ROSEVALE COALFIELD - TASMANIA

RESPONSE TO THE HYDRO-ELECTRIC COMMISSION, TASMANIA

POWER STATION COAL ENQUIRY

PROJECT PICTURE, INFRASTRUCTURE AND ENVIRONMENT

EXPLORATION & EVALUATION GROUP
CSR COAL DIVISION

NOVEMBER, 1983

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GLOSSARY

AHD	Australian Height Datum
act	annual capacity factor
BWE	bucket wheel excavator
CSR	CSR Limited
db(A)	decibels on the A scale
deg	degree
DMR	Department of Main Roads, Tasmania
EL	Exploration Licence
HECT	Hydro-Electric Commission, Tasmania
k	conductivity
km	kilometre
kPa	kilopascals
kV	kilovolt
m	metre
mm	millimetres
mg/l	milligrammes per litre
M	mega, million
ML	megalitres
ML/a	megalitres per annum
Mt	million tonnes
Mtpy	million tonnes per year
MV.A	megavolt ampere
MW	megawatt
RWSCT	Rivers and Water Supply Commission, Tasmania
sq.km	square kilometres
TDS	total dissolved solids
TRMPA	Tamar Region Master Planning Authority
t	tonne
tpd	tonne per day
tph	tonne per hour
t/m^3	tonnes per cubic metre

1. SUMMARY

The Rosevale project is a proposed open cut brown coal mine with an adjacent 400 MW thermal power station based on the Loatta and Pipers Lagoons deposits of the Rosevale Coalfield. The project area is located approximately 25 km west of Launceston.

The mine would be the responsibility of CSR and the power station is assumed to be the responsibility of HECT.

This report describes the physical layout of the project and gives a preliminary overview of stockpiling, the infrastructure requirements and environmental considerations. Some assumptions are made in respect of the power station but these are for overall study purposes and are not intended to indicate a preferred location or design which would be the decision of HECT.

A study by Rheinbraun shows that a 600,000t stockpile is possible and would use the techniques proven by stockpiling large tonnages of similar coal in Europe. The coal would be laid out in 6 x 100,000t stock piles in a system that would be designed to accommodate the total production of the mine. Stockpile surfaces would be stabilized by water sprays and a quick growing grass. Any drying out or degredation is expected to be limited to this stabilized surface layer. Laboratory tests on the coal show a low liklihood of spontaneous combustion although this would be a major consideration in the design and operation of the system.

Total project water requirements are estimated at 5,550 ML/a - 250 ML/a for mine and 5,300 ML/a for power station. The main supply could be from the South Esk River which, subject to the approval of HECT, has the capacity to supply full project requirements. It is likely however, that subject to additional studies, a significant proportion of the total requirement could be obtained from other sources including a storage dam in the area and by recovery and re-use of ground and surface water.

The major wastes are groundwater and surface water (mine); ash, waste water and flue gas (power station); sewage and industrial wastes (combined).

Depending upon final plant design, water quality, water quantity and environmental standards the following disposal strategies are proposed:

- use of surface and groundwater from the mine for power station cooling
- that water not so used to be treated (if required), and discharged to either the Tamar or the Meander Rivers.
- water that cannot be economically upgraded could be evaporated and/or used for dust control on fly ash.
- the sale of fly ash to the construction or cement industry.
- disposal of the balance of the ash in the overburden of dump area after dampening to control dust.

It is probable that sewage and domestic wastes from the mine and the power station would be treated in a common plant and disposed to the Meander River. A common approach would also be probable for oils and solid wastes which would be sold or placed in an approved tip area.

Electric power for construction could come from a new 66 kV line constructed across the Grassy Hut Tier from the Launceston area. The operating power supply for the mine would be drawn from the power station switchyard.

Main access to the site would be from a new, upgraded road off the Bass Highway and it is proposed that a new ring road be built around the site to re-direct local traffic away from the works area.

Manning during construction will peak at 852 about 5 years after site work commences and remain above or near 600 for the next six years. The permanent operating workforce will be about 480. A preliminary survey indicates that the area including Launceston would have the capability to house and support this workforce with some expansion of the existing facilities.

Launceston airport, 25 km south-east, is the nearest meteorological recording station and this data is assumed representative of the project area. This shows winds predominantly north and north west with direct westerly winds towards Launceston between 3% and 8% of the time. Annual rainfall is 709mm and evaporation is 1,395mm.

The groundwater table in the area is high and two aquifer systems have been identified. An aquifer exists below the coal measures and a series of lower yield, aquifers occur within the coal measure sequences. For mining, studies indicate a need to depressurize the lower aquifer to control floor conditions in the pit and to dewater the coal measures for pit stability. Mine dewatering as such should have little effect on regional groundwater outside the immediate mine area because of the low transmissivities of the coal measure sequences. "Groundwater harvesting" to supply power station cooling water may have a significant regional effect and is to be studied further.

Much of the area is low gradient and can become very wet in places. Drainage is by Pipers Lagoon Creek. The surface water regime will be altered by the mining operation and a series of diversion drains are proposed to redirect the water. This system will include retention ponds for the removal of particulate matter before the water is re-used or returned to natural watercourses.

Natural vegetation and fauna is typical of agricultural areas in Northern Tasmania and no endangered or rare species are reported or identified. Some additional surveys will be required in the swampy areas which overlie a section of the Loatta deposit.

Current land use is grazing and cropping.

Some archeological sites have been found but none are believed to be of major significance. No buildings in the area are on the Register of the National Estate or the National Trust.

Insufficient data exists to carry out a environmental impact statement but that work which has been done has identified the major considerations. All these require further study. They are:

Mine	topographic changes air quality effects groundwater - effects and management surface water - effects and management soils and land use impact rehabilitation
Power Station	visual effects air quality and emissions ash disposal water supply and waste water disposal

Further studies are also required to evaluate the likely socio economic effects of the proposed project.

These preliminary studies have not identified any environmental factors that would preclude the development.

2. INTRODUCTION

This report gives a preliminary overview of the infrastructure requirements and environmental aspects for development of the Rosevale Coalfield. It also develops a physical layout showing the main features of the project to illustrate the concept of an interrelated project.

It is based on the assumption of an open cut brown coal mine supplying fuel to a mine site power station. The mine would be the responsibility of CSR and the power station is assumed to be the responsibility of HECT.

In order to develop this "total project" concept, CSR has made some assumptions and undertaken some studies relating to the power station. This has been done for study purposes so that the implications of a combined mine/power station project can be considered and it is not intended that this indicate a preferred location or design which would be the responsibility of the HECT.

This is based on the preliminary evaluation of the project by CSR and brief studies by consultants. For this reason, the comments are qualified because of limited input data and it is recognised that further much more detailed studies will be required. In particular, this applies to water supply, waste disposal, land rehabilitation and the environment. Within these constraints, this report gives an overview of the project and identifies the major issues.

Some environmental and infrastructure aspects are clearly the responsibility of either the mine or the power station. Others, however, affect both the mine and the power station and in this case, sharing of these common infrastructure and environmental aspects is believed to be the most suitable arrangement. The basis of sharing will vary from item to item and would be subject to negotiation between the parties involved.

3. PROJECT PICTURE

3.1 Location

The brown coal deposits of the Rosevale coalfield occur approximately 25 kilometres west of Launceston (Figure 3.1). They are separated from the Tamar Valley and the city by the 300 to 400 metre high Grassy Hill Tier and lie on the edge of the flats to the north of the Meander River. They are bordered, except to the south and south west, by hills largely covered with eucalypt forest.

Westbury is the main town near the deposits 11 kilometres to the south west and the smaller villages of Hagley and Carrick are approximately 8 km to the south. The Bass Highway, which is a major highway linking Launceston and the North West Coast lies 8 kilometres to the south. The Western Line Railway parallels the Bass Highway.

Three major coal deposits have been delineated by exploration drilling (CSR 1983). These are the Loatta, Pipers Lagoon and Selbourne deposits which extend from west to east over a distance of about 12 kilometres. Other prospects also exist in the area and there is potential to further increase coal reserves.

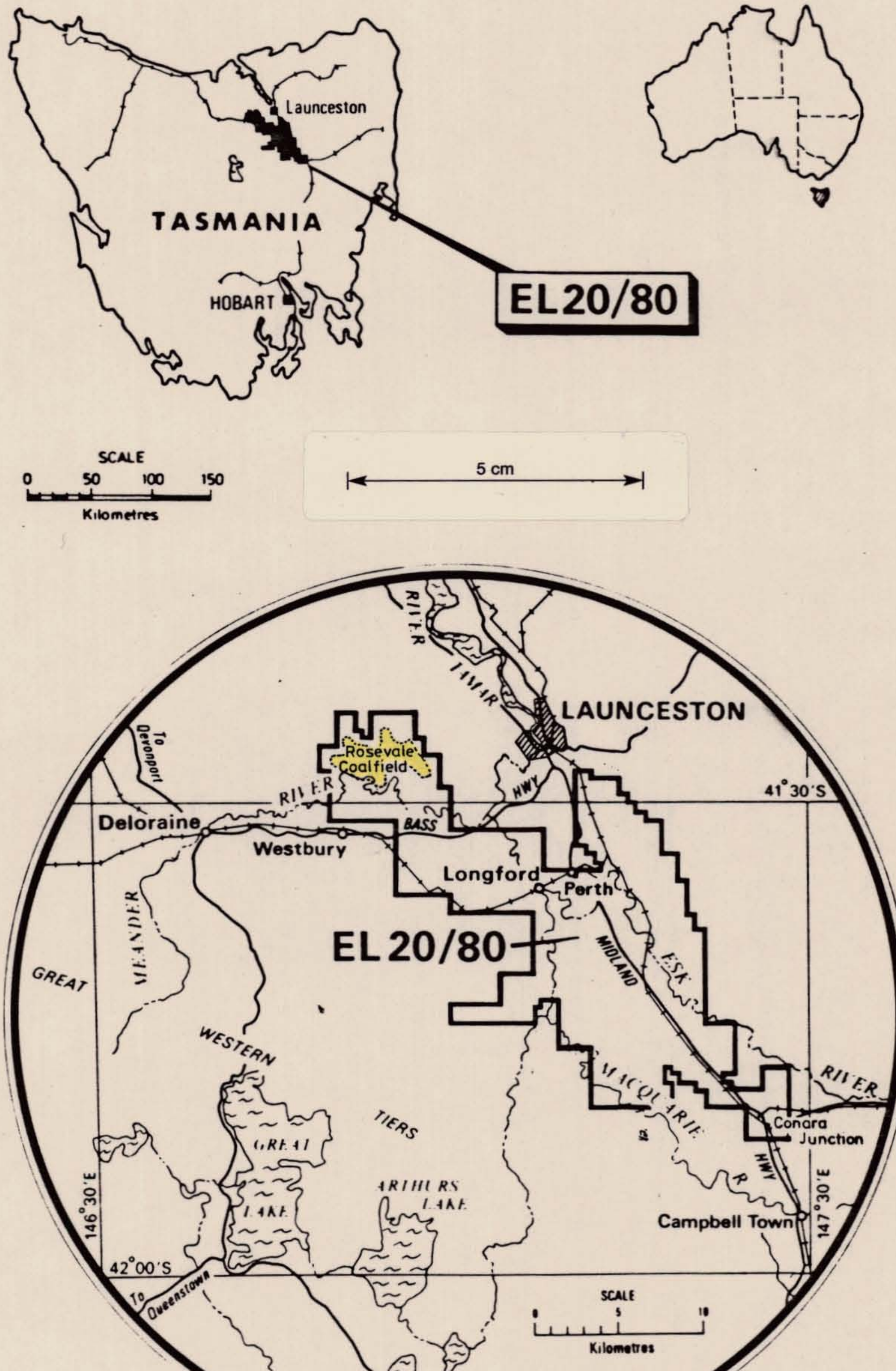

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FIGURE 3·1

3.2 Project Picture

In order to develop the spatial relationship between power station and mine, a general site project picture was developed, see Figure 3.2. While it is desirable to be more specific in locating the mine industrial area and the power station, this is not possible at this early stage of study. As a result, final layouts of conveyors and services are not shown.

A larger scale general arrangement Mining Site Plan is shown in Figure 3.3.

3.3 Stockpiling

3.3.1 Introduction

Common practice in brown coal operations involving an open cut mine and a mine site power station is to use bunkers of 24 - 48 hrs coal capacity as an intermediate storage between the mine and the power station. The bunker generally functions as:

- a surge storage
- a small security storage
- a blending facility to smooth variations in coal quality.

