Jago (Geologist) at which time discussions were held with officers of H.E.C., Mines Department, Geological Survey and the Government Railways. An inspection was also made of the Duncan Mine in the company of Mine Manager, Mr. R. Bellows and Mr. P. Allen, Inspector of Mines. During this visit as much information as was available was collected on the geology and mining conditions relating to the Exempt and adjacent areas.

The geological information was then studied by Mr. P. Jago and Part I of this report was prepared. The results of the geological study were then employed together with a number of assumptions, which are listed in Section 2 of this report, to evolve a mining concept which was, in turn, used as a basis for capital and operating cost estimates.

Mr. I.J.U. Salway, operating in the capacity of Robertson Research associate has undertaken the majority of this study, with Mr. R. G. Hancock providing input and second opinions on various aspects.

056

2.

DESIGN CRITERIA

2.1

INTRODUCTION

In order to arrive at a concept on which to base the capital and operating cost estimates for a possible coal mine in the Fingal area, it is necessary to have design criteria on which to establish the concept. This design criteria would normally be available from the results of geological exploration, drilling and mapping, analysis carried out on drill cores, washery tests carried out on bulk samples and possible examination of underground conditions by tunnelling.

In the case of the Exempt Area very little information of the above nature is available because of the very small amount of drilling that has been carried out to date in the subject area. The actual drilling results that are available relative to the Exempt Area are given in Part I of this report and the geological interpretation based on those drilling results is described.

Although there is very little information available for the Exempt Area, there is however, a lot of geological information available relating to the "Duncan Mine" which adjoins it. This information has been employed together with the limited information available on the Exempt Area to project circumstances which, it is considered, may occur within that area.

These projections together with other assumptions of design criteria, such as mining and washery recovery factors, have been used as a basis for the development of a mining concept.

057

Although these assumptions are in our opinion well founded and reasonable, future exploration and investigation could prove them to be incorrect. The estimates of capital cost for the development of a mine in the Exempt Area and the cost of producing coal from that mine are based on these assumptions, the estimates therefore, as they relate to the area considered, are as valid as the assumptions are correct.

The assumptions made have been influenced to a large extent by the conditions and experience encountered in the "Duncan Mine" which adjoins the Exempt Area.

The design criteria on which the mining concept has been based are described below. Obviously before any really confident estimates of capital and operating costs can be obtained, these criteria have to be verified by the completion of a geological exploration programme over the area and by carrying out pilot plant washery tests on bulk samples obtained from the seams encountered.

In the meantime, the estimates arrived at in this study will give an indication of the order of magnitude of capital expenditure and production costs that would be incurred should further investigations confirm the designed criteria outlined below.

## 2.2

MINEABLE SEAMS

Of the 10 coal seams intersected by DDH25 in the upper coal bearing sequence of the Upper Parameener Super Group, it has been assumed that only the Duncan Seam and the East Fingal Seam will be mineable within the Exempt Area.

The assumed geographical location of the coal reserves in the lower seam, the East Fingal, is outlined in Fig. 2.18 of Part I. It has been assumed that the seam is continuous over this area and that the seam has not been displaced by igneous intrusions.

It has also been assumed that the upper seam, the Duncan has been washed out on the eastern edge of the current exploration drilling grid and does not continue further in the easterly direction. The area that is considered for mining the Duncan is outlined in Fig. 2.19 of Part I.

The vertical interval between the two seams has been assumed to be 45 metres.

### 2.3 GEOLOGICAL RESERVES

The in situ reserves for the two seams considered mineable are given below. The cut-off thickness employed for the reserve estimate was 1.5 metres.

IN SITU RESERVES TONNES x 106			
SEAM	MEASURED	INDICATED	TOTAL
Duncan	11.20	7.01	18.21
East Fingal	6.64	8.53	15.17
TOTAL	17.84	15.54	33.38

The requirement of washed coal over the life of the power station has been projected by the H.E.C. as 33 million tonnes which, if our assumptions of mining and washery recovery factors (see Sections 2.6 and 2.7) are correct, amounts to approximately 65 million tonnes of in situ reserves. Additional tonnage is therefore to be proven in order to fulfil the power station requirement.

## 2.4

SEAM CONDITIONS

Thickness - The thickness of the seams can be expected to vary considerably over the mining areas considered. The East Fingal seam is known, from bore hole information, to vary from 1.28m to 3.62m and average 2.25 but the seam appears to thicken to about 3.5 metres as it enters the Exempt Area in the North East. For mining purposes an average thickness of 3m has been assumed in the East Fingal Seam to the N.E. of the explored area.

The Duncan Seam varies in thickness from 1.32m to 2.74m and averages 2.13m in the explored areas. This average thickness has been assumed to continue in the area where the Duncan Seam is proposed to be mined.

Quality - There is a lack of knowledge regarding the coal seam quality either due to the fact that the core samples taken have not been analysed or that the analysis has been incorrectly carried out, e.g. in some cases dirt bands were removed from the core prior to analysis. The information available, which is based on 5 drill holes only, is:-

SEAM	AVERAGE VALUES					
	% Moisture	% Ash	%V.M.	%F.C.	% S	C.V. MJ/KG
Duncan	4.1	29.5	25.7	41.6	0.29	21.51
E. Fingal	3.7	32.7	22.9	43.4	0.77	22.7

The ash content of the East Fingal decreases to the N.E. and has been assumed therefore to be 28% in the proposed Fingal mining area to the N.E. The ash content for the Duncan Seam has been assumed to be 30% over the proposed Duncan mining area.

Roof and Floor - From the experience gained in the "Duncan Mine", when the roof of the seam is of sandstone, good mining conditions can be anticipated, when the roof is mudstone difficulties can be expected with the support of the immediate roof. It has been assumed that a mixture of roof conditions will apply over the areas considered for mining.

Indications are that the roof of the East Fingal Seam will be sandstone and good conditions will prevail and that the Duncan Seam will have a mudstone roof with consequently worse roof conditions.

The floor conditions have been considered as moderately soft in all areas.

Consideration has been given to these factors when selecting mining methods, estimating production rates and costing roof supports.

The production performance at any coal mine is still governed to a large extent by the conditions of roof and floor of the seams mined. It is therefore recommended that before a decision be made on the final mining method to be employed, which in turn commits large amounts of capital to certain types of mining equipment, the underground seam conditions be thoroughly explored. This factor is taken into account in the development programme for the mine.

Dip - The exploration drilling carried out indicates that the seams dip evenly to the east at  $1^{\circ}$  -  $2^{\circ}$ . These dips have been assumed to continue into the proposed mining areas.

Cover - The thickness of the cover over the coal seams will vary. In the Eastern areas it has been assumed to be an average of 450m and in the Western area an average of 300 metres. The rocks forming the cover on the seams are massive dolerite, sandstone, mudstones, and shales.

Water - It is anticipated that conditions underground will be dry. This assumes that similar conditions to those encountered at the "Duncan Mine" will persist throughout the areas to be mined.

Faults - It is expected that faults will occur in the area but that they will be only of a minor nature and will not cause any serious disruptions to normal production.

Igneous Intrusions - It has been assumed that igneous intrusions or wash outs have removed all mineable seams other than the East Fingal in the Eastern Area and that the continuation of the East Fingal Seam to the most eastern part of the Exempt Area has been curtailed by igneous intrusions.

## 2.5

### SEAM OUTCROPS

Section 2.5.1 of Part I of this report notes that the subcrop of the East Fingal Seam as plotted occurs to the north of the Exempt Area. This also applies to the Duncan Seam. If the seams are to be entered by means of adits from the Break O'Day Valley it will be necessary to acquire land to the north of the Exempt Area, alternatively the seams can be developed from cross-measure drifts. For the purposes of this report it has been assumed that land will be acquired to the north for the purposes of establishing portals and surface facilities.

Mention is also made in Part I of this report to the possibility of open-cut coal resources in the Harefield region. Since these possible reserves lie outside the Exempt Area and are within an existing A to P they have not been considered as a mining possibility within the terms of reference of this study.

## 2.6

MINING RECOVERY

The recovery of mineable reserves obtained will depend to some extent on the mining method employed and the seam conditions encountered. Up to 90% recoveries have been achieved by the methods considered in the mining concept but this is unusually high. Until more is known of the conditions that may be encountered underground, an average recovery of 60% is considered to be a realistic figure. An increase or decrease in this factor of course affects significantly the amount of reserves required in order to establish a mine.

## 2.7

WASHERY RECOVERY

It appears from the information available that a major source of ash would be the dirt bands in the coal seams. It is possible that a large amount of this material could be removed by screening the run-of-mine coal and then passing the oversize through a Bradford Breaker which could remove some of the banded dirt before it enters the washery proper.

The product requirement is for a 24% ash product with a C.V. of 23 MJ/K. The feed of raw coal to the washery would be approximately 29% ash with a C.V. of 21 MJ/K.

It has been assumed at this stage, pending pilot plant results, that an overall washery recovery for both seams to be mined, in order to give the required product specification, would be of the order of 85-90%.

The above assumption is based on the results reportedly obtained by the "Duncan Mine" washery.

The figure of 85% has been used in calculations.

The value of the washery recovery factor also has a significant effect on the amount of reserves required to establish a mine, the future production rates and the capital cost. It is very important therefore, to ensure that laboratory washability tests are carried out on the drilling samples obtained from the proposed exploration programme and also that washery pilot plant trials are carried out on bulk samples at a later date.

064

3.

PRODUCTION PROGRAMME

The production programme for the mine has been based on a schedule supplied by the H.E.C. This schedule indicates that first supplies of coal for the proposed 2 x 200 MW coal fired station would be required by about 1989. The coal requirements for the station have been based on a coal feed with an ash content of 24% which would have an approximate C.V. of 23 MJ/K. The following Table I gives the schedule of the H.E.C. approximate requirements.

The R.O.M. annual production levels which have been based on a washery yield of 85% are also given in Table I.

The daily production levels of run-of-mine required have been based on a 5-day working and a 40 working week year, i.e. 200 days/yr. This latter figure has been proven over recent years to be a realistic number for the coal mining industry when taking into consideration holidays, sickness and strikes. These production levels have been used to estimate men and machinery requirements later on in the study.

The R.O.M. tonnages have been converted to the equivalent in-situ reserve tonnages by applying the mining recovery factor of 60%. This calculation indicates that if our assumptions are correct, approximately 65 million tonnes of in-situ coal reserves would be required to be categorised as measured prior to initiating this project.

From the time that the decision to mine coal is made then the lead time required to start producing washed coal would be approximately two years. This would be the time required to purchase and construct a washery. Other items of mining equipment have delivery delays of up to a year.

PRODUCTION PROGRAMME

Project Yr No.	Approx. Date	TONNES x 1000			Tonnes R.O.M. Daily Production
		H.E.C. Require- ment Washed Coal/Yr	R.O.M. Production Per Year	Depletion of Reserves	
1	87-88	-	-	-	
2	88-89	-	-	-	
3	89-90	360	424	707	2120
4	90-91	495	583	972	2915
5	91-92	630	742	1237	3710
6	92-93	765	900	1500	4500
7	93-94	945	1113	1856	5565
8	94-95	1080	1271	2118	6355
9	95-96	1260	1482	2470	7410
	↓	↓	↓	↓	↓
28	14-15	1260	1482	2470	7410
29	15-16	1080	1271	2118	6355
30	16-17	990	1165	1942	5825
31	17-18	955	1124	1873	5620
32	18-19	500	589	982	2945
TOTAL		33,000	38,823	64,705	

4.

MINING CONCEPT

4.1

INTRODUCTION

The mining concept outlined in this section of the report has been based on the design criteria and production programme described previously. For a variety of reasons, mainly due to the lack of substantiated data, a large number of assumptions have been made. Although it is considered that these assumptions are as realistic as possible, it is emphasised that at this point a flexible attitude must be maintained at all times so that mining methods, washery design and infrastructure requirements can be modified to take care of actual circumstances as they arise.

4.2

NUMBER OF MINES

The geographical location of the reserves as they have been assumed for purposes of calculating the reserves of coal required for the project are outlined in Fig. 1. It can be seen from this sketch that there are three distinct areas which are as follows:-

Area 1 - Both the Duncan and East Fingal seams are present in this area and are the only mineable seams. The reserves of this area are classified as Measured and Indicated.

Area 2 - The East Fingal Seam is considered to be the only mineable seam in this area. It has been assumed that the Duncan Seam is washed out and the other seams, if present, are unmineable. The reserves in this area are classified as inferred.

067

Area 3 - Only the Duncan Seam is mineable in this area, the East Fingal and other seams have been assumed to be too thin for mining. The reserves in this area are classified as inferred.

The maximum annual production that would have to be mined in order to satisfy the requirements of the power station would be 1.5 million tonnes. The reserves are contained in two seams and at this stage it is considered that the reserves of both seams would have to be mined in order to fulfil the total requirement of the power station over it's full life.

The geographical location of the reserves and the fact that both seams are only mineable in Area 1 suggests that the most logical development of the reserves would be by two separate coal mines, one mine being in the Duncan Seam and one mine in the East Fingal Seam with both mines operating simultaneously and independently. The coal from both mines could be centralised at a common coal washery where it could be blended and dispatched to the power station as one product.

For the purposes of this study, it has been assumed that two such mines would be developed.

#### 4.3

#### MINE ENTRIES

It has been assumed that land to the North of the Exempt Area can be obtained by the H.E.C. for the purposes of establishing mine entries and surface installations.

This land would contain the sub-crops of both the Duncan and East Fingal Seams. The area required would not lie within the E.L. 5/61 held by Industrial and Mining.

Entrance to both seams would be via the sub-crop and after this was exposed all development would be in the coal seam.

Cuts would be bull-dozed and the seam exposed. Portals would then be established to allow entries to be driven in the coal seams to the coal reserves in the Exempt Area.

Three entries would be driven into each seam (See Fig. 2). One entry would be used as a conveyor road and intake airway, another entry would be used for machine access and for men and materials transport. The third entry would be employed as a return airway and would have the main ventilators installed at the surface.

The cross section of the entries would be 6 metres wide by 3 metres high. The belt and supply roads would be spaced at 30 metres centre to centre. The return airway portal would be isolated from the other two in order to reduce the noise level in the area adjacent to the supply road portals.

The Duncan Seam entries would be driven south along the strike of the Seam and the East Fingal Seam entries would be driven South East across the dip of the seam.

In both cases the three entries would be driven parallel in the seams to the edge of the Exempt Area and then multiple entries would be used to develop the two seams (See Fig. 2).

069

- 17 -

#### 4.4 MINING METHODS

##### 4.4.1 SELECTION OF METHODS

The underground conditions are unknown. Assuming the geological conditions described in Section 2 of this report, it can be expected that the mining conditions will differ in the two seams. Mining methods have been selected which would suit the anticipated conditions in each case.

It is anticipated that the roof strata in the Duncan Seam would be predominantly mudstone.

From experience in the "Duncan Mine" it is expected that with a multiple entry system, roof support will be required close to the face at all times, that props and bars and roof bolts will be needed as roof supports and that the width of roadways may have to be decreased from time to time.

The East Fingal Seam is expected to have a sandstone roof over the majority of the workings. Roof support would be by roofbolting or roofbolting and straps only and immediate close-to-the-face supports would not be called for.

The mining methods which have been considered for application under the above conditions are the various multiple entry systems and longwall or shortwall mining systems using self advancing shield supports.

The majority of underground coal mined in Australia is by multiple entry methods using continuous miners and shuttle cars. The reason that this system has been adopted is that in the past the method and machines have best suited Australian conditions.

070

Over the past 10 years, however, longwall equipment has been developed to suit conditions such as those encountered in Australia and is now being used more frequently and with some success in Australia. There is little doubt that it's use will continue to increase as experience is gained with this method of mining and mines are forced to go to ever increasing depths.

Longwall methods have been seriously considered for this project but rejected in favour of multiple entry methods. The principal reason for rejecting the method is the lack of reliable information available relating to production levels and costs over a wide range of Australian conditions. One other reason is that the isolation of the mine from other coal fields and available service personnel argues against the use of more uncommon equipment at this stage.

If it is decided to go ahead with mining coal from these coal seams, then serious consideration should be given at a later date to the use of longwall methods and equipment. More reliable information relating to production costs should be, by then, available.

The method selected for the Duncan Seam is one which is used in N.S.W. under conditions similar to those expected in Tasmania. This is a multiple entry system employing Load Haul Dump (L.H.D.) machines, similar to those used in metal mining, for coal loading and transportation.

The method selected for the East Fingal Seam is a conventional multiple entry system employing continuous miners (C.M.) and shuttle cars (S.C.).

071

The general mining plan in both cases involves driving main entries as near as possible along the centre axis of the reserve area with production headings being driven off to the right and left of the main entries. The methods are described in more detail below. Fig. 3 gives the general mining plan proposed.

#### 4.4.2 DUNCAN SEAM (L.H.D. METHOD)

The coal is bored using an electric/hydraulic boring jumbo which is also employed for roofbolting. The coal is then blasted off the solid, the depth of blasting round being controlled to suit the roof conditions, the coal is then cleaned up, transported and dumped into a conveyor feeder breaker by the L.H.D. machine. Roof supports are then placed in position and the cycle recommences.

A normal mining section layout for this method is given in Figure 4 and a possible shotfiring pattern is given in Figure 5.

The headings are driven to a pre-determined point and then the pillars are extracted on the retreat. Very high mining recovery rates have been obtained using this method. Fig. 6 shows the method of extracting pillars. Pillar sizes would be about 30m x 45m and width of headings 5.5 metres.

Usually L.H.D. machines are only used when mining conditions preclude the use of continuous miners and shuttle cars, i.e. roof conditions which demand timbering close to the coal face, soft floor conditions which cause miners and shuttle cars to bog, gradients which are too steep for the efficient working of continuous miners. However, there are examples in the U.S.A. of L.H.D. machines being used in direct competition to continuous miners/shuttle cars.

072

- 20 -

This method should be employed for initial development in both seams and the conditions proven suitable for continuous miners and shuttle cars prior to orders being placed for such equipment.

One disadvantage of this method is that the equipment would be diesel powered, which can give some ventilation problem and also the operating cost would increase as fuel costs rise.

#### EQUIPMENT REQUIREMENT/UNIT

A production unit would normally consist of six production headings which, working on the above L.H.D. method, would require the following major equipment -

- 2 - L.H.D. Machines
- 2 - Electric coal boring jumbos
- 1 - Belt Feeder Breaker
- 1 - 36" Belt Conveyor Unit
- 1 - General Purpose Vehicle (Men and Materials)
- 1 - Section Power Centre
- 1 - Auxiliary Fan

#### PERSONNEL REQUIREMENT/UNIT

The personnel required to operate one production unit employing the L.H.D. method would be as follows -

- 2 - Loader Drivers
- 2 - Borers
- 2 - Shotfiring
- 2 - Roof Supports
- 1 - Deputy
- 1 - Utility

PRODUCTIVITY/UNIT SHIFT

The productivity achieved by this method is dependent on seam thickness, roof conditions, hardness of the coal, effectiveness of the production bonus system and many other factors. Under the conditions described previously, a production of 300 tonnes per unit shift should be achieved.

PRODUCTION UNITS REQUIRED AT PEAK PRODUCTION LEVEL

The units would produce coal on an average of  $2\frac{1}{2}$  shifts per day, during the other half shift the machines would be available for maintenance.

Peak production rate for both seams	=	7410 tonnes/day
Peak production rate for Duncan Seam	=	3700 tonnes/day
Unit shifts required @ 300 tonne/unit shift	=	12.33
Units required @ $2\frac{1}{2}$ production shifts/day	=	4.92 say <u>5</u>

## 4.4.3

EAST FINGAL SEAM (C.M. & S.C.)

The method suggested for the Fingal Seam is the more conventional continuous mining method which, when used under ideal conditions, is highly productive. This method employs a continuous miner to cut the coal and load it into shuttle cars which then transport the coal to a belt feeder-breaker. The work is continuous and is not in cycles as in the previous method described.

Roofbolting machines or hydraulic timber jacks can be mounted on the continuous miner which facilitate the rapid erection of supports or roof bolts over the machine.

Main entries are driven by this method and then production headings are developed and pillars extracted on the retreat in a similar manner to that explained in the L.H.D. method.

All the machinery employed in this method is powered by electricity with the exception of the general purpose transport vehicles which are diesel powered. Diesel powered shuttle cars are available and in certain circumstances are preferred, however, there is a better selection of electric shuttle cars on the market and this type of car has been considered at this stage.

EQUIPMENT REQUIREMENT/UNIT

A production unit of this type would require the following major equipment -

- 1 - Continuous Miner with roofbolters/timber jacks
- 2 - Shuttle Cars
- 1 - Belt Feeder Breaker
- 1 - 36" Belt Unit
- 1 - Section Power Centre
- 1 - Auxiliary Fan
- 1 - General Purpose Vehicle

MANPOWER REQUIRED/UNIT

The number of people employed varies considerably from mine to mine, and is dependent on roof conditions, bonus system, unions and management etc. The following manpower requirement is about average for the N.S.W. coalfield.

1	-	C.M. Operator	
1	-	C.M. Offsider	
2	-	Roof Supports/Brattice	
2	-	Shuttlecar Operators	
$\frac{1}{2}$	-	Fitter	) 2 men service 2 units
$\frac{1}{2}$	-	Electrician	
1	-	Deputy	
<hr/>			
8			
<hr/>			

#### PRODUCTIVITY/UNIT SHIFT

Productivity varies from mine to mine and depends on mining conditions and efficiency of machine maintenance etc. Under the conditions envisaged for the East Fingal Seam, an average per unit production shift that could be expected, would be of the order of 420 tonnes.

#### PRODUCTION UNITS REQUIRED AT PEAK PRODUCTION

The units would be producing on an average of  $2\frac{1}{2}$  shifts per day with  $\frac{1}{2}$  shift available for maintenance.

Peak production rate for both seams	=	7410 tonnes/day
Peak production rate for East Fingal Seam	=	3710 tonnes/day
Unit Shifts required @ 420 tonnes/unit shift	=	8.80 unit shifts/day
Units required @ $2\frac{1}{2}$ production unit shifts/day	=	3.52 say <u>4</u>

#### 4.5

#### UNDERGROUND COAL TRANSPORTATION

A system of trunk conveyor belts would be used for coal transportation from underground to the surface. These conveyors would be sited as

076

nearly as possible down the centre of the reserves and would be fed by production unit conveyor belts from the left and the right. The production unit belts would be fed through belt feeders which would ensure an even flow of coal onto the trunk belts.

The trunk belts would be designed to handle peak loads and would be of standard design.

The underground conveyors would feed directly into surge bins from which the washery would be fed.

All underground conveyors would have the same standard drive head and belt width would be standard at 900mm. Separate standard speeds and horsepower would be established for production units and trunk belts.

#### 4.6 PERSONNEL AND MATERIAL TRANSPORTATION

General purpose vehicles would be used for transportation of men and materials. These vehicles consist of a diesel powered, rubber tyred prime movers which is designed to accept various types of trailer. Flat top units are available for materials transport and special covered units for personnel transport.

Each production unit would be serviced by a single prime mover.

One entry would be especially for the use of these vehicles and graded rock road base would be maintained to ensure the most efficient operation.