Large stockpiles are not always used because of the difficulty in stockpiling some brown coals and because of the flexibility and security inherent in the open cut mining operation.

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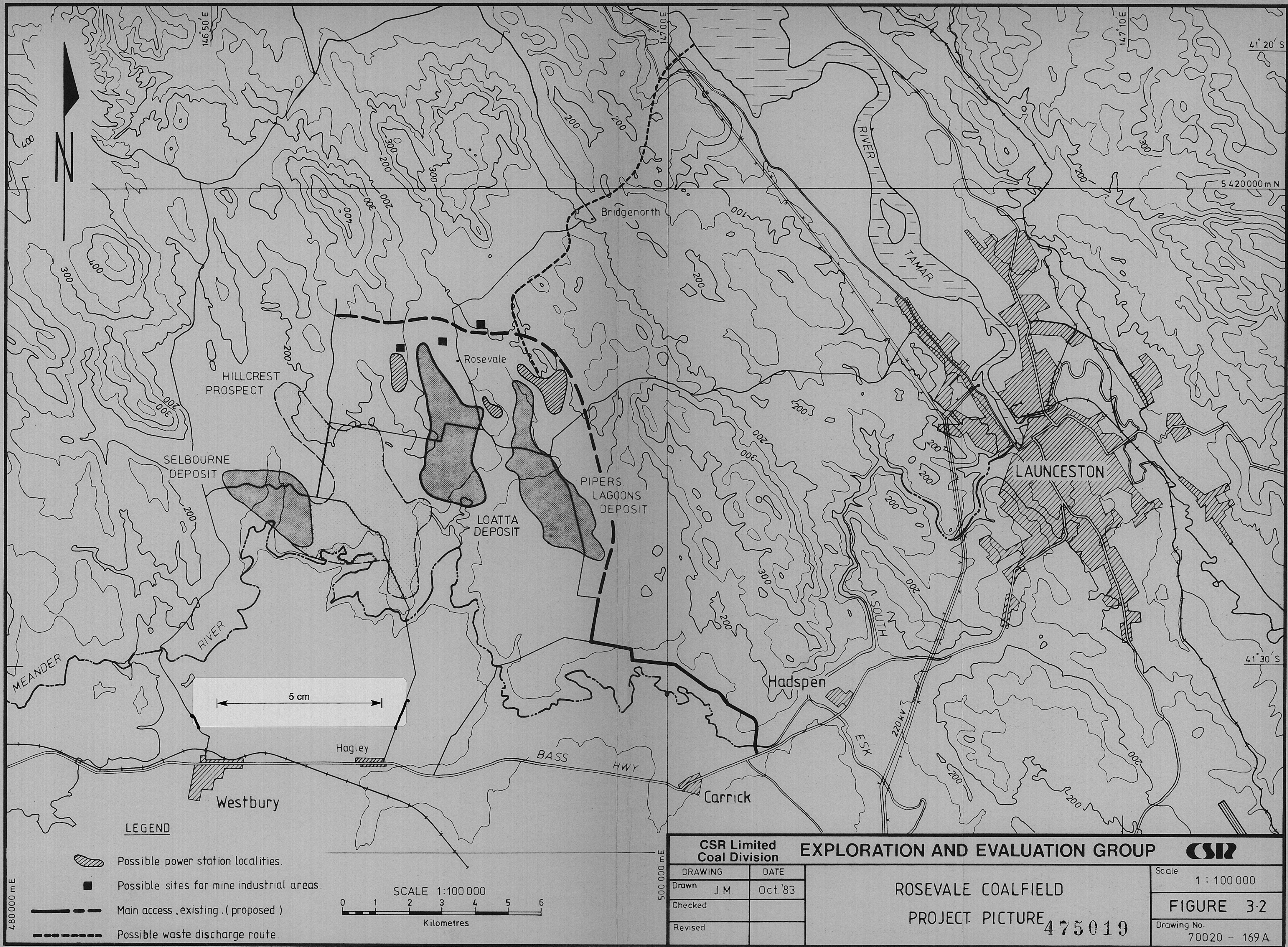

146°50'E
147°00'E
147°10'E
41°20'S
41°30'S
5420000 m N
480000 m E
500000 m E
N
Bridgenorth
Rosevale
HILLCREST
PROSPECT
SELBOURNE
DEPOSIT
LOATTA
DEPOSIT
PIPERS
LAGOONS
DEPOSIT
LAUNCESTON
RIVER
TAMAR
SOUTH
ESK
220 kV
Hadspen
MEANDER
RIVER
Hagley
BASS
HWY
Westbury
Carrick
5 cm
LEGEND
Possible power station localities.
Possible sites for mine industrial areas.
Main access, existing. (proposed)
Possible waste discharge route.
SCALE 1:100 000
0 1 2 3 4 5 6
Kilometres
CSR Limited
Coal Division
EXPLORATION AND EVALUATION GROUP
DRAWING
DATE
Drawn J.M.
Oct.'83
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Revised
ROSEVALE COALFIELD
PROJECT PICTURE
Scale
1 : 100 000
FIGURE 3·2
Drawing No.
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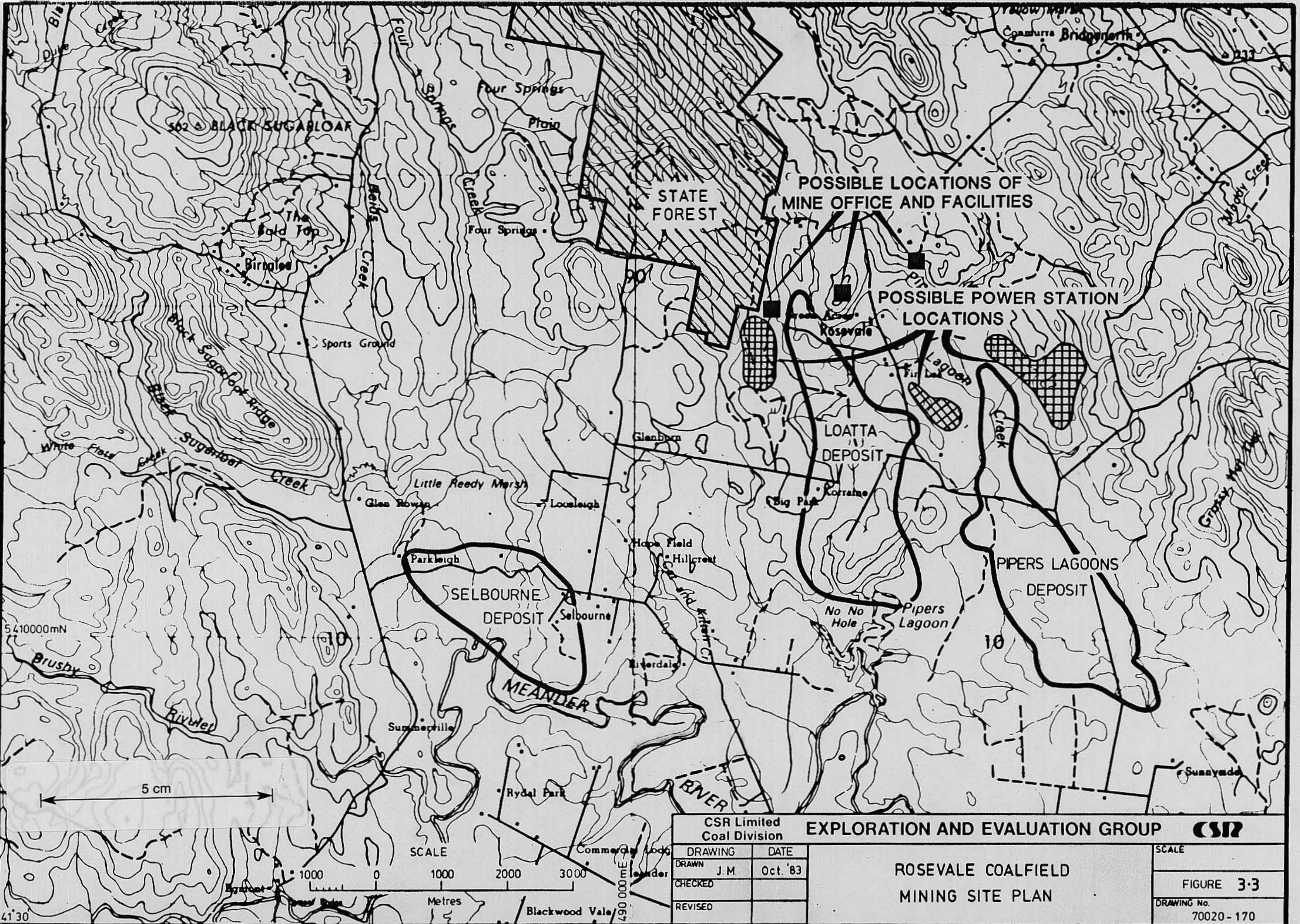

BLACK SUGARLOAF
502
The Bald Top
Birralee
Black Sugarloaf Ridge
Black Sugarloaf Creek
White Flats Creek
Sports Ground
Reids Creek
Four Springs Plain
Four Springs
Four Springs Creek
STATE FOREST
POSSIBLE LOCATIONS OF MINE OFFICE AND FACILITIES
POSSIBLE POWER STATION LOCATIONS
Rosevale
Lagoon Creek
LOATTA DEPOSIT
Glenburn
Little Reedy Marsh
Glen Rowan
Loosleigh
Big Park
Lorraine
Hope Field
Hillcrest
Parkleigh
SELBOURNE DEPOSIT
Selbourne
PIPERS LAGOONS DEPOSIT
No No Hole
Pipers Lagoon
Grassy Hut Creek
Bridgenorth
Riverdale
MEANDER
RIVER
Brushy Rivulet
Summerville
Rydal Park
Sunnyside
Blackwood Vale
5 410 000 mN
490 000 mE
41°30'
5 cm
SCALE
1000 0 1000 2000 3000
Metres
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Coal Division
EXPLORATION AND EVALUATION GROUP
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ROSEVALE COALFIELD
MINING SITE PLAN
SCALE
FIGURE 3·3
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HECT called for a coal stockpile, equivalent to 1.88 Mt of Rosevale coal (500,000t black coal) in their Coal Enquiry of 3rd October. The mining study prepared in response to this enquiry (1) allowed for a total coal inventory of 1.88 Mt - 400,000 tonnes in external stockpile and the remainder (1.48 Mt) stored in pit as uncovered coal. With the flexibility and security of the proposed mining operation, it is believed this represents a compromise between the desire for a large external stockpile and the practicality and cost of this approach.

Subsequently, CSR retained Rheinbraun Consulting Australia Pty. Ltd., to undertake a feasibility study for a larger 600,000t external stockpile. This larger tonnage was selected for study to allow some flexibility in reaching a final decision on the appropriate external stockpile size.

The scope of this brief study is:

- technical feasibility of stockpiling Rosevale coal. This is to include an evaluation of coal quality and local climatic conditions and a comparison with existing brown coal stockpiling operations
- experience in stockpiling similar coals
- recommended methods and equipment for stockpiling Rosevale coal
- comment on stockpile capacity and duration
- possible quality degredation and means of minimising this
- recommendations for further work.

The study is to include testing by Rheinbraun of a sample of Rosevale coal. Initially a 6 kg composite sample of coal left from previous laboratory tests in Australia was sent to Germany and this has now been followed by 5 kg sample of fresh coal from a borecore.

3.3.2 Size of Stockpile

Stockpile Capacity	=	600,000 t

Assumed Power Station Consumption

100% acf (full load)	=	17,000 t/day
65% acf	=	11,000 t/day

Nominal Stockpile life (assuming no coal input)

at 100% acf	=	35 days
at 65% acf	=	54 days

3.3.3 Proposal

A progress report has been received from Rheinbraun and this is attached as Appendix 1.

Findings to date are as follows:

- Rheinbraun find that stockpiling of Rosevale coal is quite practical and would use techniques already proven in large stockpiling overations overseas.

- The proposed stockpiling system for 600,000t (total) is 6 x 100,000t stockpiles laid out above ground. The system would be designed to allow all coal production from the mine to pass through the stockpiling cycle but there would also be provision for by passing the stockpile direct to the power station. Equipment proposed is shown in Appendix 1.

- Tests on Rosevale coal show it to be probably less prone to spontaneous combustion and more stable than Rheinbraun brown coals. The Rheinbraun coals from the German Rheinland have never shown tendency to self-ignition.

- Notwithstanding, spontaneous combustion tendencies and not the drying out or the physical degredation of the coal is likely to be the controlling factor for stockpiling and any stockpiling system would be designed accordingly.

- Nominal stockpile life is four months. Longer storage may be feasible but this should be based on field tests with a large stockpile.

- Dust control and surface stability of the stockpile would be achieved by seeding the surface of the coal with a quick growing green grass and by water sprays. The grass seed would be sprayed onto the surface of the pile in a solution which includes a fertilizer and a stabilizing polymer.

- Coal degredation and drying out would be confined to the surface and it is expected that the surface would be stabilized as described above.

Stockpiles now in operation or planning are:

Rheinbraun, Fortuna	300,000 t
Rheinbraun, Frimmersdorf	620,000 t
Puentes, Spain	270,000 t
Elbistan, Turkey	900,000 t
Megalopolis, Greece	400,000 t

4. INFRASTRUCTURE

4.1 Introduction

This section of the report discusses the main infrastructure aspects under the headings of water, waste disposal, power supply, roads and access, manning, housing and cost sharing ratios.

4.2 Water Supply

Water is used in both the mine and the power station but it is the power station requirements which dominate and therefore have the major influence on water supply strategies.

4.2.1 Water Quantity

Estimated water requirements are:

Mine	250	ML/a
Power Station	5,300	ML/a
Total	5,550	ML/a

Mine use is for general services including wash down and domestic services.

A power station has a complex water use system (2) which in the case of Rosevale, is assumed to be based on conventional water circuits, dry fly ash disposal and a natural draft cooling tower for condenser cooling. Water is a major process requirement and is used in this series of different water circuits which require a detailed study of the full range of operating conditions to determine the optimum usage of water. Until such a design study is completed, water quantities are estimates based on typical power station experience where water is used predominantly for:

- replacement of cooling tower evaporation losses
- make up for cooling tower blowdown
- furnace ash sluicing
- boiler make up
- general station services.

Final quantities will be dependent upon:

- power station design
- water quality
- availability and cost of water.

Water from a number of different sources, all with different qualities, are being considered. In the absence of firm quality data for each of the different sources, a typical water quality of TDS 625 mg/L or lower supplied to the power station is assumed. It is further assumed that use is not limited by any particular compound (eg., silica). Water usage is based on this figure and is not adjusted for the possible quantity variations due to quality changes. Unless actual quality differs significantly from that assumed, optimisation in design is assumed to have a greater effect on water use than will quality.

A typical water use scenario for a power station at Rosevale is based on these assumptions and is illustrated in Figure 4.1. It is based upon the information supplied by ERM (2).

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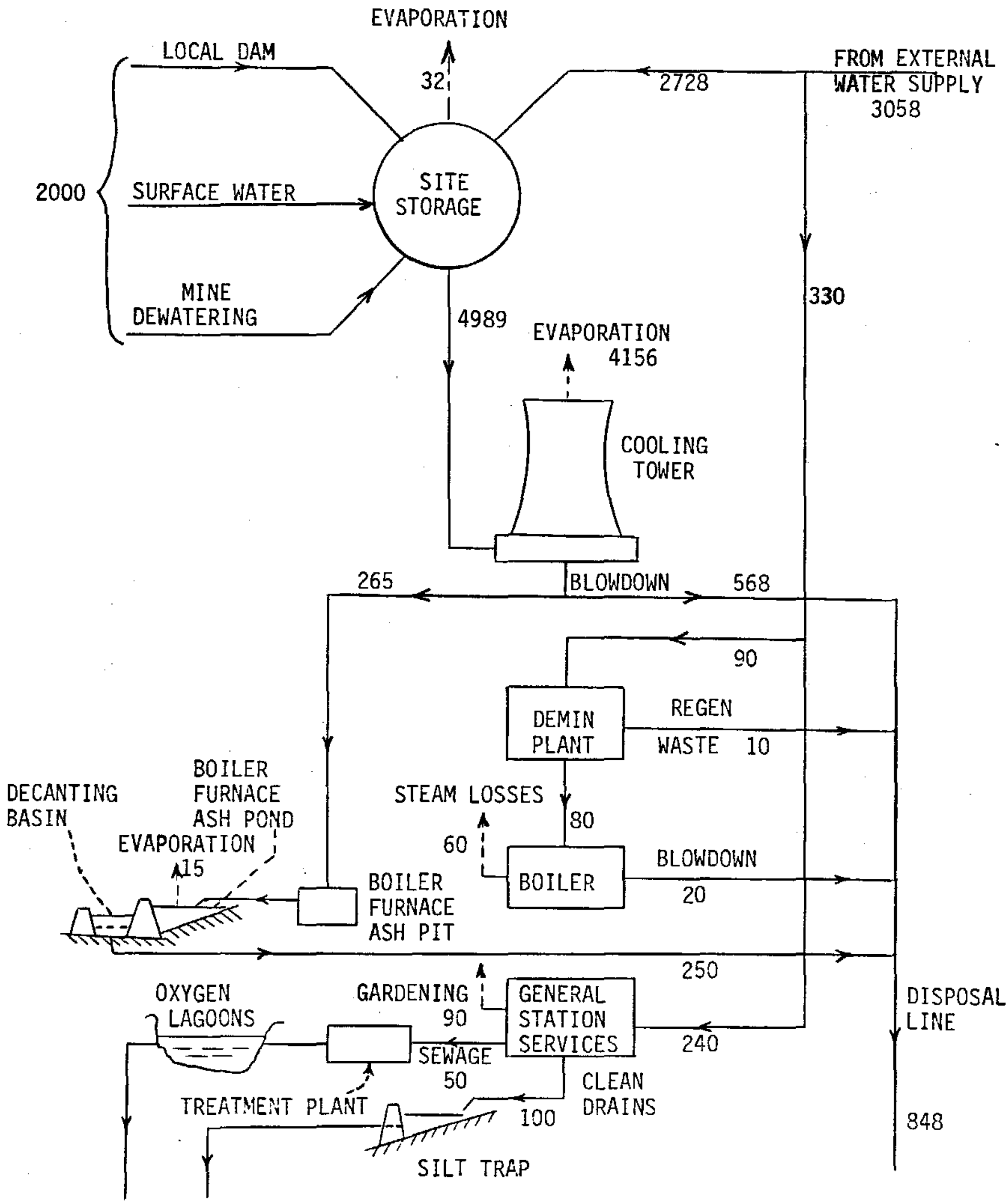

NOTE: WATER QUANTITIES SHOWN ARE MEGALITRES/ANNUM

CSR Limited Coal Division — EXPLORATION AND EVALUATION GROUP — CSR

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CHECKED	WATER USE 400MW MINE SITE STATION	FIGURE 4.1
REVISED		DRAWING No 70020-178

4.2.2 Water Sources

A number of different water sources are available. These are:

- groundwater
- local supply dam
- supply from the rivers or more distant dams (existing or proposed) in the area
- surface water.

4.2.2.1 Groundwater

A preliminary groundwater study by Australian Groundwater Consultants (3) reported in Section 5.4 indicates the potential to supply water from mine dewatering and from specific water supply bores.

Mine dewatering would produce a variable yield, initially estimated at 180 - 620 ML/a. Water quality is good at 150 - 200 mg/L TDS and so would be suitable for power station cooling.

If required, additional water could be produced from water supply bores drilled to the south of the deposits which would be capable of approximately 500 ML/a each. The quality is estimated to be possibly lower than that of groundwater from dewatering and so some blending may be required to maintain total water quality within acceptable limits for power station and other use. A decision to use this water would be taken only after careful study which would include:

- necessity to use additional groundwater
- possible effects on existing groundwater users
- actual groundwater quality
- economics of this method of supply.

4.2.2.2 Local Supply Dam

Two possible sites have been identified by ERM (2):

- either a eastern tributary of Pipers Lagoon Creek across a steep valley below Shaws Road, with full supply level at about 200 metres AHD.

  This would produce a storage of approximately 70 hectares surface area and 17,500 ML volume. Net supply capability is estimated at 1,200 ML/a.

- or Black Sugarloaf Creek below White Flats Creek to the west of the Selbourne coal deposit, with full supply level at about 210 metres AHD.

  This would produce a storage of approximately 270 hectares surface area and 67,500 Ml volume. Net supply capability is estimated at 2,800 ML/a.

These storages are illustrated on Figures 3.2 and 4.2.

Both these options are preliminary selections and further study of their potential is required.

4.2.2.3 Other Water Sources

i) South Esk River

The South Esk River between Hadspen and Trevallyn Dam is considered a suitable source for water supply to the Rosevale project.

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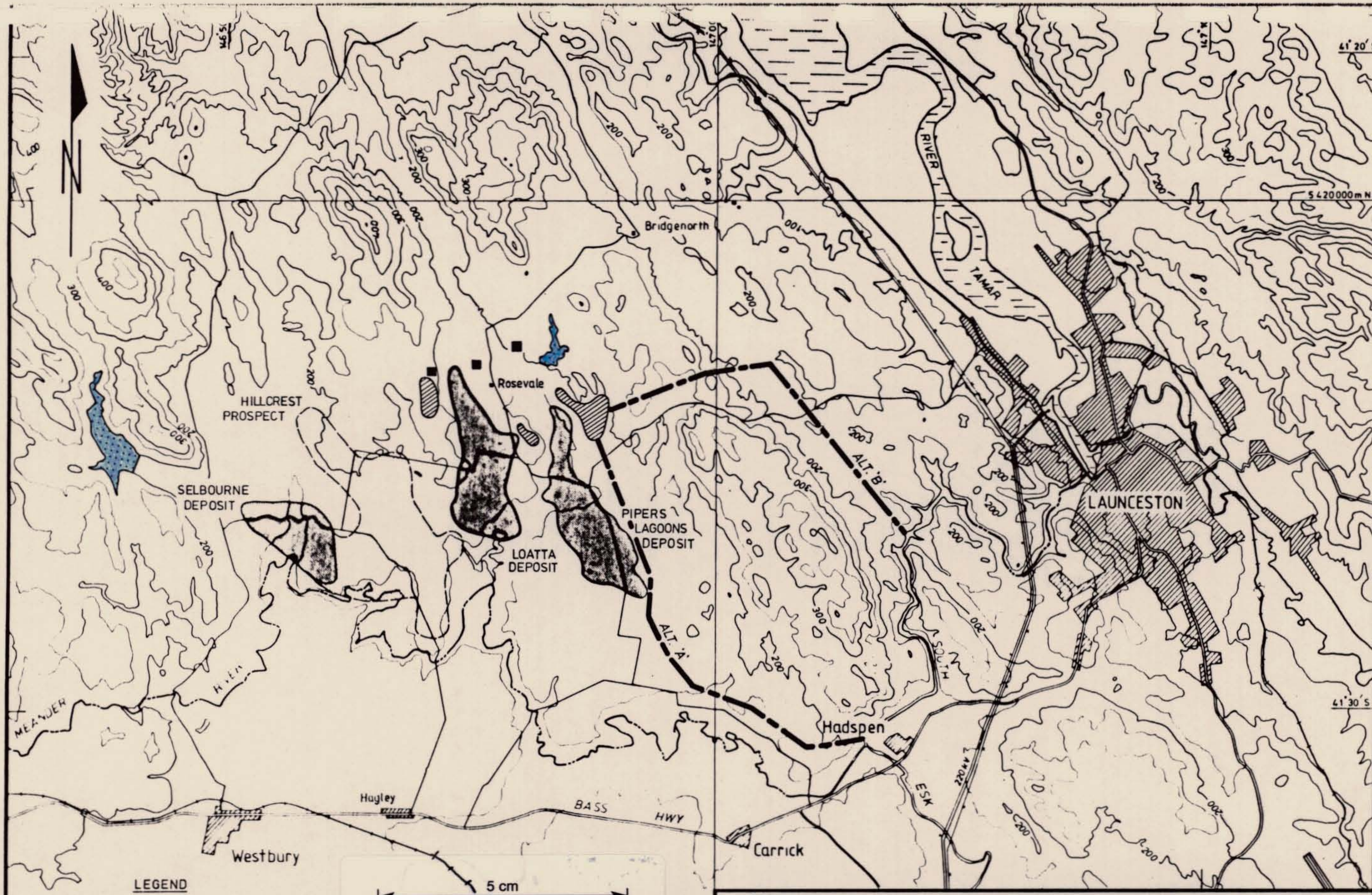

CSR Limited Coal Division		EXPLORATION AND EVALUATION GROUP CSR	
DRAWING	DATE	ROSEVALE COALFIELD PROPOSED WATER SUPPLY	Scale
Drawn J.M.	Oct '83		FIGURE 4·2
Checked			
Revised			Drawing No. 70020 - 175

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There is sufficient water from the River either at Hadspen or the Trevallyn Dam to supply up to the total water requirement of about 5,550 ML/a.