In addition to the general purpose vehicles, other smaller diesel vehicles would be used for transportation of supervisors, mechanics and electricians etc.

## 4.7

MACHINE MAINTENANCE

In the case of the Duncan Mine where L.H.D. machines will be used extensively, it would be preferable to have underground workshops provided at a central underground point rather than to comply with general practice which is to bring the machines to the surface for servicing.

The underground workshops should be equipped to handle routine maintenance and repairs. Repairs of a major type or major overhauls would be carried out in the surface workshops. Underground workshops are preferred because of the longer travelling distances which will eventually be involved as the mine develops ahead.

The continuous miners and shuttle cars employed in the East Fingal Seam would be maintained in the working places where possible. Repairs which could not be carried out in the working place would be of a major nature and would be done in the surface workshops.

## 4.8

SURFACE FACILITIES

For a mine of the size and life contemplated, substantial surface facilities of a permanent nature would be required and hence the high expenditure would be warranted.

Workshops which should be more completely equipped than would be the normal standard would be required because of the isolation of the mine from machinery supplier's facilities. The majority of mines

078

in N.S.W. for example, are within a few hours of mining equipment manufacturers' workshops where either exchange units are available or expert assistance and facilities available for emergency repairs. Workshops with overhead cranes, degreasing facilities, hydraulic repair shops would be required for overhauling and rebuilding continuous miners and shuttle cars.

The usual boilermakers, electrical and fitting and turning facilities would also be required.

Service bays and re-fuelling station would also be needed for the underground mobile diesel equipment and surface vehicles.

The workshops would be sited on the flatter ground in the valley below the mine entries and would be connected by sealed road for personnel and material access. The mine stores would be incorporated with the workshop building and a compacted or sealed area would be required for timber storage and for the loading of underground transporters.

A bath house for 450 men would be required, this could be built in sections as the mine personnel requirement increased. The bath house building would also incorporate the first-aid centre, rescue room and lamp house. The mine administration offices would be adjoining the bath house.

A bulk stone dust store would be required and also a powder magazine.

Oil storage and diesel fuel storage tanks would be needed.

A mine sub-station and power reticulation system would be required.

Water tanks and water reticulation and sewerage treatment facilities would be necessary.

## 4.9

MINE VENTILATION

Both mines would be ventilated in a similar manner and the eventual requirement in both mines would be approximately the same.

From the surface to the main development headings there would be two intake airways, one containing the trunk conveyor belt and the other used as an access road. The return airway development headings would be connected via overcasts and a single return airway to the surface.

The mine fans would be sited at the entrance of the return airways. At this stage, it is envisaged that two fans would be used for each mine, one for the first half of the mine development period and the two together for the second half.

## 4.10

WASHING PLANT

The washing plant would be sited further down the valley from the workshops in a place convenient for stockpiling.

The coal from both mines would be received in storage bins at the washery. The coal would then be passed over dry screens and the oversize fed to a Bradford Breaker where it is anticipated that an oversize product containing mainly dirt band material would be removed. The undersize from the Breaker would, together with the undersize from the screens, then be conveyed to the washery.

The washery would consist of Jigs and Cyclone washers and the final product would be crushed and screened down to 38mm.

The washed coal would then be conveyed to some form of stockpiling facility either at the power station or at a rail loading facility.

The coal treatment facilities would be designed to match the mine production and would have a capacity of 350 tonnes per hour. The planned operating time for the washery would be 22 hours per day and it would be operated 5 days per week.

The manpower requirement for washery and stockpile operation would be 3 per shift plus a washery supervisor on day shift.

#### 4.11 STOCKPILING AND TRANSPORT TO POWER STATION

The kind of stockpiling required would depend on the siting of the power station and the coal transport system employed between the mine and power station.

Three separate cases have been considered in this study:-

- \* Washed coal conveyed from washery into a road haulage truck loading bin. The coal then being trucked to the power station.
- \* Washed coal would be conveyed to a train loading stockpile and then transported by unit train to the power station.
- \* Washed coal transported by belt conveyors directly from the coal washery to the power station stockpile.

081

The first case could be considered as an alternative to conveying from the washery to either the power station or the train loading facility. In this case a 1000 tonne truck loading bin would be installed and provision made for emergency stockpiling using trucks with front end loader reclamation.

In the case that the power station is a long distance from the mine at Bell Bay and rail haulage is used for transporting coal from mine to station, then the coal from the washery would be conveyed to the train loading stockpile and the stockpiling would be done using high level tripper conveyors. The stockpile would have a capacity of about 100,000 tonnes. Reclamation would be via reclaimer tunnel and belt-conveyor which would have a capacity of 1500 tonnes per hour. The tunnel conveyor would feed into a 1000 tonne train loading bunker. This would give the facility a live capacity to load a 2500 tonne train in one hour.

In the third case where the power station would be sited close to the mine and washed coal belt-conveyed from the washery to the station the stockpile would be at the power station. Coal would be conveyed from a washed coal bin and deposited onto a low level stockpile which would have a capacity of 750,000 tonnes. Bull-dozers would be used to level out the stockpile. The coal would be reclaimed from the stockpile by bull-dozing onto a reclaim conveyor erected in a tunnel which would extend half the length of the stockpile.

The latter method, which is more costly to operate but which has a lower capital requirement per tonne, has been adopted because the stockpile

082

would only normally be used during emergencies and the capital requirement for high level tripper with full length reclaim tunnel for a stockpile of the size envisaged could hardly be justified.

Capital and operating cost estimates have been arrived at for the three alternatives suggested above.

#### 4.12 INFRASTRUCTURE

It is understood from the Australian National Railways Commission that if the power station is sited at Bell Bay or Avoca and coal is transported by rail, then the siding accommodation, loading and unloading facilities would be the responsibility of the consignor and consignee. The Commission however, would supply main line and rolling stock facilities.

High tension power supply would be required for the start of mine development.

Some housing would be required for mine employees.

An all weather road would require constructing to the mine site.

083  
5.CAPITAL REQUIREMENT

5.1

INTRODUCTION

Estimates of capital requirements have been based on the production programme and mining concept outlined in the previous two sections of this report.

Some of the estimates have been based on preliminary design and current quotations and some estimates are of an order of magnitude accuracy only. Details of the capital estimates and the way that they have been arrived at are described in Appendix 1 of this report.

Separate estimates have been given for truck loading facilities ex-washery as well as for the provision of a 100,000 tonne washed coal stockpile and train loading facility. In addition to this an estimate has been made for a 750,000 tonne power station stockpile which could be fed directly from the mine washery. If coal is either trucked or rail hauled from the mine to the power station in preference to the station being sited adjacent to the mine so that the coal could be belt-conveyed directly to the power station, then expenditure on stockpiling facilities at both mine and power station will be necessary.

In addition to the direct capital cost, development cost equivalent to three months working capital has been included.

No account has been taken of interest on capital investment during development or of interest cost on stockpiled coal since it has been assumed that the H.E.C. will take this into account in their financial evaluation of the project.



INITIAL CAPITAL PHASING \$ X 1000

085

PROJECT YEAR	-3	-2	-1	1	2	3	4	5	6	7	8	9	TOTAL
Production Tonnes	-	-	-	-	-	424	583	742	900	1113	1271	1482	
Exploration Expenditure	1000	1000											2000
Feasibility Studies			600										600
Land Acquisition				100									100
Infrastructure - Road				554									554
- Rail				750	750								1500
- Power				1200									1200
Surface Facilities				2910	2050								4960
Mine Fans					400			400					800
Mining Equip. Duncan Face					885	886	885		886	885	886		5313
E. Fingal Face					981	981	981		981	981	981		5886
Other U/G					1480	340	340		340	340	340		3180
Freight					124	62	62		61	61	61		431
Surface Conveyor					580								580
Washery				1200	1200								2400
Stockpile Alt-2				650	1240								1890
Housing Staff				350	350								700
Caravan				100	100								200
Single Q.					100	180			100	100			480
Houses				815	1120	1080	1080		1080	1080	1080		7335
Total Direct Cost	1000	1000	600	8629	11360	3529	3348	400	3448	3447	3348		40109
Design Supervisor Admin.	-	-	-	600	600	-	-	-	-	-	-	-	1200
Total	1000	1000	600	9229	11960	3529	3348	400	3448	3447	3348		41309
Contingencies 15%	150	150	90	1385	1794	529	502	60	517	517	502		6196
Total	1150	1150	690	10614	13754	4058	3850	460	3965	3964	3850		47505
Development Cost					5572								5572
GRAND TOTAL	1150	1150	690	10614	19326	4058	3850	460	3965	3964	3850		53077

187097

086

187098

- 34 -

5.4 REPLACEMENT CAPITAL AND PHASING

Replacement capital for major items of equipment for the life of the mine has been calculated as follows:-

YR	\$ X 1000
4	120
5	240
6	670
7	280
8	1305
9	805
10	945
11	375
12	2495
13	375
14	1305
15	805
16	945
17	415
18	1375
19	375
20	1305
21	805
22	985
23	375
24	1375
25	375
26	1305
27	595
TOTAL	19950

087

6. DIRECT COSTS OF PRODUCTION

6.1 INTRODUCTION

Estimates of direct costs of production have been made either by synthesising costs to suit the concept outlined in Section 4 of this report or by transplanting costs from other mining operations which have similar conditions to those anticipated and which use similar mining methods. Details of how these estimates of costs were arrived at are given in Appendix 2 of this report. The following is a summary.

6.2 LABOUR REQUIREMENTS AND COST

The largest contribution to cost comes from the labour element. The number of employees required in order to produce the 1.5 million tonnes per annum of R.O.M. coal has been estimated to be 433 which would be split up as follows:-

Underground Coal Face	216
Underground Others	67
Surface and Washery	124
Staff	26
TOTAL	433

Labour cost estimates have been based on the above figures and on the following:-

- \* The 1978 Award rates as applied to coal mining in Tasmania.
- \* A mine bonus system which, for the rate of production required from the equipment and personnel utilisation anticipated, would result in a payment to all mine personnel of \$60 per week.

088

- \* An overtime allowance of half a shift per week to all face men employed in both seams.
- \* A 40% loading on weekly earnings to cover the cost of Workers' Compensation, Payroll Tax, annual and statutory leave, retirement and any perquisites which may be provided by the company free to employees. In the case of Key staff personnel this loading has been increased to cover the provision of a free house and car.

## 6.3

OTHER COSTS

Costs other than labour costs have been arrived at in various ways:-

Roof Supports - These costs have been estimated by assuming a support system which is considered to be adequate for the conditions envisaged. This system was then costed taking into consideration the conditions existing in the Duncan Mine and the conditions expected in the Exempt Area. The cost of roof supports is higher than average, as would be expected.

Major Overhaul - Provision for major overhauling of continuous miners, shuttle cars and L.H.D. machines has been based on current overhaul cost and estimated pre-overhaul period. The major overhaul cost is about average.

Power Costs - These have been derived by estimating power consumption and then employing a unit cost of 3.77¢ per Kwh. These costs are slightly higher than anticipated.

089

Maintenance Materials - These costs have been arrived at by assuming that similar costs would be incurred at the mine as would be at mines using similar equipment in similar conditions and transplanting those costs.

Mine Stores - The estimate for these costs has been arrived at in the same way as maintenance materials.

#### 6.4 SUMMARY DIRECT PRODUCTION COSTS

A summary of direct production costs is given below. These costs do not include any provision for depreciation or head office administration.

The run-of-mine cost is \$11.64 and the washed coal cost is \$15.04 assuming a washery recovery of 85%.