The HECT controls the water rights within the South Esk River and their approval would be necessary. Also, the RWSCT has an allocation of 20 cusecs for irrigation but this does not affect the capacity of the South Esk to supply up to the likely total requirements of the project.

This river supplies Launceston and the Trevallyn Power Station and further studies would be required to confirm supply availability.

ii) Warners Creek Dam

This dam is a possible project for Federal Government finance and would provide irrigation to the Deloraine area together with water supply for Deloraine and Westbury townships. A decision on the project has not been made and the project appears unlikely in the immediate future. However, this should be included in any future studies.

iii) Meander River

Stream flow information from the RWSCT indicates that there is insufficient river flow to provide the project requirement. During drought in January 1983 the river flow almost stopped. As there is insufficient reliable supply and this source is not considered further.

4.2.2.4 Surface Water

Surface water is a potential water supply for the project and would be recovered from:

- civil works necessary to protect the mine and power station from surface run off and floods
- where existing water courses are diverted around the mine.

This water would be redirected by installing banks and channels as necessary and collected in holding basins. Particulate matter would be removed by sedimentation in these basins or in separate settling ponds and the water would then be pumped for use as power station cooling water or it would be discharged as discussed in Section 6.1.1.5.

4.2.2.5 Total Supply

Total water requirements for the project are assumed to be made up as follows:

groundwater		
dewatering	200 - 600 ML/a	
water bores	to be established	
local storage surface water	1,200 - 2,800 ML/a	
Sub total	2,000	ML/a (assumed)
South Esk River	3,550	ML/a
Total	5,550	ML/a

If further studies confirm the feasibility of the local storage, surface water and groundwater supplies, they may supply even more than a total of 2,000 ML/a. This would reduce the requirement from the South Esk. Alternatively, if they are unable to supply, the South Esk has the capacity to supply up to the total of about 5,500 ML/a.

4.2.3 Water Supply From South Esk River

Two routes have been examined and they are:

i) A pump station near the confluence of the Meander and South Esk Rivers with a pipeline along the west side of the Grassy Hut Tier.

ii) A pump station at the Trevallyn Dam and a pipeline along the east side then across the Grassy Hut Tier.

Within the limits of the study both routes are feasible but particular pump station sites and pipeline routes will require a more detailed study. They are illustrated on Figure 4.2.

4.2.4 Water Cost

The cost of water will be an important factor in selecting the preferred sources. Insufficient information is available at this time but costs are being sought and will be considered in a future study.

4.3 Waste Disposal

Ultimate waste management and disposal strategies will depend upon detailed feasibility and design studies, which will consider water quality standards, acceptable disposal methods and the opportunities for re-use. Based upon the information currently available it is believed that acceptable disposal will be achieved using proven techniques.

4.3.1 Mine

It is anticipated that the major mine wastes will include:

- groundwater produced in dewatering
- surface water
- sewage and domestic wastes
- waste oil and industrial wastes from machine maintenance and general operations.

Groundwater from mine dewatering is the major mine waste and is estimated at 180 ML/a to 620 ML/a. Surface water collected from stream diversion and run off will also be a significant water stream. Dependent upon quantities and qualities it is proposed to re-use this water for power station cooling.

Quantities used in the power station will depend on quality. (Section 4.2). Assuming satisfactory quality including a total dissolved solids content less than about 625 mg/l up to about 5000 ML/a could be used in this way. Water not used will be disposed of according to its quality and the quality standards for receiving waters.

Options for disposal are:

- Discharge to Tamar River via a Pipeline

  It is believed that the higher salinity of the Tamar River would allow the discharge of lower quality water than may be permissible to the Meander.

Preconditions for disposal would be:

- suspended matter, TDS, chemical contaminants and other criteria within the limits set by the Department of the Environment (4). Treatment to remove particulate matter and possibly chemical treatment would be undertaken if required

- discharge was permitted by the Department of the Environment (Section 7).

  A notional route for a pipeline discharge to the Tamar is shown on Figures 3.2 and 4.3.

- Draining into Meander River

  This is a tributary of the South Esk and supplies water for irrigation and domestic use including Launceston.

  The same general procedures but with more stringent controls because of the tighter standards would be required.

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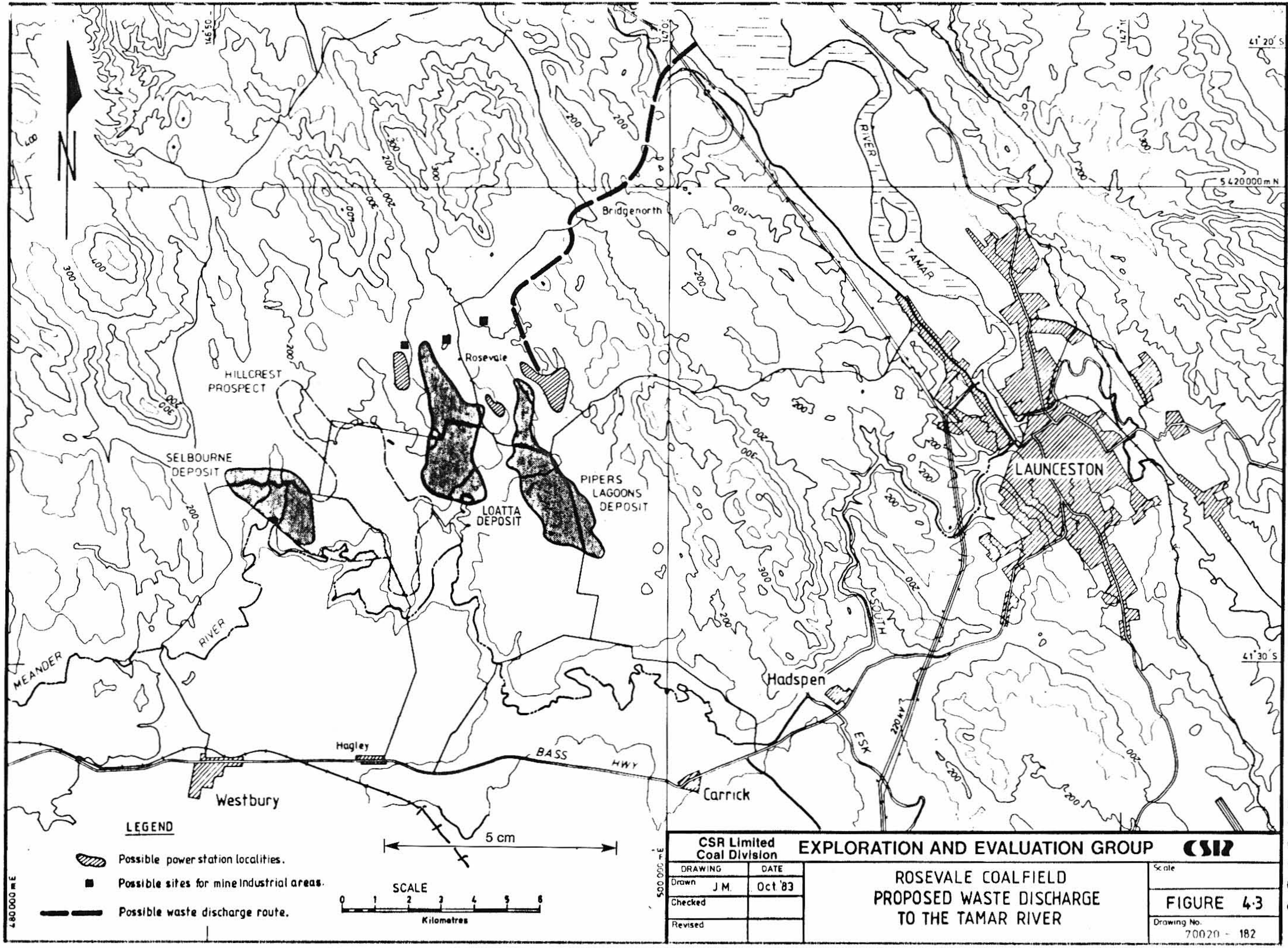

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Coal Division
EXPLORATION AND EVALUATION GROUP
CSR
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DATE
Drawn J.M.
Oct '83
Checked
Revised
ROSEVALE COALFIELD
PROPOSED WASTE DISCHARGE
TO THE TAMAR RIVER
Scale
FIGURE 4·3
Drawing No. 70020 - 182
LEGEND
Possible power station localities.
Possible sites for mine industrial areas.
Possible waste discharge route.
SCALE
0 1 2 3 4 5 6
Kilometres
5 cm
N
LAUNCESTON
Bridgenorth
Rosevale
HILLCREST
PROSPECT
SELBOURNE
DEPOSIT
LOATTA
DEPOSIT
PIPERS
LAGOONS
DEPOSIT
TAMAR
RIVER
MEANDER
RIVER
SOUTH
ESK
Hadspen
Hagley
Westbury
Carrick
BASS
HWY
220 kV
5 420 000 m N
41°20'S
41°30'S
480 000 m E
500 000 m E
146°50'
147°0'
147°10'

47036

- Ash wetting

  If "dry ashing" techniques were used for the disposal of power station fly ash, the ash would require dampening to control dust. Based on the assumption of 4.6 Mtpy coal with 25% ash burnt in the power station and 20% water addition to control dusting, 207 ML/a could be disposed in this manner.

- Evaporation

  Water unacceptable for discharge to either the Tamar or Meander because of its quality could be evaporated.

  Based on the rainfall (709mm per year) and evaporation data (1,395mm per year) from Launceston Airport, approximately 650mm of water could be evaporated in a year, subject to detailed feasibility and design studies. A suitably designed evaporation basin could be located in the overburden dumping area or elsewhere and if necessary, lined with an impervious clay layer to prevent seepage. Such a pond, 500m x 500m in surface area, could evaporate about 160 ML/a.

Sewage, domestic liquid wastes and wash down water will be treated using conventional settlement and/or sewage treatment methods and the effluent disposed of according to water quality.

Oils and chemical wastes from maintenance operations would be collected then recycled, dumped in an approved area or sold for use or re processing.

Solid wastes will be placed in an approved tip or dumping area.

4.3.2 Power Station

Wastes generated by the power station could have a major impact, but given existing practices it is probable that this impact can be minimised by an integrated disposal approach with the mining operation.

The major wastes from the power station will be:

- Ash

  Disposal requires a study that would consider, possible sales, existing ash disposal practices and the special characteristics of this project.

  Initially it is believed that dry ashing and disposal back in the mine is a realistic option (2).

- Waste Water

  Final waste water quantities will be established by power station design studies. As illustrated in Figure 4.1, conceptual quantities of more difficult liquid wastes are:

  - boiler blowdown and water treatment wastes 30 ML/a
  - cooling tower blowdown 833 ML/a up to 833 ML/a
  - any liquid wastes from ash sluicing.

Depending upon ash disposal strategies, some of this could be used for ash wetting (207 ML/a). Options for disposal of the balance are:

- treatment and disposal, probably to the Tamar River
- evaporation.

- Flue Gas

Flue gas emissions from the power station which will consist mostly of water vapour (28%), carbon dioxide (12%), nitrogen (57%) and residual oxygen (3%). Small quantities of carbon monoxide, sulphur oxides, nitrogen oxides and that fraction of the fly ash not removed from the flue gas will also be present.

Design of electrostatic precipitators for the control of particulates will require particular care but it is believed that these will use state of the art technology and will control the particulates to within the statutory limits ruling in Tasmania. Subject to computer modelling of the stack discharge, emissions of oxides of sulphur, oxides of nitrogen and carbon monoxide are all likely to be within the standards set by the Department of the Environment.

In addition to utilization of mine groundwater for condenser cooling, concepts for the use and interchange of wastes include the sale of fly ash for civil engineering works, cement manufacture and batching, and dry ash disposal back to the mine pit. The treatment sewage in a single plant serving both the mine and the power station is an attractive option as is a joint strategy for other industrial wastes.

4.4 Power Supply

4.4.1 Introduction

The two phases of the project are construction and operation.