COST ELEMENT	\$/TONNE R.O.M.		
	Duncan	E.Fingal	Mine
<u>MINE</u>			
Labour	7.34	5.32	6.33
Roof Supports	1.70	.85	1.27
Provision for M/C Overhaul	.28	.39	.34
Power	.41	.41	.41
Maintenance Materials	1.76	2.06	1.91
Mine Stores	1.25	1.00	1.13
Administration & Insurance	.25	.25	.25
<u>TOTAL EX-MINE</u>	12.99	10.28	11.64
<u>WASHERY &amp; STOCKPILE</u>			
Labour	.17	.17	.17
Spares and Stores	.75	.75	.75
Power	.14	.14	.14
<u>TOTAL EX-WASHERY</u>	14.05	11.34	12.70
WASHERY YIELD ALLOWANCE	2.48	2.00	2.24
WASTE DISPOSAL	.10	.10	.10
<u>WASHED COAL COST</u>	16.63	13.44	15.04

090  
6.5TRANSPORT COSTS

The following Freight rates have been given by the Australian  
National Railways Commission -

Fingal Siding to Avoca	-	\$1.50
Fingal Siding to Bell Bay	-	\$4.27

APPENDIX - ICAPITAL REQUIREMENTS

The following estimates of capital requirement have been based on the mining concept outlined in Section 4 of this report. The equipment costs are in the main based on current quotations for the particular machine specified. The bases for the other cost estimates are explained in this section.

1. PRE-DEVELOPMENT COSTS

Before development of the mine is undertaken further expenditure would be incurred on geological exploration, planning and engineering, feasibility studies and environmental studies.

As has been pointed out previously in this report, but because of its relative importance and urgency, it is repeated, it will be necessary to carry out an extensive exploration programme in the Exempt Area. Previous and present investigations have been and are being concentrated in the Duncan Mine reserve area and in a small portion of the Exempt Area in the N.W. corner.

A detailed exploration plan would be required in order to arrive at an accurate exploration expenditure estimate. At this stage, that plan is not available, consequently the expenditure estimated is an order of magnitude figure based on past experience of exploration in areas of a similar nature. The area to be explored has difficult access because of the rugged terrain and the absence of roads would make exploration expensive. The drilling would also be expensive because of the thick basalt cover overlying the coal measures.

092

The estimate considers drilling on a wide grid over the areas outlined in Fig. 1 followed by closer drilling where wide grid drilling results indicate the necessity. A two year exploration period has been envisaged for the completion of a competent programme.

Following the completion of the exploration programme and the interpretation of results obtained from the analysis of drill cores and washery tests, planning and feasibility studies would be taken to the final stage in order to determine the viability of the proposed coal mining operation as a supplier of fuel to the proposed power station. This work would be carried out by a project team of engineers skilled in the necessary disciplines and with the back up of design draftsmen, surveyors and architects.

The work would encompass the design of rail loop, roads, power supply, washery, surface workshops, baths and offices, underground layout and ventilation, housing etc. It is anticipated that this work would take one year to complete.

In addition to the preparation of an engineering design and feasibility study, an Environmental Study and Impact Statement would be needed and this Statement would have to be approved by the various government bodies. However, if it was decided to construct a power station adjacent to the mine, then a single Impact Statement would be sufficient to cover the power station and the mine and expenditure on this aspect would be reduced.

For the purposes of this study, it has been assumed that the mine would require an environmental study and independent impact statement and the capital expenditure has been estimated accordingly.

093

<u>CAPITAL REQUIREMENT:-</u>	<u>\$ x 1000</u>
Exploration	2000
Planning and Feasibility Studies	350
Environmental Studies	250
	<hr/>
TOTAL	2600
	<hr/>

2. LAND ACQUISITION

Land would be required for construction of mine portals, construction of roads and railway loop, installation of H.T. electricity supply, construction of surface facilities and washery, coal stockpiling and waste disposal and housing.

It is advised that the average price of land in the vicinity of the mine would, on resumption, only be about \$100 per hectare, it is therefore proposed to purchase more land than is actually necessary for surface facilities. The reason for this being that generally the further away that neighbours are from mining operations the less trouble they are likely to be caused by noise, waste disposal, traffic which would be associated with the operation.

It is proposed to purchase a strip of land between the Exempt Area and the railway. The area of this land would be approximately 1000 hectares.

<u>CAPITAL REQUIREMENT:-</u>	<u>\$ x 1000</u>
1000 hectares @ \$100/hectare	100
	<hr/>

094

3.

INFRASTRUCTURE

The main rail line and main road pass close to the proposed mine site, however, capital expenditure will be required to amplify these facilities. This also applies to the supply of electric power to the mine.

An all weather road will be required connecting the main road to the washery, surface workshops and offices. These buildings would be located on the flatter ground at a lower level than the mine entrances. A further road would then be built from the workshops to the mine entrances, which would be approximately 100 metres in elevation above the workshops. The first section of road would be constructed at a fairly flat gradient and would be approximately 3km in length.

From the workshops to the mine, the gradient would be about 5% or 1 in 20. The length of this road would be approximately 2km.

Both roads would be sealed.

The unit costs used in this estimate were supplied by the Tasmanian Department of Main Roads.

The proposed train size is 2500 tonnes, which would have a length of approximately 800 metres. The recommended minimum length of loop required for a train of this size would be 1600 metres. The cost of building this loop would have to be borne by the project. The Tasmanian railways would be responsible for provision of signalling equipment, any upgrading that may be required on the main line and provision of rolling stock.

095

The cost estimate for a rail loop has not been based on an actual engineering design and as the majority of the cost would probably be civil works associated with the construction, an order of magnitude figure of \$500,000 per kilometre has been employed, and it has been assumed that in order to provide a first class facility a total of 3km of track could be necessary.

The power requirements of the mine would be such that the existing H.T. transmission facilities would have to be upgraded. Consideration has been given to this matter by the H.E.C. who have advised that they would propose installing an incremental sub-station at St. Marys and a double circuit 22KV line from St. Marys to Fingal. The power would then be supplied to the proposed mine sub-station at 22KV from Fingal.

CAPITAL REQUIREMENT:-\$ x 1000

<u>Road:-</u>	3km Flat @ \$96,000/km	
	2km 1 in 20 @ \$108,000/km	
	5km seal @ \$10,000/km	554
<u>Rail:-</u>	3km @ \$500,000/km	1500
<u>Power:-</u>	H.E.C. Amplification Cost	1000
	Mine Transmission line	200
	TOTAL	<u>3254</u>

4. SURFACE FACILITIES

This again is a case where some detailed design work is necessary in order to arrive at an accurate figure for capital requirement. The following estimate with the exception of equipment costs is an order of magnitude figure based on the concept described in Section 4 of this report and cost information for similar installations associated with other projects.

Design costs are not included in this item and all estimates of civil works and building assume employment of Contractors.

<u>CAPITAL REQUIREMENT:-</u>	<u>\$ x 1000</u>
Site Preparation	250
Concrete Portals (6)	360
Bulk Stone dust facilities	100
Sub-station and Distribution	350
Bath house, Lamproom, First-aid and Rescue Rooms	1000
Workshop and Stores and Supply Yard	1500
Admin. Buildings and Equipment	500
Sewerage and drainage and water treatment	500
Water Tanks and Reticulation	100
Oil Storage	50
Powder magazine	10
Front End Loader	110
Fork Lift	40
Road Truck	20
Pickup Trucks (3)	20
Mobile Crane	50
TOTAL	<u>4,960</u>

097

5. MINE VENTILATION FANS

The initial ventilation would be by a single fan sited at each of the two mine return airways. The fans would be on concrete foundations sited outside of the mine and would be connected to the mine return airways by steel ventilation ducting. The fan ducting would be designed to accept a second fan for each return airway at a later date as the necessity arose.

CAPITAL REQUIREMENT:-

\$ x 1000

4 - 200,000 c.f.m. at 6" W.G. "Hi-Flow"	
117" Wheel Diameter Centrifugal	
fan units complete with 250 H.P.	
electric motor, electrics, fan	
diffuser, vol. control guide vanes	
@ \$113,000 each	450
2 - Foundations, ductwork, fan house,	
motor and control house, instrumentation,	
fan installation, electrical installation,	
@ \$175,000 per installation	350
TOTAL	800

6. UNDERGROUND MINING EQUIPMENT

The underground mining equipment capital estimate has been worked out for each mine independently. The initial capital requirement for each mining method can be seen to be approximately the same. All the prices used in this estimate are current ex-factory quotations. Because of the geographic situation of the mine 3% has been added to the ex-factory price to cover the cost of freight.

This percentage has been arrived at by calculating the actual freight rates on the major items of equipment.

Provision has been made for spare equipment to cover the absence of some equipment for major overhaul and major repair.

CAPITAL REQUIREMENT:-

\$ x 1000

Coal Face Equipment Duncan Mine:

10	- Eimco 913 L.H.D. m/c @ \$120,000	1,200
10	- Secoma CMH23 Face Drill/roofbolter @ \$130,000 each	1,300
5	- Fox Series 1500 Conveyor Belt Drive heads, structure, tail end tensioner and conveyor belting for 1700 metres conveyor length @ \$212,000 each	1,100
5	- Fox Feeder Breakers @ \$83,000 each	415
5	- Noyes Multi-Purpose Transport Vehicles @ \$55,000 each	275
5	- Man Canopy Units @ \$5,000 each	25
10	- Flat Top units @ \$2,800 each	28
5	- 36" 20,000 c.f.m. auxiliary ventilation fans @ \$13,000 each	65
5	- Flyt - D2151 27 H.P. submersible pumps @ \$4,000 each	20
5	- Belt & Section Power Centres @ \$77,000 ea.	385
	TOTAL	4813

Spare Equipment

2	- Eimco 913 @ \$120,000 each	240
2	- Secoma CMH23 @ \$130,000 each	260
	TOTAL	5313

099

OTHER UNDERGROUND EQUIPMENT - DUNCAN MINE

In addition to the coal face equipment detailed above, the following underground equipment and expenditure would also be required.

CAPITAL REQUIREMENT:-\$ x 1000

2 - Portable Electrically powered air compressor	70
1 - Eimco 913 L.H.D. with rock bucket	120
1 - Fox stone dusting machine	60
1 - Domino Road Grader	85
1 - Secoma CMH23 Roofbolter	120
2 - Flyt dewatering pumps @ \$16,000 each	32
3 - Fox 1500 Series Trunk belts	636
1 - General Purpose Vehicle	55
2 - Mine Rovers @ \$35,000 each	70
Water Reticulation System	150
H.V. Reticulation, Transformers & Switchgear	52
Telephone System	15
Self rescuers, safety lamps, mine lamps, rescue equipment, methanometers, fire fighting equipment, first aid equipment	125
TOTAL	<u>1590</u>

100

<u>Face Equipment - East Fingal Seam</u>	<u>\$ x 1000</u>
4 - Lee-Norse HH497 Fixed Head Continuous Miners with timber jacks, floor jacks, power lubrication, operator canopy, spinner disc gathering @ \$443,500 each	1,774
8 - Noyes Hydrocars HE-15-16 with hydraulic power take-off @ \$124,000 each	992
4 - Fox Series 1500 Conveyor Belt drive heads, structure, tail end tensioner and conveyor belting, 1200 metres long conveyor @ \$220,000 each	880
4 - Fox Feeder Breakers @ \$83,000 each	332
4 - General Purpose Vehicles @ \$55,000 each	220
4 - Man Canopy Units @ \$5,000 each	20
8 - Flat Top Units @ \$2,800 each	25
4 - 36", 20,000 c.f.m. auxiliary ventilation fans @ \$13,000 each	52
4 - Flyt - D2151 27 HP Submersible pumps @ \$4,000 each	16
4 - Belt & Section Power Centres @ \$110,000 ea.	440
	<hr/> 4751
 <u>Spare Equipment</u>	
2 - Continuous Miners @ \$443,500 each	887
2 - Shuttle Cars @ \$124,000 each	248
	<hr/> 5886
TOTAL	<hr/> 5886

OTHER UNDERGROUND EQUIPMENT - EAST FINGAL MINE

The cost of the underground equipment other than face equipment which would be required in the East Fingal Mine would be approximately the same as in the Duncan Mine, i.e.

---

1590

SUMMARY - EXPENDITURE ON U/G EQUIPMENT

	<u>\$ x 1000</u>
Face Equipment - Duncan Mine	- 5313
Other Underground Equipment Duncan Mine	- 1590
Face Equipment - East Fingal Mine	- 5886
Other Underground Equipment E.Fingal Mine	- 1590
Total Ex-factory cost	- 14379
Allowance for Freight @ 3%	- 431
TOTAL	<u>14810</u>

7.

SURFACE CONVEYOR

The intention is to transport the coal from the two main trunk conveyors to the washery by means of a common conveyor belt. The conveyor would be constructed with protective cover and would be supported on independent conveyor support frames. The conveyor would be of special design and the cost would depend on the degree of difficulty of the selected route and the actual distance between the mine entrances and the site selected for the washery.

It has been assumed that conveyor would be 1000 metres long and that a 1000mm wide steel cored belt would be used. The maximum duty of the conveyor would be about 800 tonnes per hour at a speed of 3m/sec. The H.P. of the conveyor would be 200.

CAPITAL ESTIMATE

	<u>\$ x 1000</u>
1000 metre conveyor complete with drive head independent support frames, tail end, structure and conveyor belt for 1000 metres of conveyor length	500
Installation of Conveyor	80
TOTAL	<u>580</u>

8. COAL WASHING PLANT

The proposed washery was described in Section 4 of this report. The washery description and duty was described to a washery manufacturer who supplied an order of magnitude estimate for a plant of that nature. The cost estimate includes R.O.M. bin, clean coal bin and waste bin. The washery cost is based on the use of a Bradford Breaker, jigs and centrifuges and screening and crushing to 38mm but no pulverising.

It has been assumed that waste disposal work employing trucks would be carried out by contractors. This assumption has been reflected in washery costs.

CAPITAL REQUIREMENT:-

\$ x 1000

1 - Coal washing plant as described	2,400
-------------------------------------	-------

9. STOCKPILING FACILITIES

The three alternatives mentioned in Section 4 have been costed. Provision has been made for purchase of machinery for working the stockpile in emergency.

It has been assumed in the case of Alternative 1 that contractors trucks would be employed for coal haulage and this factor has been reflected in the estimate of direct operating costs.

<u>ALTERNATIVE 1</u> - 1000 tonnes live capacity truck loading bins with hydraulically operated loadout gates, foundations and truck washer all installed -	235
1 - D.9 Bulldozer	310
1 - 8 Cubic Metre Front End Loader	280
	<u>825</u>

	<u>\$ x 1000</u>
<u>ALTERNATIVE 2</u> - A 100,000 tonnes washed coal stock- pile employing a high level tripper conveyor for stockpiling and a tunnel reclaimmer of 1500 tonnes per hour capacity feeding a 1000 tonne live capacity train loading bin all installed -	1300
1 - D.9 Bulldozer	310
1 - 8 cubic metre Front End Loader	280
	<hr/> 1890 <hr/>

<u>ALTERNATIVE 3</u> - A 750,000 washed coal stockpile employing low level tripper conveyor with bulldozer levelling and half length reclaim tunnel fed by bulldozer	1200
1 - Hough D5400 Wheeled-Dozer	450
1 - Wabco 333 Elevating Scraper	370
	<hr/> 2020 <hr/>

10. HOUSING REQUIREMENTS

The housing requirements and capital estimates have been based on the personnel requirements described in Appendix 1 of this report, together with the following assumptions.

- \* Of the total number of personnel to be employed at the mine, i.e. 433 people, 130 will be local inhabitants and will have their own accommodation. (We are informed by Cornwall Coal Company that they have a waiting list of workers numbering in excess of 100).

- \* Staff houses will be required for 10 senior personnel.
- \* 40 people who would travel from further afield in Tasmania or the mainland would prefer to live in their own caravans on company owned serviced van sites. (This is the case with most new mining projects in Queensland and Western Australia).
- \* Single quarters would be provided with messing and recreational facilities for 80 single status employees.
- \* Houses would be provided for the remaining 163 people and these houses would be of good quality brick veneer structure.
- \* The houses would be attached to various existing communities and there would be no large expenditure required for amplification of existing water, power and sewerage services.
- \* There would be no financial assistance forthcoming for the provision of housing from the Housing Commission of Tasmania.
- \* All facilities such as schools and hospitals would be provided by the State.

CAPITAL REQUIREMENT:-

	<u>\$ x 1000</u>
10 - Staff houses @ \$70,000 each	700
50 - Caravan Sites @ \$4,000 each	200
80 - Single Quarters and messing	480
163 - Houses @ \$45,000 each	7335
<u>303</u>	<u>8715</u>
TOTAL	<u>8715</u>

105

The above costs include the purchase of the land and provision of roads, power, water and sewerage to each particular lot from existing main facilities.

11. REPLACEMENT CAPITAL

Capital requirement estimates for replacement of major items of equipment have been based on the following criteria -

Surface Plant

Front End Loader	-	replace every 3 years
Fork Lift	-	" " 3 years
Bulldozers - Stockpile	-	" " 6 years
Road Trucks	-	" " 3 years
Pick-Up Truck	-	" " 3 years
Mobile Crane	-	" " 6 years

Underground Equipment

Eimco 913 L.H.D.	-	replace after 20,000 hrs service
Secoma CMH23	-	" " 750,000 tonnes production
Continuous Miners	-	" " 1,500,000 " "
Shuttle Cars	-	" " 750,000 " "
General Purpose Vehicle	-	" " 20,000 hrs service
Mine mobile	-	replace every 3 years

Conveyors

Each mine would require a further 3 trunk conveyors with switchgear.

H.V. Reticulation and Pipes

Each mine would require a further 3Km H.T. Cable and Pipes.

Using the above criteria, the replacement capital over the life of the mine has been calculated as follows:-

106

REPLACEMENT CAPITAL

YR	SURFACE EQUIP.	DUNCAN FACE	E. FINGAL FACE	CONVEYOR	H. V. & PIPE	TOTAL
4		120				120
5		240				240
6	430	240				670
7	40	240				280
8	360	370	575			1305
9	430	250	125			805
10	-	370	575			945
11	-	250	125			375
12	450	370	575	800	300	2495
13	-	250	125			375
14	360	370	575			1305
15	430	250	125			805
16	-	370	575			945
17	40	250	125			415
18	430	370	575			1375
19	-	250	125			375
20	360	370	575			1305
21	430	250	125			805
22	40	370	575			985
23	-	250	125			375
24	430	370	575			1375
25	-	250	125			375
26	360	370	575			1305
27	470	-	125			595
TOTAL	5060	6790	7000	800	300	19950

107

187119

APPENDIX 2PRODUCTION COSTS

The following production costs have been synthesised on the basis of the concept described in Section 4 of this report. An explanation of the way they were arrived at follows. These costs compare with production costs relating to actual operating mines producing at approximately the same production levels and under conditions similar to those assumed for the two mines.

1. PERSONNEL REQUIREMENTS AND LABOUR COST1.1 SUMMARY

The following is a summary of the total personnel requirement and the estimated labour cost per tonne. The cost per tonne has been calculated on the assumption that the mine will produce 1,482,000 tonnes per annum with 50% coming from each seam,

COST CENTRE	Total No. Employees	Annual \$ Cost	\$Cost/Tonne R.O.M.
<u>DUNCAN MINE</u>			
Coal Face	136	3,509,978	
Others U/G	34	664,809	
TOTAL	170	4,174,787	5.64
<u>E. FINGAL MINE</u>			
Coal Face	80	2,039,856	
Others U/G	33	645,589	
TOTAL	113	2,685,445	3.62
* <u>SURFACE</u> Both Mines	112	1,948,124	1.31
* <u>STAFF</u> Both Mines	25	574,000	.39
* <u>TOTAL</u> - Mine	433	9,382,356	6.33
<u>WASHERY &amp; STOCKPILE</u>	13	255,435	.17

\* Excludes Washery and stockpile labour.

1.2

DUNCAN MINE - UNDERGROUND

CATEGORY	NO.	\$ / WEEK				\$ / YEAR
		AWARD	BONUS	OVERTIME	TOTAL	
<u>COAL FACE (5 Units)</u>						
L.H.D. Operators	25	211	60	75	346	629720
Boring	25	211	60	75	346	629720
Shotfiring	25	230	60	86	376	684320
Roof Supports/Bract.	25	211	60	75	346	629720
Utility	12	211	60	75	346	302265
Deputies	12	230	60	86	376	328473
Mechanics	6	215	60	75	350	152880
Electricians	6	215	60	75	350	152880
TOTAL COAL FACE	136					3509978
<u>OTHERS UNDERGROUND</u>						
Deputies	6	230	60	-	290	126672
Ventilation	4	204	60	-	264	76877
Belt Maintenance	6	204	60	-	264	115315
Stone Dusting	2	204	60	-	264	38438
Materials	5	204	60	-	264	96096
Grader	1	204	60	-	264	19219
Utility Crew	10	204	60	-	264	192192
TOTAL OTHERS U/G	34					644809
TOTAL U/G	170					4174787

1709

EAST FINGAL MINE - UNDERGROUND

CATEGORY	NO.	\$ / WEEK				\$ / YEAR
		AWARD	BONUS	OVERTIME	TOTAL	
<u>COAL FACE (4 Units)</u>						
C.M.Operator	10	211	60	75	346	251888
C.M.Offsider	10	211	60	75	346	251888
Roof Supports	20	211	60	75	346	503776
S.C.Operator	20	211	60	75	346	503776
Deputy	10	230	60	86	376	273728
Mechanics	5	215	60	75	350	127400
Electricians	5	215	60	75	350	127400
TOTAL COAL FACE	80					2039856
<u>OTHERS UNDERGROUND</u>						
Deputies	6	230	60	-	290	126672
Ventilation	4	204	60	-	264	76876
Belt Maintenance	5	204	60	-	264	96096
Stone Dusting	2	204	60	-	264	38438
Materials Dist.	5	204	60	-	264	96096
Grader	1	204	60	-	264	19219
Utility Crew	10	204	60	-	264	192192
TOTAL OTHER U/G	33					645589
TOTAL UNDERGROUND	113					2685445

1.4

SURFACE - COMBINED MINES

CATEGORY	NO.	\$/WEEK				\$/YEAR
		AWARD	BONUS	OVERTIME	TOTAL	
Engin. Fitters	51	215	60	-	275	1,021,020
Elec. Fitters	25	215	60	-	275	500,500
Apprentices	25 Say 120	-	-	-	120	218,400
Carpenters	2	215	60	-	275	40,040
Stores	2	204	60	-	264	38,438
Bath/Lamp	3	204	60	-	264	57,657
First Aid	1	204	60	-	264	19,219
Washery	6	204	60	-	264	115,314
Stockpile	3	204	60	-	264	57,657
Utility	6	204	60	-	264	115,314
<b>TOTAL</b>	<b>124</b>					<b>2,183,559</b>
<b>1.5</b> <u>STAFF - COMBINED MINES</u>						
Manager	1					50,000
Assistant Manager	1					40,000
U/G Manager (Day)	2					60,000
U/G Manager (A/noon)	2					50,000
U/G Manager (Night)	1					25,000
Surveyor	1					25,000
Assist. Surveyor	4					50,000
Safety/Vent. Eng.	1					25,000
Chief Engineer	1					40,000
Workshop Foreman	1					25,000
Foreman Elect.	1					25,000
Shift Engineer	3					65,000
Washery Foreman	1					20,000
Timekeeper/Book.	1					17,000
Storekeeper	1					17,000
Clerks	4					60,000
<b>TOTAL</b>	<b>26</b>					<b>594,000</b>

2.