During construction, power will be brought in for general construction and support facilities and this will be much less than the requirements for the operating project when the power station will be the major supply.

4.4.2 Construction Phase

An estimate of construction power requirements for a 200 MW power station and mine project is 5 MV.A.

HECT advice is that the existing 22 kV power reticulation to the area is unsatisfactory for full construction phase power supply and a new system will need to be constructed.

One option is to build a new power line along the high voltage transmission line corridor right into the power station switch yard. Should the route be finalised and land resumption completed before construction, this would be a reasonable solution.

Otherwise, the most likely and easily constructed power line route would be along Ecclestone Road from the recently constructed sub-station on the high voltage West Tamar transmission line.

In the absence of any other information, the latter is considered the best solution and would provide adequate power to the site during the construction phase, up to 8 MV.A. (3 MV.A above likely requirements).

This route is shown on Figure 4.4.

4.4.3 Operations Phase

During operations, the mine will require a 66 kV power supply of about 25 MW.

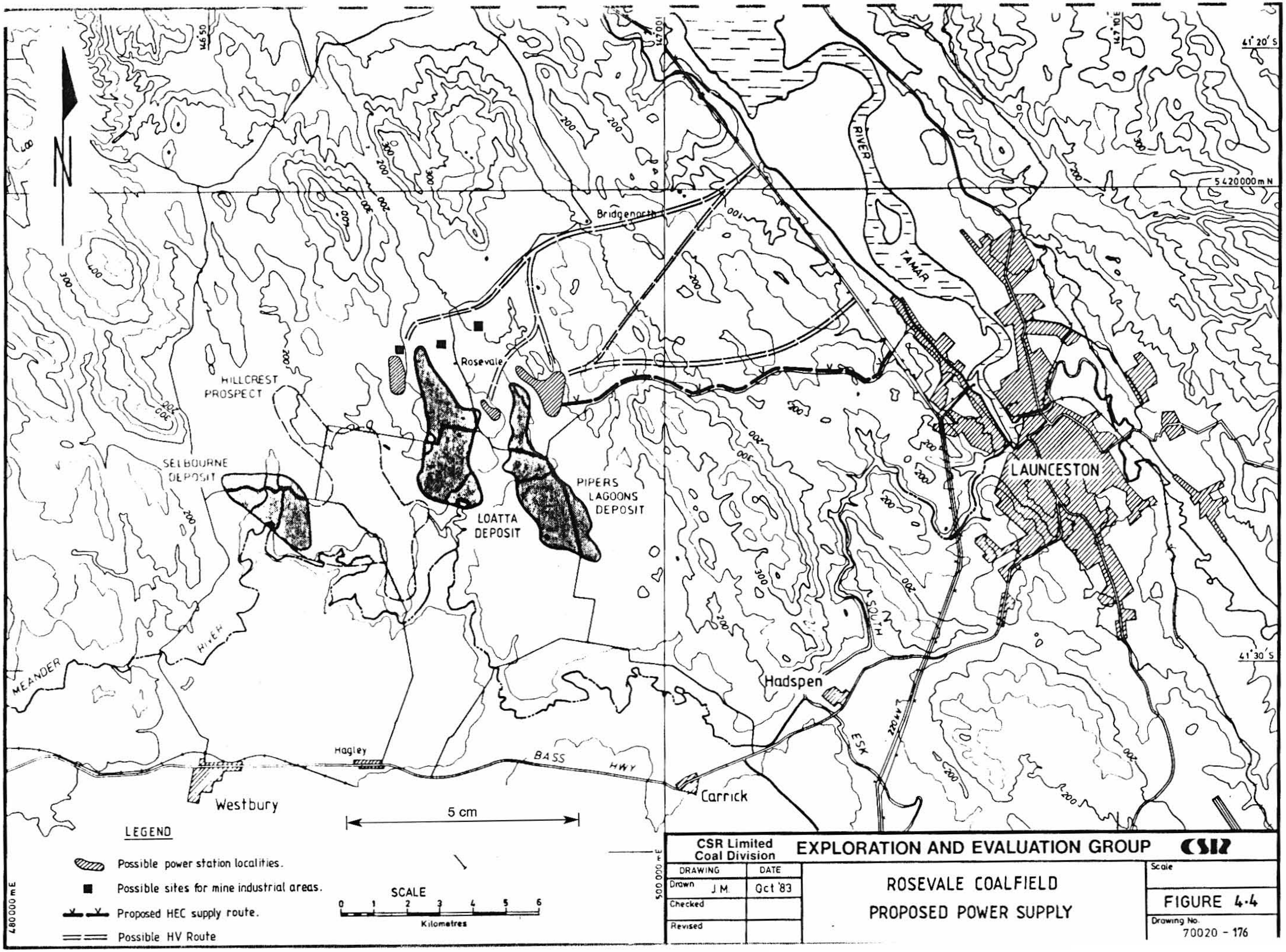
It is proposed that this would be supplied direct from the power station switchyard.

Possible alternate routes for a HV transmission line from the power station to the existing 220 kV grid are shown on Figure 4.4.

4.5 Roads and Access

4.5.1 Introduction

Access to the site will be by road. This will necessitate upgrading of the existing road system to accommodate significantly increased general taffic, articulated vehicles, heavy construction plant and heavy loads up to about 200t during the construction phase.


N
41°20'S
41°30'S
5420000mN
480000mE
500000mE
RIVER
TAMAR
Bridgenorth
Rosevale
HILLCREST PROSPECT
SELBOURNE DEPOSIT
LOATTA DEPOSIT
PIPERS LAGOONS DEPOSIT
LAUNCESTON
MEANDER
RIVER
SOUTH
ESK
Hadspen
Hagley
BASS HWY
Westbury
Carrick
5 cm
LEGEND
Possible power station localities.
Possible sites for mine industrial areas.
Proposed HEC supply route.
Possible HV Route
SCALE
0 1 2 3 4 5 6
Kilometres
CSR Limited
Coal Division
EXPLORATION AND EVALUATION GROUP
CSR
DRAWING
DATE
Drawn J.M.
Oct '83
Checked
Revised
ROSEVALE COALFIELD
PROPOSED POWER SUPPLY
Scale
FIGURE 4·4
Drawing No.
70020 - 176

4.5.2 Local Road Access To The Site

These are shown on Figure 3.2.

Major access to the site would be from the Bass Highway. The use of local roads would be restricted to the Westwood Road and Bridgenorth Road which is the shortest local road route to the site from the highway. This route obviates the need to be involved with more than one Municipality or a longer length of local Council roads from the Bass Highway.

The alternative route across the Grassy Hut Tier to the West Tamar Highway is less satisfactory because of the more difficult terrain and the higher cost of re-constructing this road. Major upgrading of the West Tamar Highway would also be required.

The existing roads are of light duty, rural construction and will break up quickly under the construction traffic envisaged for the Rosevale project. It is therefore considered that access to the site be confined to the eastern leg of Westwood Road and then to Bridgenorth Road. (Figure 3.2). To upgrade the main access road to a satisfactory standard, the following works will be required:

- widening of the seal to a nominal 6.4m
- additional gravel pavement to 200mm minimum thickness
- providing 600mm wide shoulders
- improving drainage and culverts

- some corner improvement and realignment of the road
- excavation and/or filling to improve sight distance at some locations
- reconstruction of the Bass Highway intersection
- upgrading the bridge over the Meander River. This is an old, single lane bridge which will need to be widened and strengthened.
- the thickened concrete culvert crossing along Westwood Road is too narrow and will need to be widened
- a timber bridge on the Westwood Road will need to be replaced.

In addition, it is suggested that a new ring road be constructed from Bridgenorth Road around the eastern and northern extremities of the project area, connecting to Ecclestone Road, Bridgenorth Road and Birralee Road.

Construction of this ring road will have the following advantages:

- replace local roads which are severed during mine and power station construction
- remove local traffic away from the works area
- save the cost of upgrading and improving all the local roads
- will provide a well aligned road of adequate standard for construction and operation phases of the project.

The ring road route is shown on Figure 3.2.

4.5.3 Tasmanian Entry

Entry to Tasmania for major materials, plant and equipment will be through Bell Bay or Burnie.

Burnie has been the favoured port for major plant and equipment for HEC and other projects.

The route from Burnie is:

- Bass Highway from Burnie to the Westwood Road
- upgraded local roads to the site.

There are no overpass constraints on the Bass Highway from Burnie.

If Bell Bay is the entry point, the road route to the site will be:

- East Tamar Highway to Launceston
- through Launceston City
- Bass Highway from Launceston to Westwood Road
- Upgraded local roads to the site.

The Department of Main Roads, Tasmania (DMR) advises that very heavy loads (of the stator or transformer class) would not cross the Batman Bridge over the Tamar River. This means that the East Tamar Highway through Launceston to the Bass Highway is the preferred route for these large, heavy loads rather than down the west side of the Tamar.

Crossing the Launceston city area is best done during off-peak times such as late at night or early in the morning. DMR advise there are no particular problems in doing this provided the necessary approvals are obtained.

Constraints on the East Tamar Highway are highway underpasses with maximum height clearance of 5.2m.

4.5.4 Bridges

The DMR is the responsible authority for all bridges including minor bridges and culverts on council roads. Their advice indicates there is no difficulty with bridges on the Highways but the existing council access roads to the site all have bridges and culverts which would be substandard for the loads anticipated. The planned upgrading of the local roads would eliminate this restriction.

4.6 Manning

Total manpower for the mine and a 400 MW mine power station is estimated to be 480 permanent personnel during the operating life of the project and a total workforce peaking at 852 during construction. The attached manning schedule Table 4.1 shows the buildup of this workforce.

4.7 Housing

Table 4.2 indicates the likely level of direct and consequential employment and population associated with the mine, while Table 4.3 indicates the likely order of accommodation requirements associated with these populations.

TABLE 4.1

ROSEVALE PROJECT
MANNING SCHEDULE

Mine and 2 x 200 MW Power Station

	Year Ending March (YEM)													
	88	89	90	91	92	93	94	95	96	97	98	99	2000	2001
	(-5)	(-4)	(-3)	(-2)	(-1)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
OWER STATION														
Construction	120	254	443	625	610	479	261	268	426	314	114			
Operation					20	150	150	150	170	240	242	242	242	242
Total	120	254	443	625	630	629	411	418	596	554	356	242	242	242
1INE														
Construction			50	120	120	20	100	20						
Operation	–	–	–	8	102	157	173	199	210	221	221	221	228	237
Total	–	–	50	128	222	177	273	219	210	221	221	221	228	237
OMBINED														
Construction	120	254	493	745	730	499	361	288	426	314	114			
Operation				8	122	307	323	349	380	461	463	463	470	479
Total	120	254	493	753	852	806	684	637	806	775	577	463	470	479

TABLE 4.2

ROSEVALE COALFIELD - ANTICIPATED, MINE-GENERATED EMPLOYMENT AND ASSOCIATED POPULATION

Project Year	EMPLOYMENT						POPULATION			
	Direct		Indirect		Flow On					
	Construction	Operation	Construction	Operation	Construction	Operation	Direct	Indirect	Flow on	Total
-3	50	-	33	-	7	-	142	64	18	224
-2	120	8	78	5	15	6	329	162	45	536
-1	120	102	78	66	15	74	620	282	179	1,081
1	20	157	13	102	3	115	545	235	229	1,009
2	100	173	65	112	13	126	819	407	276	1,502
3	20	199	13	129	3	145	677	289	288	1,254
4	-	210	-	136	-	153	652	267	297	1,216
5	-	221	-	143	-	161	687	281	316	1,284
6	-	221	-	143	-	161	687	281	316	1,284
7	-	221	-	143	-	161	687	281	316	1,284
8	-	228	-	148	-	166	707	287	326	1,320
9+	-	237	-	154	-	173	739	301	340	1,380

NOTES:

1. Figures calculated assuming 65% local recruitment of mine workforce.
2. Indirect component represents newcomers recruited to fill jobs vacated by mine recruitment locally.
3. Flow-on component represents employment generated in service industries required to meet the needs of in-migrants to the district resulting from the mine evelopment.
4. Refer Appendix 2 for assumptions used in calculating this table.