ROOF SUPPORTS

Because of the varying conditions assumed for the two seams different degrees of support would be required in each seam. The method adopted for purposes of costing has been selected on the basis of the roof support practice in the Duncan Mine. Fig. 7 depicts the proposed system which gives minimum support requirement.

For the purposes of costing it has been assumed that the average distance between roof support settings in the Duncan Seam would be 1.5 metres and that the East Fingal Seam would require approximately one half of the roof support that is required in the Duncan Seam. In addition to this, an allowance of 20% has been made for roof repairs to airways, travelling ways and junctions.

The costing estimate has been based on the use of chemical anchored roof bolts.

The following material costs have been used as a basis for the estimate:

Timber props 8" diameter - 10¢/foot		
Steel W-Straps 5m x 240mm-\$15 each		
Roof Bolt 1.8m x 24mm - \$2.88 ea. )		
Chemical bolt anchor - 64¢ ea. )		
Bolt plates 150mm x 150m - 73¢ ea.)		
		\$4.25/complete bolt

Employing the above costs and assuming an average seam thickness of 2.13 metres for the Duncan Seam, the following costs have been estimated:

Duncan Seam	=	\$1.70 /tonne R.O.M.
E.Fingal Seam	=	.85 /tonne R.O.M.
Average	=	\$1.27 /tonne R.O.M.

112  
3.PROVISION FOR OVERHAUL

The period for which continuous miners can be expected to operate without requiring major overhaul has been found to depend on a number of factors such as hardness of coal, manufacture of machine, and quality of operator. For example, in one seam it may be necessary to have a major overhaul after a machine has produced only 150,000 tonne of coal, yet the same machine operating under different conditions may produce 700,000 tonnes before a major overhaul is required.

According to experience at the Duncan Mine, it would be reasonable to expect a continuous miner to produce 500,000 tonnes and a shuttle car 250,000 tonnes before a major overhaul is required.

The L.H.D. machines would require a major overhaul after about 5000 hours of operation.

The cost of major overhauls is as follows:-

Eimco 913	-	\$35,000
C.M.	-	\$120,000
S.C.	-	\$37,000

Using the above information and relating this to the production expected, the following would be the cost per tonne in each mine.

Duncan Seam	28¢/tonne
E.Fingal Seam	39¢/tonne
Both Seams	34¢/tonne

4. POWER COSTS4.1 POWER REQUIREMENTS

The power requirement has been calculated by listing the equipment and respective electric H.P. and then estimating the length of time that this equipment would be operating on full load per day.

In the case of continuous miners, shuttle cars and belts, this amounts to about 3 hours per shift and correspondingly the same applies to conveyor belts. The total Kwh requirement was then calculated.

The following is the estimated daily requirement for the production rate of 1.5 million tonnes per year of R.O.M. coal.

No. of Units	Type of Unit	H.P./ Unit	Total H.P. Load	Hr/Day Full Load	Kwh Total Load	Total Kwh Requirement
<u>UNDERGROUND AND MINE SURFACE</u>						
10	Coal Borer	50	500	8	375	3,000
4	Continuous Miners	600	2400	8	1800	14,400
8	Shuttle Cars	100	800	8	600	4,800
9	Belt Feeders	100	900	8	675	5,400
9	Auxiliary Fans	30	270	5	203	1,015
9	Section Belts	200	1800	8	1350	10,800
	Trunk Belts	250	1000	8	750	6,000
4	Main Fans	250	1000	24	750	18,000
	U/G Pumps etc.	-	200	4	150	600
	Surface & W/shops	-	400	5	300	1,500
1	Surface Belt	150	150	8	113	904
						66,419
<u>WASHERY AND COAL LOADER</u>						
	Washery	-	1600	22	1200	26,400
	Trainloader	-	1000	2	750	1,500
						27,900

114  
4.2POWER COSTS

The annual requirements have been calculated on the basis of a 200 day year mining and washery operation and on the mine fans operating for 365 days/yr.

The annual cost for power has then been calculated using a unit cost of 3.77 cents per Kwh.

The cost per tonne has then been calculated by dividing the annual power cost by the annual planned production of 1,480,000 tonnes R.O.M.

Cost Area	Kwh/day	Days/yr Required	Kwh/yr	Total Cost \$	\$ Cost/ R.O.M.
Fans	18,000	365	6,570,000	247,689	.17
Rest.U/G & Surface	48,419	200	9,683,800	365,056	.24
			16,253,200	612,746	.41
Washery & Train- loader	27,900	200	4,480,000	210,366	.14
	-	-	21,833,200	823,112	.55

115  
5.

MAINTENANCE MATERIALS & SPARES

The following costs have not been synthesised as the previous costs have been, these costs are based on historical costs. The costs given below correspond to costs incurred at other mines where similar machines are used in conditions similar to those expected in the Exempt Area.

The maintenance costs in the Duncan Seam would be lower than in the E. Fingal Seam because of the difference in the type of equipment to be employed. It has been assumed that 50% of the production will come from each seam.

The following costs are for replacement spares and materials only, labour is not included.

Duncan Seam - Machine Spares

L.H.D. Machines - includes tyres, spares, greases and oil	13¢/tonne
Boring M/C	10¢/tonne
TOTAL	<u>23¢/tonne</u>

East Fingal Seam - Machine Spares

C.M.	38¢/tonne
S.C.	15¢/tonne
TOTAL	<u>53¢/tonne</u>

Other underground maintenance of pumps, belts, electrical equipment etc.	<u>20¢/tonne</u>
--	------------------

Other maintenance of surface equipment excluding washery and stockpile	<u>\$1.33/tonne</u>
--	---------------------

Duncan Seam	\$1.76
East Fingal Seam	\$2.06
<u>Total Mine</u>	<u>\$1.91</u>

116

6. MINE STORES

Because of the differing mining method, the Duncan Seam stores cost would be higher than in the East Fingal Seam. The extra cost is for supply of drill steels, bits and explosives which would not be required in the East Fingal Seam.

The other costs covered in this section are for purchase of stone dust, brattice, stopping materials, fuel etc. and freight costs.

These costs would be of the order of -

Duncan Seam	-	\$1.25/tonne
East Fingal Seam	-	\$1.00/tonne
Both Seams	-	\$1.13/tonne

7. WASHING COSTS AND STOCKPILING COST

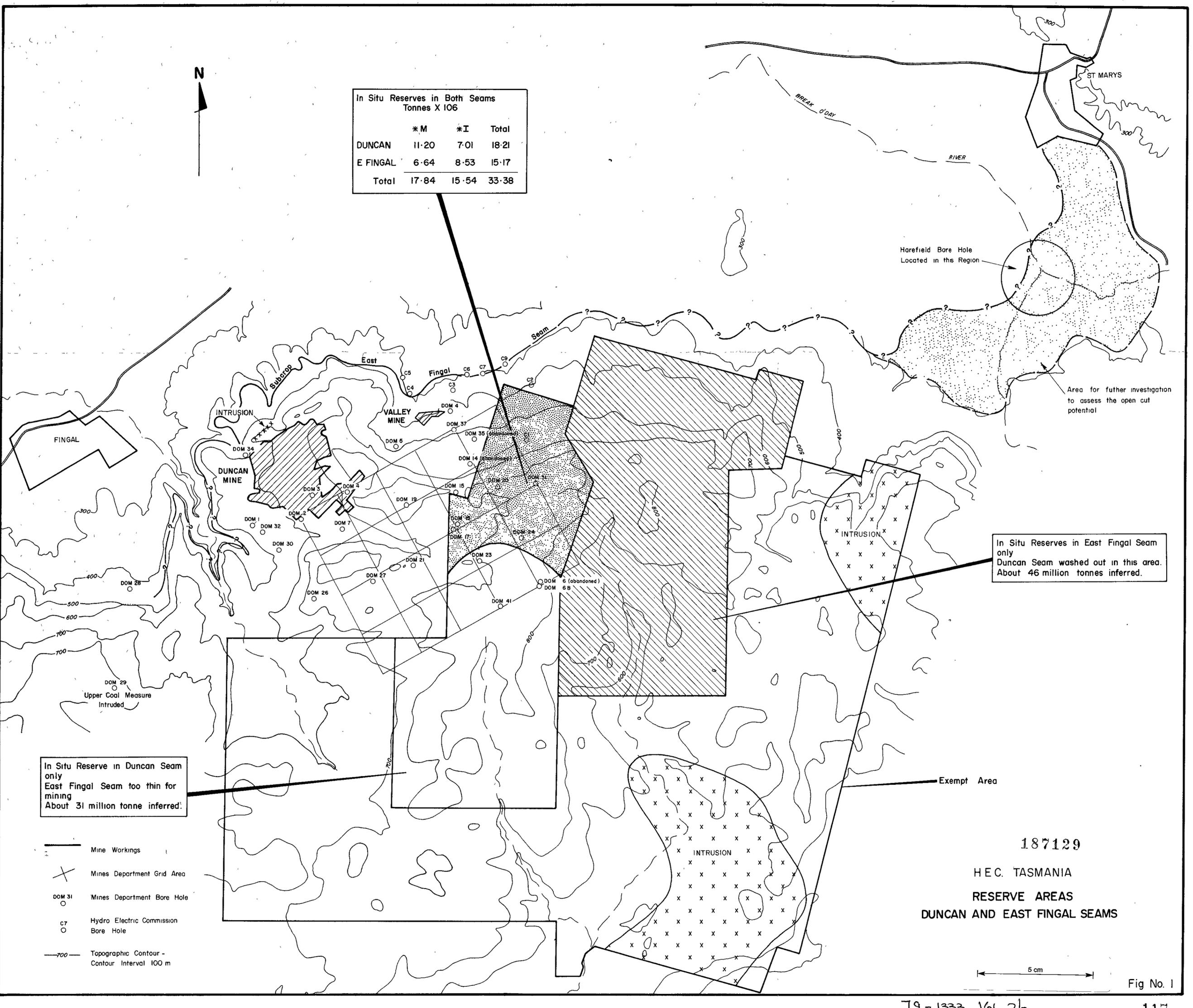
Labour costs have been covered elsewhere. The cost of stores and spares for washery would be of the order of 50¢ per tonne. The maintenance of the stockpile equipment would cost a further 25¢ per tonne giving a total of 75¢ per tonne.

8. HOUSING MAINTENANCE

It has been assumed that the income from rents on company houses would be sufficient to pay for all outgoings on rates and maintenance except in the case of the staff houses where allowance has been made for this expenditure in the salary cost.



In Situ Reserves in Both Seams Tonnes X 106			
	*M	*I	Total
DUNCAN	11.20	7.01	18.21
E FINGAL	6.64	8.53	15.17
<b>Total</b>	<b>17.84</b>	<b>15.54</b>	<b>33.38</b>



Harefield Bore Hole  
Located in this Region

Area for further investigation  
to assess the open cut  
potential

In Situ Reserves in East Fingal Seam  
only  
Duncan Seam washed out in this area.  
About 46 million tonnes inferred.

In Situ Reserve in Duncan Seam  
only  
East Fingal Seam too thin for  
mining  
About 31 million tonne inferred.