TABLE 4.3

ROSEVALE COALFIELD - ANTICIPATED, MINE-GENERATED, ACCOMMODATION REQUIREMENTS

Project Year	DIRECT POPULATION				INDIRECT AND FLOW-ON POPULATION			
	Temporary Accommodation		Permanent Accommodation		Temporary Accommodation		Permanent Accommodation	
	Construction Camp Places	Caravan Park Berths	Family Dwelling	Single Persons Accommodation Places	Family Accommodation Units	Single Persons Accommodation Places	Family Accommodation Units	Single Persons Accommodation Places
-3	13	4	-	-	16	15	-	-
-2	16	6	2	1	37	35	4	4
-1	16	6	23	12	37	35	55	53
1	5	2	35	18	6	6	85	81
2	26	9	39	20	31	30	94	89
3	5	2	45	23	6	6	108	102
4	-	-	47	24	-	-	114	108
5	-	-	50	26	-	-	121	113
6	-	-	50	26	-	-	121	113
7	-	-	50	26	-	-	121	113
8	-	-	51	26	-	-	124	117
9+	-	-	53	28	-	-	130	121

NOTES:
1. Figures calculated assuming 65% local recruitment of mine workforce.
2. All locally-recruited personnel are assumed to not require accommodation.
3. Refer Appendix 2 for assumptions used in calculating this Table.

An analysis has not been undertaken for the power station, but a similar general pattern is likely.

During construction, a high proportion of the total workforce will be contractor-employed and likely to be relatively mobile. Based on experience with similar projects, it is expected that some will be accommodated in a construction camp and/or caravan park near the project area. Others will live in Launceston and in the more immediate area.

It is anticipated that some specialist and senior management personnel will be recruited from outside the area but that a major proportion of the operational workforce will be drawn from the region. It is envisaged that a limited amount of new housing will be required for newcomer mine and power station personnel.

A preliminary examination of the district's capacity to absorb the level of housing demand likely to be created by the project has indicated that a substantial supply of serviced residential and rural-residential allotments already exists, and that water supply and sewage systems have excess capacity or are readily capable of being expanded to meet the increased demands of the project. Details are outlined below:

- Rural-Residential Allotments

  An assessment of the demand and supply of rural residential lots in the region has been made by the Tamar Regional Master Planning Authority (TRMPA). These are allotments of 0.4 to 6 hectares in area. A total of 402 vacant allotments have been identified, which represents over fifteen years supply at existing usage rates (TRMPA, August 1983).

. Residential Allotments and Services

The townships of Westbury, Hagley, Carrick, Hadspen and their town planning consultants have provided some preliminary information on water supply, sewage and vacant lots within these centres and some views on suitable areas for expansion.

The best serviced and most suitable areas for expansion are Westbury, Prospect Vale, Hadspen and to a minor extent, Carrick.

a) Westbury has approximately 100 vacant serviced lots. Existing water supply arrangements cound cater for approximately 50 additional houses and are currently being seriously considered for improvement by the Council. Sewage treatment facilities have a spare capacity for some 250 homes.

There is adequate land for almost unrestricted expansion as outlined in the draft planning schemes under preparation.

b) Hadspen has been growing rapidly in recent years, 60 vacant lots have been indentified in the town with further areas of land having potential for subdivision.

The current water supply scheme is adequate for all existing vacant lots and could be extended to some adjoining areas. Sewage treatment is currently a problem as the existing plant is overloaded. New works are expected to be substantially completed by mid 1984 and this will provide sufficient capacity for future requirements for both Hadspen and Carrick.

c) <u>Carrick</u> although small is also growing rapidly. Approximately 15 vacant lots could be available. Carrick at present is not sewered. However, the Council has intentions of providing sewerage treatment facilities from Hadspen. An almost untreated water supply is reticulated from the nearby Liffey River and any major development in Carrick would be likely to require augmentation of headworks.

d) <u>Prospect Vale</u> has recently had the water reticulation and supply storage greatly improved, and the system is able to adequately service all vacant residential land, with extensions to some adjoining areas in the future. A new sewage trunk main and facilities have recently been provided which will cater for all immediate future needs.

e) <u>Launceston Area</u> - The TRMPA has surveyed the availability of residential "infill" sites and other possible areas suitable for future residential development in the Launceston area (TRMPA. August 1983 (b)).

This study identified a total of 2,645 "infill" and 7,240 allotments in other areas. This includes 600 and 2,010 in the Prospect-Prospect Vale and Summer Hill areas. Infill areas are those areas either having access to services or services could be provided by the extension of existing infrastructure. Other areas are potential growth areas as identified in the Tamar Region Plan.

4.8 Cost Sharing Ratios

With the assumption of a mine and a mine-site power station, total infrastructure requirements are the sum of the individual needs of the mine and the power station. The proportion attributable to each differs according to requirements and sharing ratios for the cost of infrastructure are therefore proposed.

The actual ratios to be used will be the subject of discussion between HEC (for the power station) and CSR (for the mine).

The basis of sharing would vary from item to item and will be dependent upon the most appropriate measure in each case. For example, the cost of supplying water might be split in proportion to the actual water use of the mine and the power station. The cost of the main access roads might be shared on the basis of capital cost of the mine and the power station. Those roads serving just the mine or the power station would however, be wholly the responsibility of CSR and HECT respectively.

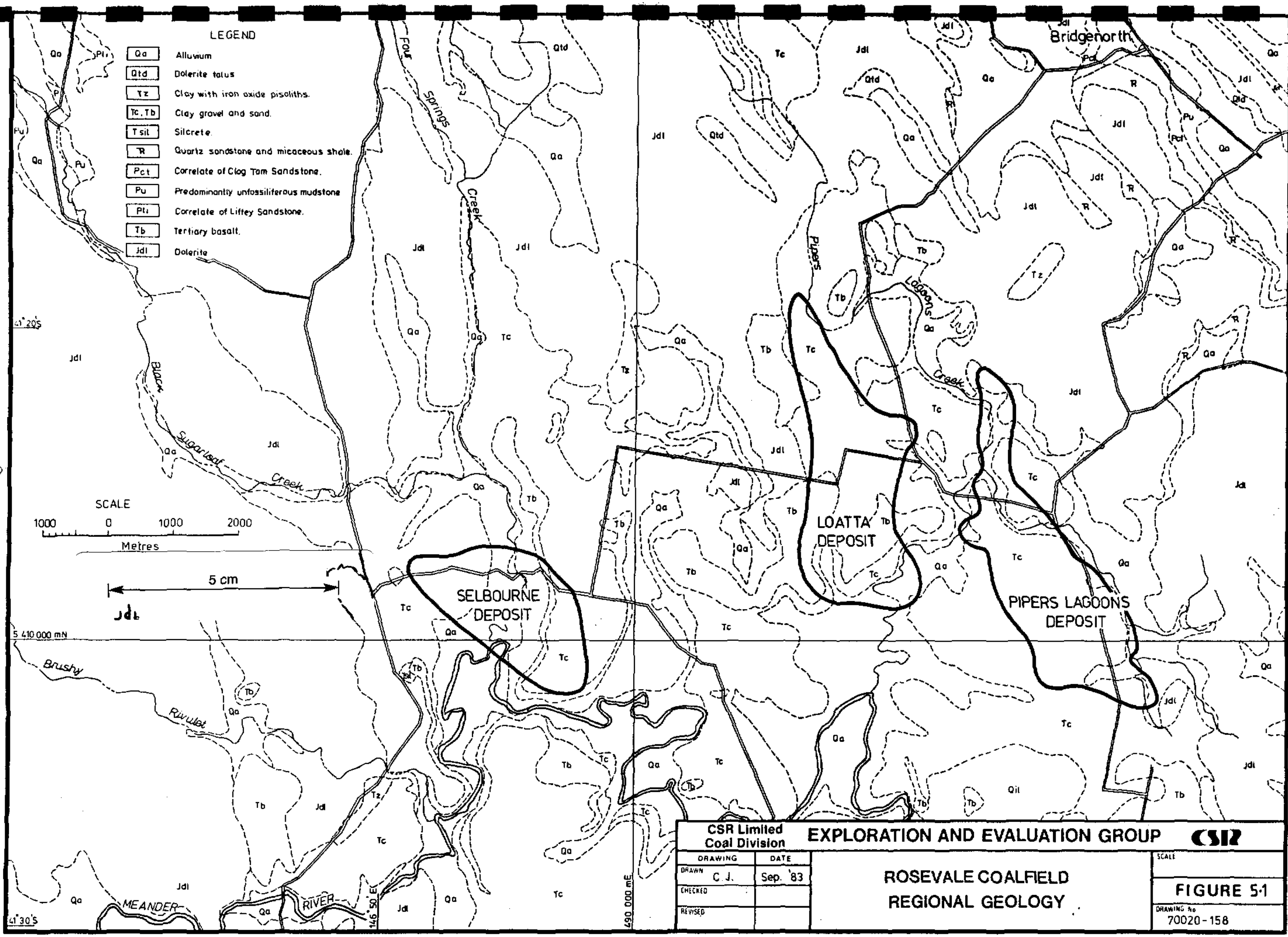
5. PHYSICAL ENVIRONMENT

5.1 Introduction

This section of the study has been carried out to provide a preliminary background description of the physical and biological characteristics of the site and to then assess the major issues which require further study. Consistent with the total project approach, the impacts of the power station are addressed and some ameliorative measures suggested, but any decision on these strategies would be responsibility of the HECT.

5.2. Topography and Geology

Topography of the Rosevale area is a reflection of the local geology, with the coal-bearing, Tertiary Launceston Beds expressed as physiographic lows, and the more erosion-resistant Jurassic dolerites and Permo-Triassic sediments occurring as hills around the northern, eastern and western margins of the coal deposits. See Figure 5.1. Late Tertiary basalts cover isolated areas of the Launceston Beds, forming low, flat-topped hills and ridges. Total relief in the immediate environs of the coalfield is of the order of 50m. However, a range of hills separates the Rosevale basin from Launceston, and encircles it to the north.


LEGEND
Qa Alluvium
Qtd Dolerite talus
Tz Clay with iron oxide pisoliths.
Tc, Tb Clay gravel and sand.
Tsil Silcrete.
R Quartz sandstone and micaceous shale.
Pct Correlate of Clog Tom Sandstone.
Pu Predominantly unfossiliferous mudstone
Pli Correlate of Liffey Sandstone.
Tb Tertiary basalt.
Jdl Dolerite
SCALE
1000 0 1000 2000
Metres
5 cm
Four Springs Creek
Black Sugarloaf Creek
Brushy Rivulet
MEANDER RIVER
Pipers Lagoons Creek
Bridgenorth
SELBOURNE DEPOSIT
LOATTA DEPOSIT
PIPERS LAGOONS DEPOSIT
41°20'S
41°30'S
5 410 000 mN
146°50'E
490 000 mE
CSR Limited
Coal Division
EXPLORATION AND EVALUATION GROUP
CSR
DRAWING
DATE
DRAWN C. J. Sep. '83
CHECKED
REVISED
ROSEVALE COALFIELD
REGIONAL GEOLOGY
SCALE
FIGURE 5·1
DRAWING No
70020-158

5.3 Climate

5.3.1 Introduction

The northern region of Tasmania apart from highland areas, has a temperate climate with mild to warm summers and cool to cold winters. Frosts are common. For most of the year, Tasmania is under the influence of the "Roaring Forties", out of the westerly quarter.

In this region a major topographical influence is the Tamar Valley which is orientated approximately north-west to south-east. This deflects the prevailing winds and is responsible for a high frequency of north westerly winds. In summer, the weather patterns move south and result in a basic easterly air stream which tends to be channeled from a south easterly direction along the Tamar Valley.

The project area is located to the west of the Tamar Valley and separated by the Grassy Hut Tier, up to 400 metres in height.

The only nearby meteorological station with significant information is Launceston Airport which is located 25 km south east of the project area. See Figure 3.2. This station records a range of meteorological information, including rainfall, temperature, evaporation, wind speed and direction. However, no information is available on thermal stratification and wind regimes at altitude. Launceston airport data is assumed to be generally representative of conditions at Rosevale although it is recognised that local topographic conditions could give rise to different climatic conditions. This data is tabulated in Appendix 3.

5.3.2 Meteorological Monitoring at Rosevale

CSR has now installed a meteorological monitoring station at Rosevale to measure local conditions and to correlate with Launceston Airport and other locations. The location of this station is shown on Figure 5.2.

This local station became operative on 15th October, 1983. It is measuring:

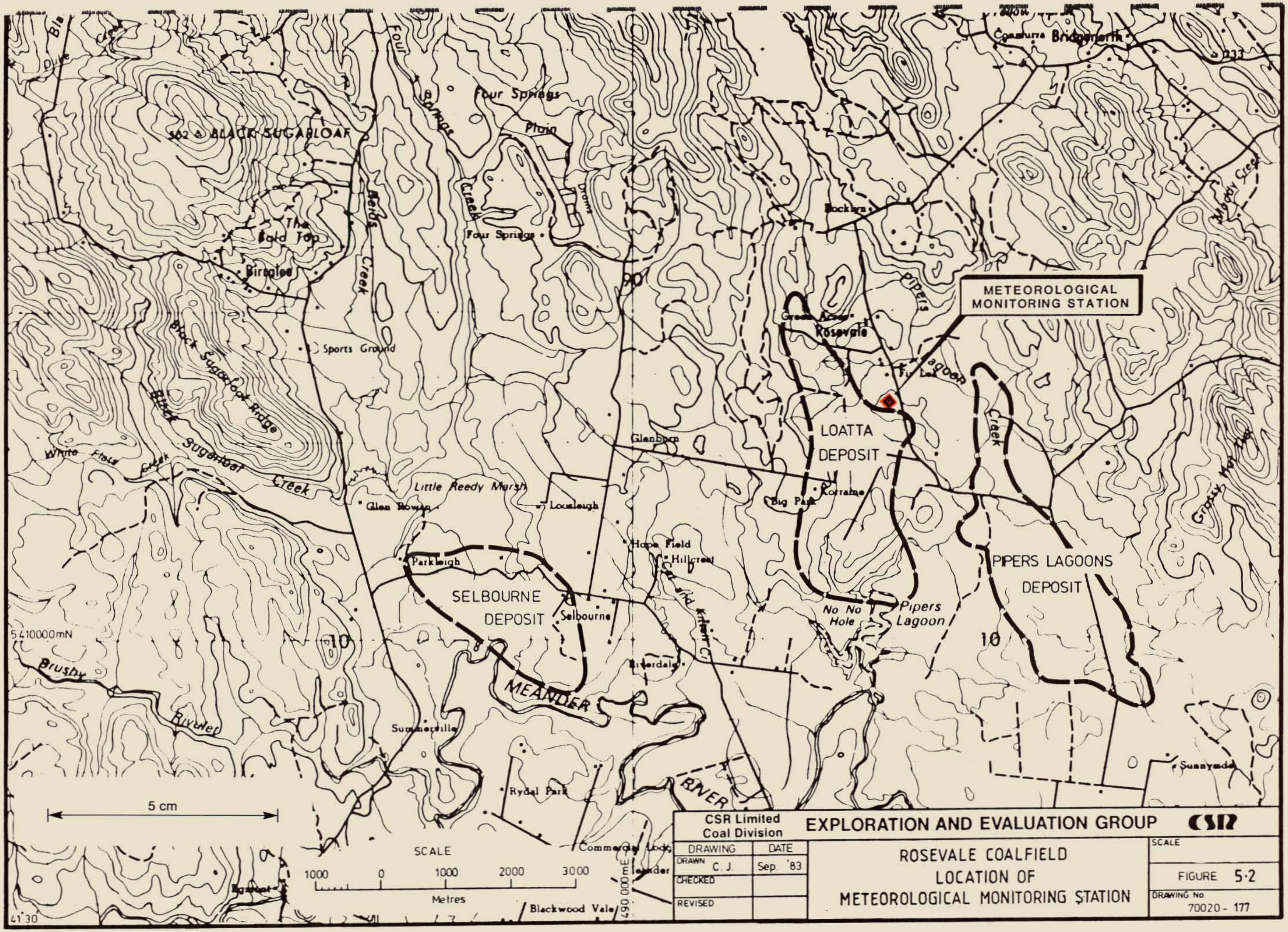
- wind velocity and direction at 10m elevation (and consequently stability class)
- temperature and humidity
- rainfall

5.3.3 Rainfall and Evaporation

Average rainfall for Launceston Airport is 709mm and evaporation 1,395mm. The monthly mean values of rainfall and evaporation for Launceston Airport are shown in Table 5.1. More detailed data is listed in Appendix 3, Table A3.1 and A3.2.

5.3.4 Wind

Wind roses have been derived by ERM (2) from Bureau of Meteorology data for Launceston Airport. (Appendix 3 Table A3.3). These are attached as Figures 5.3 and 5.4.


METEOROLOGICAL MONITORING STATION
LOATTA DEPOSIT
SELBOURNE DEPOSIT
PIPERS LAGOONS DEPOSIT
562 BLACK SUGARLOAF
The Bald Top
Birralee
Black Sugarloaf Ridge
Black Sugarloaf Creek
White Flats Creek
Four Springs Plain
Four Springs
Sports Ground
Little Reedy Marsh
Glen Rowan
Louisleigh
Glenburn
Hope Field
Hillcrest
Parkleigh
Selbourne
Riverdale
Korrama
Big Park
Green Acres
Rosevale
Bockin
Pipers Lagoon
Pipers Creek
No No Hole
Brushy Rivulet
MEANDER RIVER
Summerville
Rydal Park
Blackwood Vale
Grassy Hut Tier
Muddy Creek
Bridgenorth
Sunnyside
5 410 000 mN
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SCALE
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Metres
CSR Limited
Coal Division
EXPLORATION AND EVALUATION GROUP
CSR
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DRAWN C. J.
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CHECKED
REVISED
ROSEVALE COALFIELD
LOCATION OF
METEOROLOGICAL MONITORING STATION
SCALE
FIGURE 5·2
DRAWING No.
70020 - 177

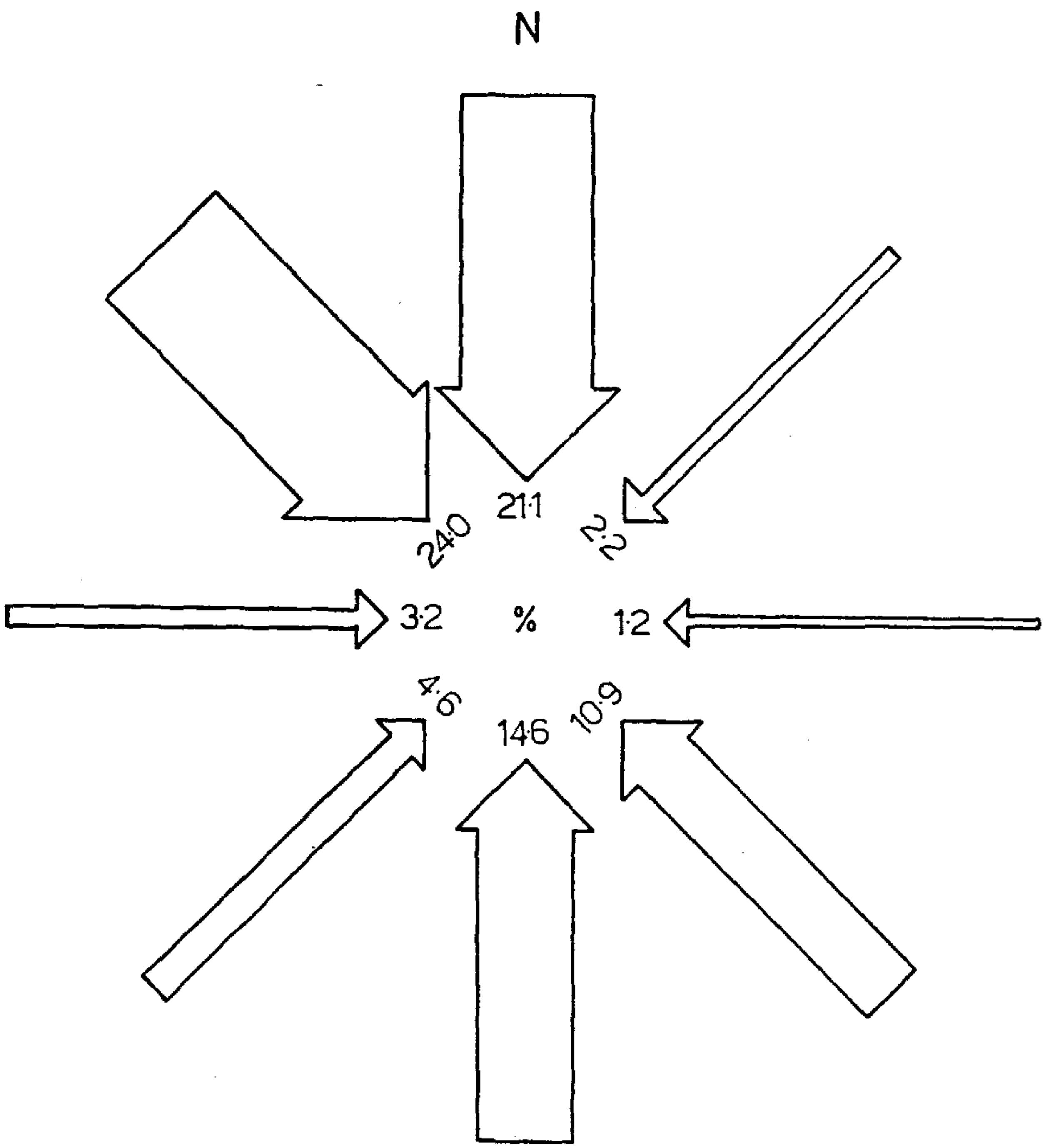
TABLE 5.1

Rainfall and Evaporation
Launceston Airport

Month	Rainfall (mean,mm)	No. of Rain Days (mean)	Evaporation (mm)
January	41	8	225
February	45	7	197
March	42	9	146
April	58	11	84
May	63	13	49
June	62	13	30
July	83	16	35
August	80	16	51
September	65	13	85
October	65	13	124
November	52	11	162
December	53	10	207
Total	709	140	1,395

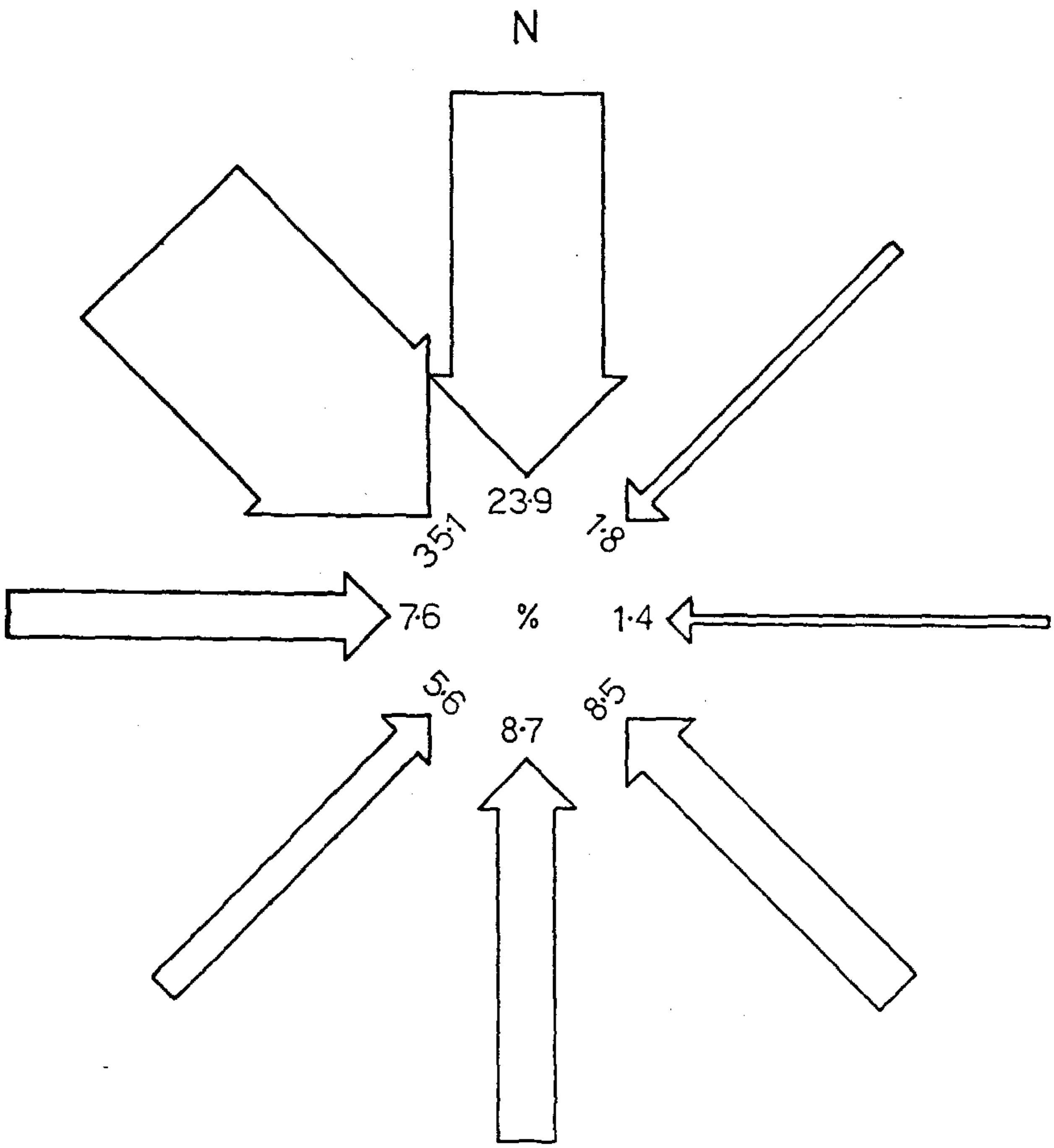
Reference: Bureau of Meteorology for Launceston Airport, Station 091104.