- Mine Workings
- ✕ Mines Department Grid Area
- DOM 31 Mines Department Bore Hole
- C7 Hydro Electric Commission Bore Hole
- 700— Topographic Contour - Contour Interval 100 m

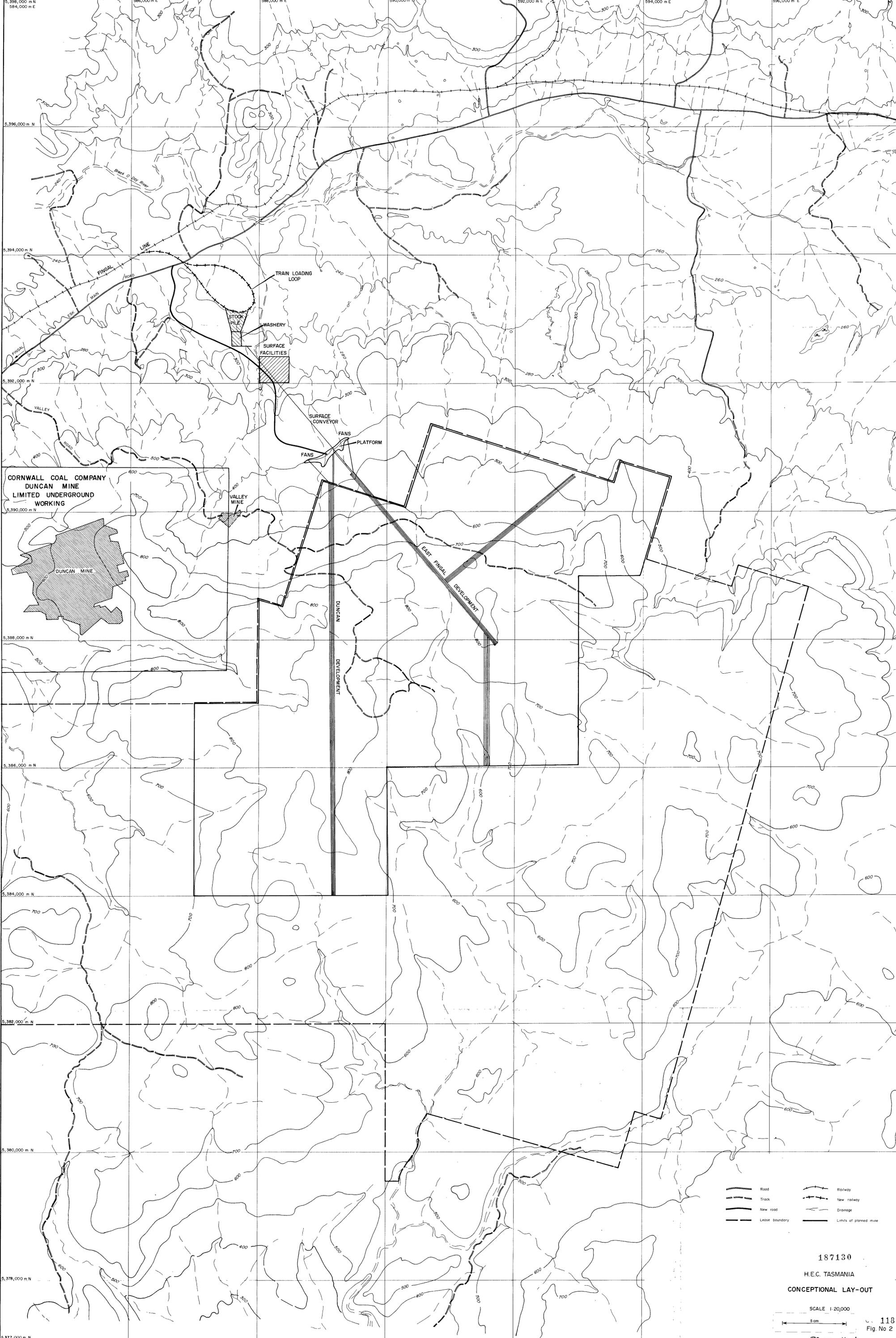
Exempt Area

187129

H.E.C. TASMANIA  
RESERVE AREAS  
DUNCAN AND EAST FINGAL SEAMS

5 cm

Fig No. 1



CORNWALL COAL COMPANY  
 DUNCAN MINE  
 LIMITED UNDERGROUND  
 WORKING

DUNCAN MINE

VALLEY MINE

- |  |                |  |                        |
|--|----------------|--|------------------------|
|  | Road           |  | Railway                |
|  | Track          |  | New railway            |
|  | New road       |  | Drainage               |
|  | Lease boundary |  | Limits of planned mine |

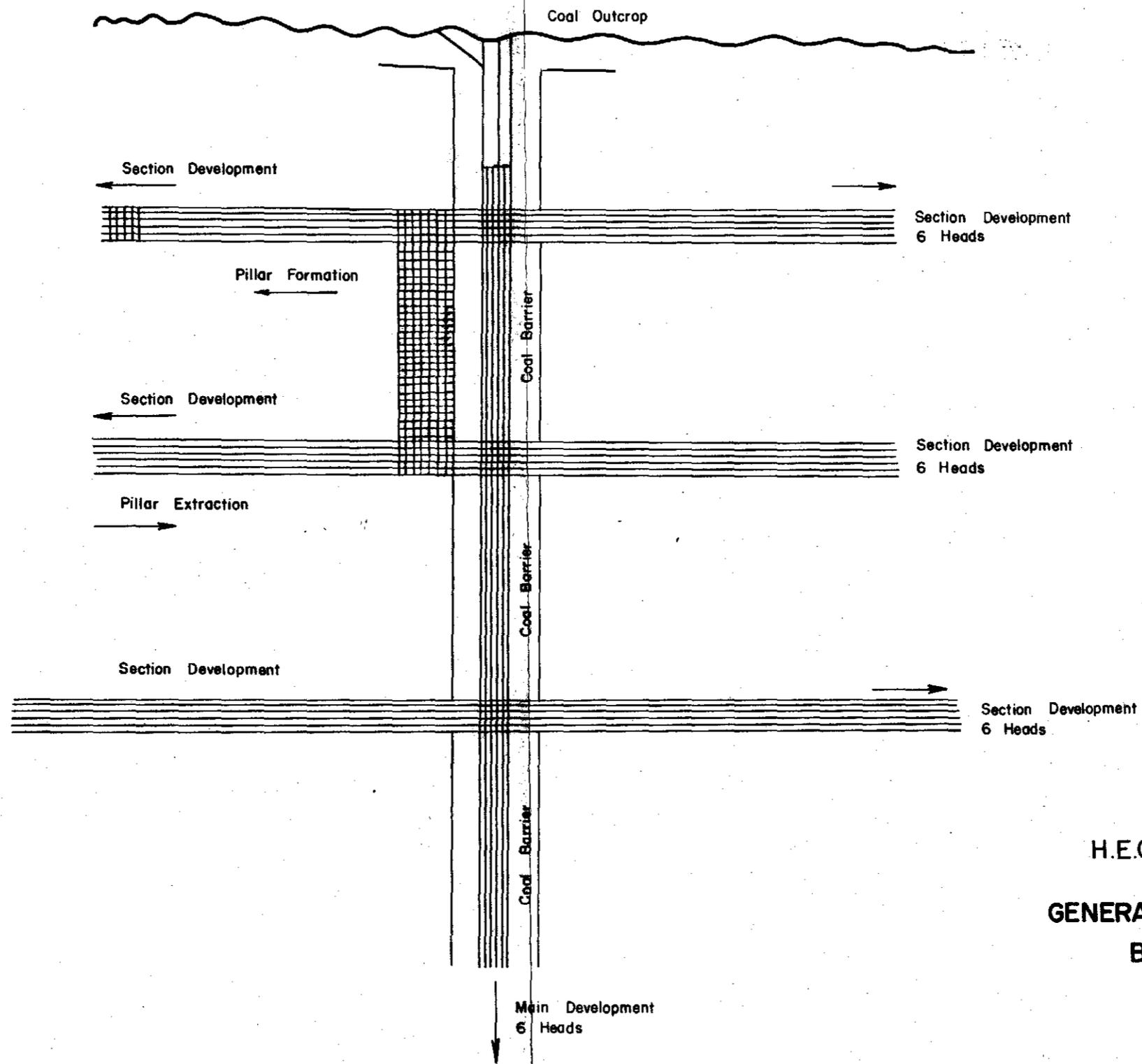
187130  
 H.E.C. TASMANIA  
 CONCEPTUAL LAY-OUT

SCALE 1:20,000

5 cm

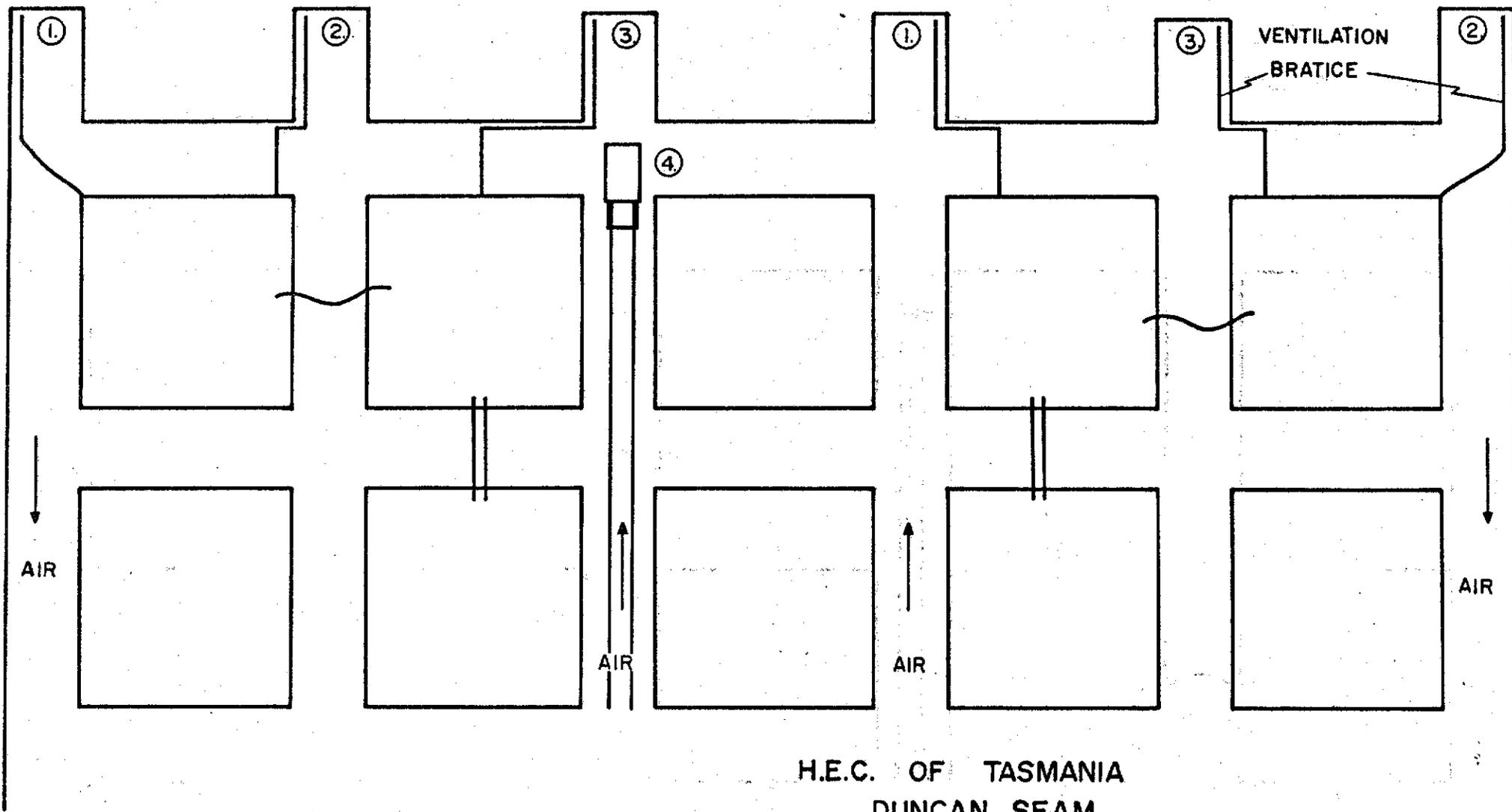
118  
 Fig. No 2

79-1335 Vol 2



H.E.C. TASMANIA  
GENERAL MINING PLAN  
BOTH SEAMS

79-1333 Vol 2/2



H.E.C. OF TASMANIA  
DUNCAN SEAM

PROPOSED NORMAL MINING SECTION LAY-OUT

- 1. LOADER
- 2. ROOF BOLTER
- 3. BORER AND SHOTFIRER
- 4. FEEDER BREAKER

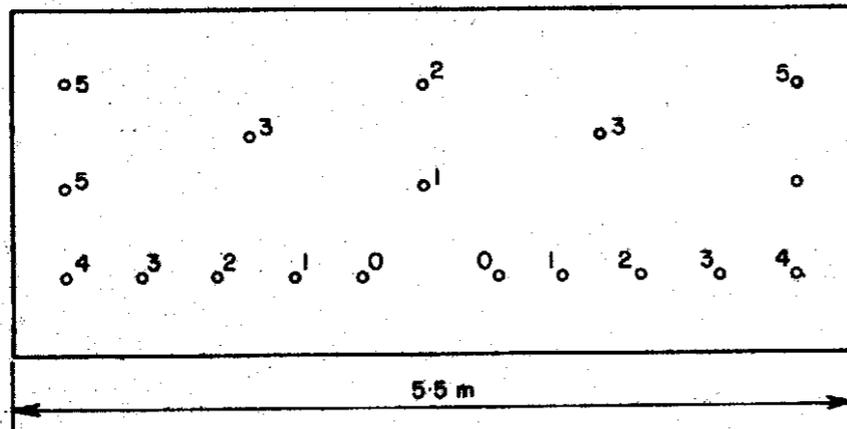
Fig 4

79 152 11 21

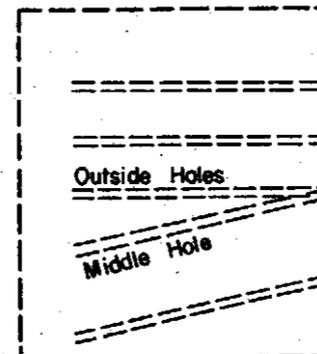
120

187132

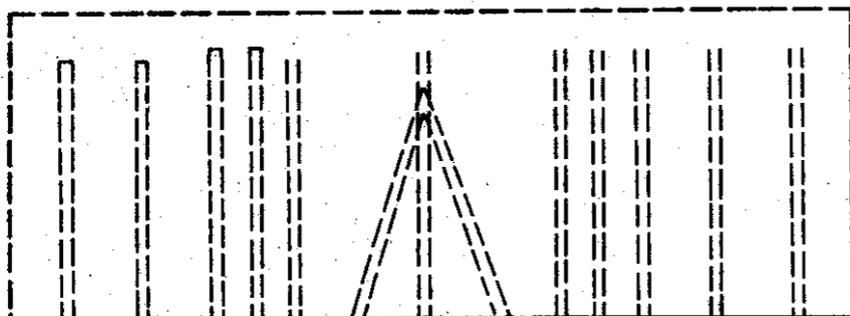
FRONT ELEVATION



SIDE ELEVATION



PLAN



H.E.C. TASMANIA  
PROPOSED SHOTFIRING PATTERN  
DUNCAN SEAM

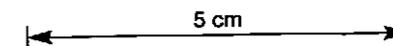
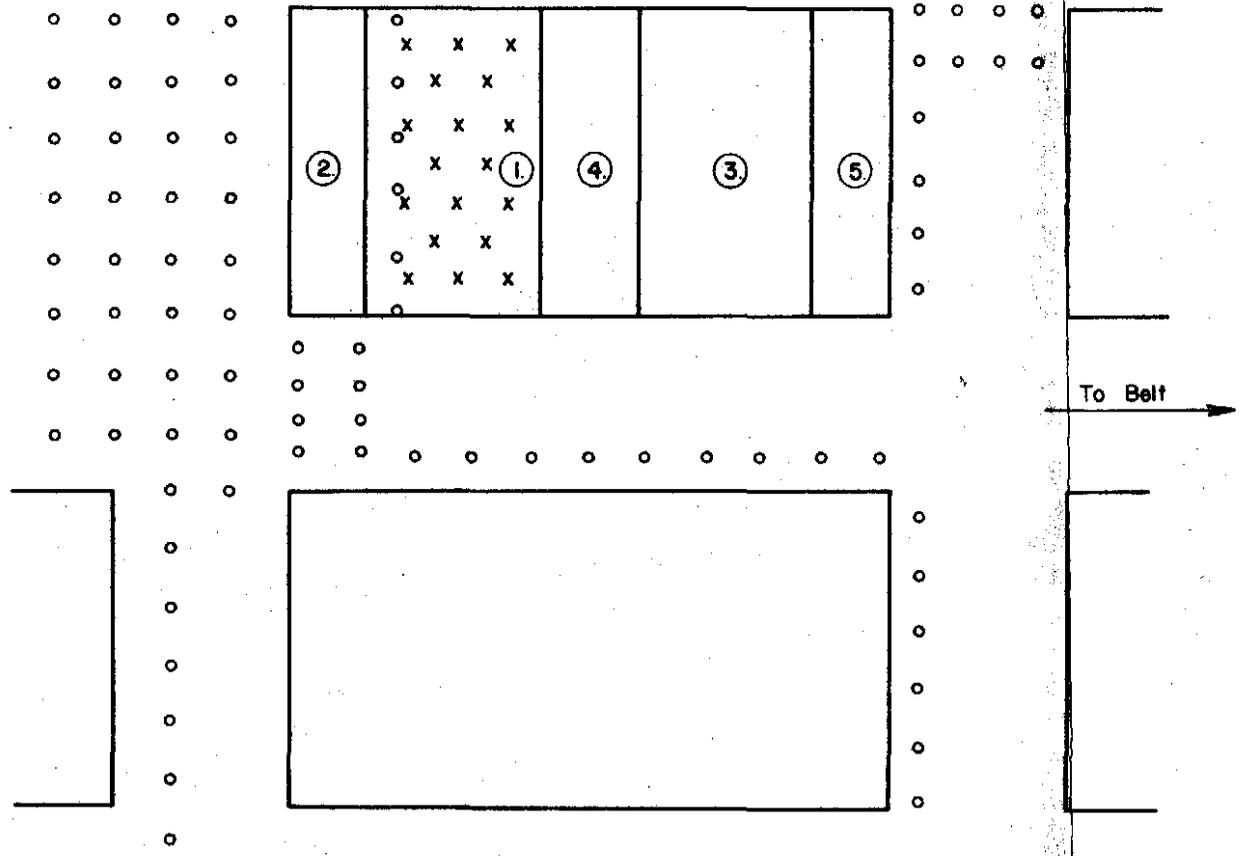


Fig No. 5



EXTRACTION and TIMBERING SEQUENCE

1. Split pillars
2. Starting from outside pillars remove lifts as shown in plan
3. Props to be placed no more than 1.8m. apart.
4. Roof bolting on "W"- Pattern.

o Prop.  
 x Roof bolts.

H.E.C. TASMANIA

PROPOSED PILLAR EXTRACTION SEQUENCE  
 DUNCAN SEAM

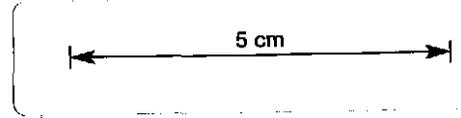
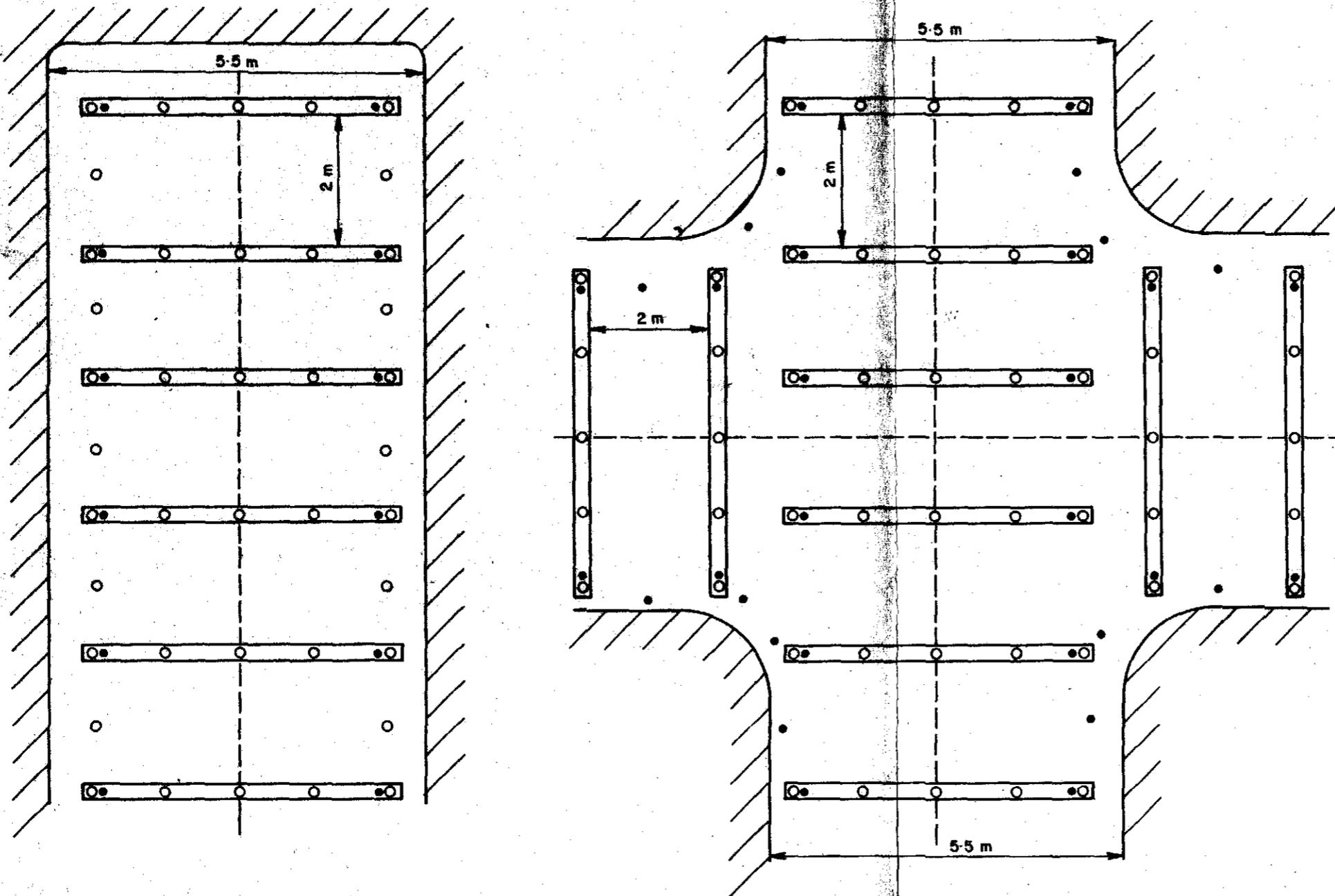


Fig. No. 6

187135

NOTES:

1. Distance between adjacent W-Straps to be not more than 2 metres.
2. Distance between last W-Strap and face to be not more than 3 metres.
3. Middle three bolts to be bolted as mined outside bolts as soon as possible where necessary.
4. These are minimum requirements, more supports can be set if conditions warrant them.



H.E.C. TASMANIA  
PROPOSED TIMBERING PLAN  
DUNCAN SEAM

5 cm

Fig No. 7