Note: Rainfall data for period 1931 to 1982.
Evaporation data for period 1967 to 1983.



MONTHLY AVERAGE COMPOSITE
9 AM READINGS ON ANNUAL
BASIS - 43 YEAR RECORDS
18.3% CALMS

CSR Limited Coal Division	EXPLORATION AND EVALUATION GROUP	CSR
DRAWING / DATE	LAUNCESTON AIRPORT WIND ROSE	SCALE
DRAWN October 1983		FIGURE 5·3
CHECKED		DRAWING No 70020 / 167
REVISED		



MONTHLY AVERAGE COMPOSITE
3 PM READINGS ON AN ANNUAL
BASIS - 43 YEAR RECORDS
7.4% CALMS

CSR Limited Coal Division	EXPLORATION AND EVALUATION GROUP CSR	
DRAWING / DATE	LAUNCESTON AIRPORT WIND ROSE	SCALE
DRAWN October 1983		FIGURE 5·4
CHECKED		
REVISED		DRAWING No 70020 / 168

Wind direction is typically north to north westerly. It is from a westerly direction towards Launceston about 5.5% of the time. The records show that westerly winds are most common in the spring and summer months and in the medium wind range (11 to 30 km per hour). Calm conditions occur 18.3% of the time at 9 a.m. and 7.4% at 3 p.m. and are most common in the periods April to August with a peak of seven days per month in June. It is these months when the highest frequency of low level inversions can be expected.

The local topography at Rosevale is expected to have a significant effect on both wind speed and direction. Cold air drainage (katabic winds) is expected to have a pronounced north-south orientation. Winds of higher velocity and at greater elevation may also be deflected but to what direction and degree is uncertain without monitoring.

5.3.5 Fogs

Fog frequencies are highest in sheltered valleys where slight inshore drifts of moisture combine with strong nocturnal cooling of the land mass. Launceston Airport and Deloraine have an average of about 34 and 32 fog days per year, respectively (5). Fogs are most common in the winter months.

5.3.6 Ambient Air Quality

There is no information on ambient air quality at Rosevale. However, it is believed to be typical of a rural environment.

5.3.7 Temperature

No data is available for the Rosevale site. Data from the Launceston airport station, is given below:

	Nov-April	May- Oct.
Daily maximum (mean)°C	17-23	10-16
(highest)°C	19-27	12-19
Daily minimum (mean)°C	7-10	2- 6
(lowest)°C	5- 8	0- 4

More detailed data is given in Appendix 3 Table A3.4.

5.4 Hydrology

Both confined and unconfined groundwater under artesian conditions is observed for the deposit. This is associated with a more transmissive (deep) aquifer underlying the immediate coal measures and less permeable sandy interburden and overburden strata within the coal measure sequence. Multiple piezometer installation, (Hole RO81) demonstrates a maximum artesian head of 2.4m from the deep aquifer and 0.3m from interburden aquifers. Interpretation of deposit geology and the groundwater readings suggest some vertical hydraulic correction between the deep and coal measure aquifers.

There are two dewatering considerations:

1. The need for depressurisation of the interburden and the floor aquifers to promote stable pitwalls and pit operating conditions.

2. The possibility to provide some water (to supplement other services) for power station cooling.

Due to the significantly low transmissivities of the interburden aquifers, any requirement for depressurisation for pitslope stability is likely to result in a borehole array within and immediately outside the open cut area. Dewatering requirements have as yet to be assessed, but will be a function of:

- the need and potential to improve material strength parameters to achieve stable design slopes
- need to improve trafficability
- the need to depressurise pit floor aquifers to control floor heave.

Given the low transmissivities, the quantities of groundwater inflow should not be large and simple sump and pump pit operations should suffice.

A preliminary hydrogeological assessment by AGC (3) indicates that the artesian sub-coal aquifer represents the highest yield potential for water supply. Modelling of a conceptual borefield indicated a daily discharge of between 0.5 and 1.7 ML (180 to 620 ML/a) can be expected over the life of the mine. This rate represents a safe yeild, achieving maximum drawdown in the deep aquifers and allowing for leakage from overlying interburden aquifers.

5.5 Surface Water

Southerly flowing ephemeral streams drain the coalfield area, through various low gradient marshy zones (e.g. Pipers Lagoons) into the Meander River, which is the major water course in the area. The river crosses the Tertiary basin south of Loatta and Pipers Lagoons deposits and passes over the southern limit of the Selbourne deposit, before joining the South Esk River close to Hadspen.

Landowners around Rosevale draw their water supplies largely from spring-fed dams and rely more on surface run-off than ground water for domestic and stock use.

In the immediate area of Loatta and Pipers Lagoons, the most significant creek system is Pipers Lagoon Creek. This rises near Bridgenorth and flows through a number of channels to the east of Rosevale to be joined by streams including Jimmys Creek. It discharges into Pipers Lagoon and eventually to the Meander River. Although the catchment is not large, it generates significant flows and localised flooding along the stream channels, particularly near the Pipers Lagoons deposit.

Water quality appears to be good, with a generally low level of suspended solids. A low salinity could also be expected. However testing is required to ascertain quality and it is proposed that this work be undertaken as part of a surface water study.

5.6 Soils

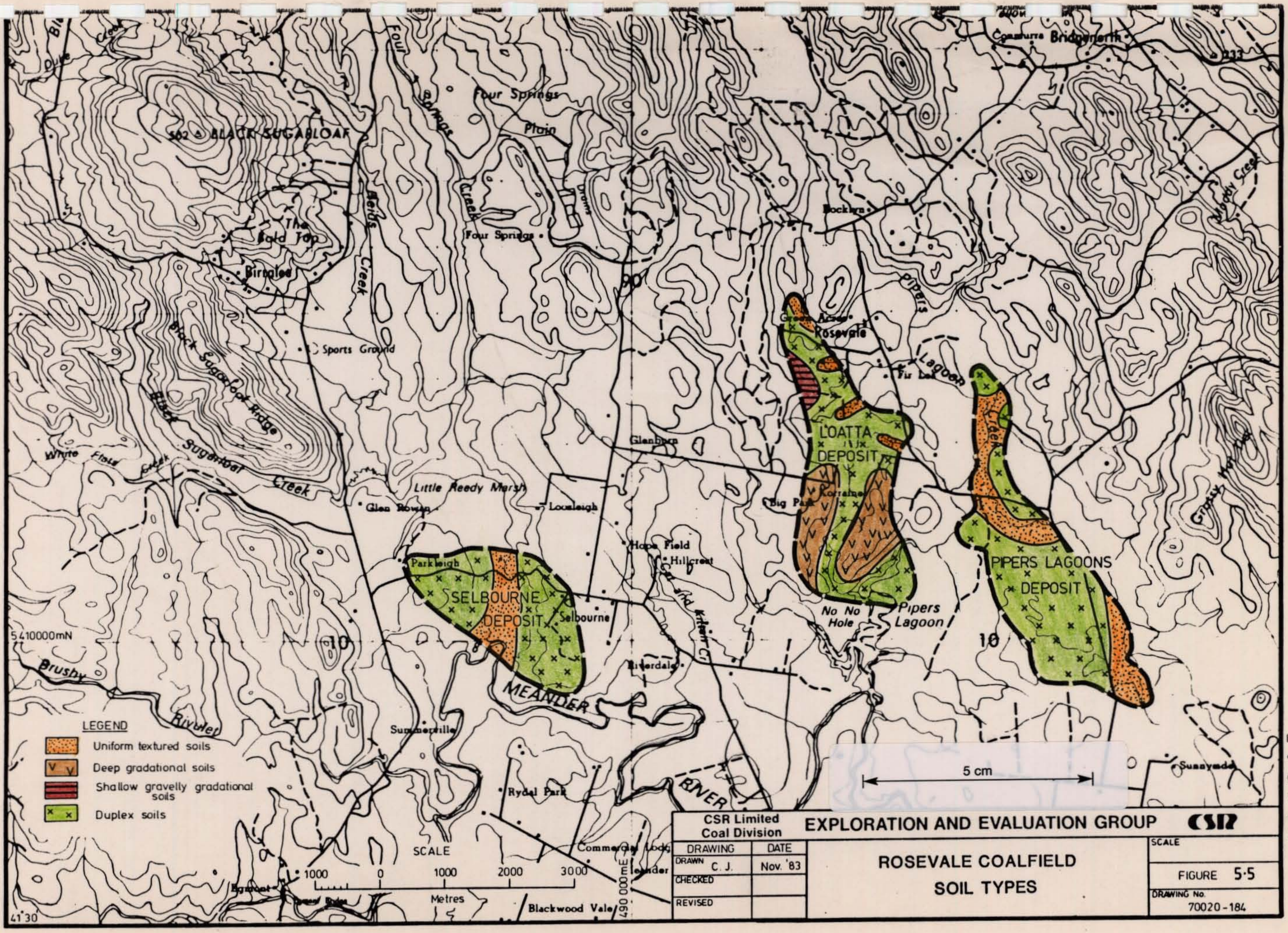
Several broad soil surveys which include the Rosevale region have been conducted, the latest in 1980. This survey, by the Tasmanian Department of Agriculture to identify and describe major land units existing in north-east Tasmania, provides the basis of this resume. Preliminary ground verification of the described units was conducted by the consultants, John Miedecke and Partners in October, 1983 (5) for the Loatta and Pipers Lagoons deposits only.

Three main soil types cover the deposits. They include uniform, gradational and duplex soils. The uniform textured soils, commonly found along drainage lines, consist of brown or grey coloured light clay soils at times becoming mottled with depth. They are generally less than two metres in depth. The gradational soils occur as two main types viz; red to reddish brown clay loam surface horizons with increasing textures to depths between one and two metres; and shallow (less than one metre) stoney red or brown soils with gravelly clay loam surface horizons. The duplex soils consist of sandy loam to clay loam, grey or brown. A horizons overlying mottled brown or red clays. Soils can be up to two metres in depth.

The uniform soils overly Tertiary and Quaternary clays, gravels and sands and are found on valley bottoms, lower terraces or flood plains. The gradational soils are commonly located on rolling hills or plateaux ranging from 2 to 10^{o} in slope. The shallow and deep soils overlie Jurrassic dolerite and basalt respectively. The duplex soils overlie Tertiary clays, gravels and sands and are widespread over undulating plains. A preliminary identification of the general soil location is found in Figure 5.5.

5.7 Overburden and Interburden

The overburden consists principally of soft clays with occasional hard siderite bands and some basalt caps. These caps are expressed as topographic highs overlying the other materials.


BLACK SUGARLOAF
The Bald Top
Birralee
Black Sugarloaf Ridge
Black Sugarloaf Creek
White Flats Creek
Four Springs Plain
Four Springs
Four Springs Creek
Sports Ground
Little Reedy Marsh
Glen Rowan
Louisleigh
Glenburn
Hope Field
Hillcrest
Riverdale
Parkleigh
SELBOURNE DEPOSIT
Selbourne
Summerville
Rydal Park
MEANDER
RIVER
Brushy Rivulet
Egmont
Blackwood Vale
Leander
Commercial Lodge
Rosevale
Bockburn
LOATTA DEPOSIT
Big Park
Pipers Lagoon
No No Hole
Fir Lea
PIPERS LAGOONS DEPOSIT
Bridgenorth
Moody Creek
Grassy Hollow
Sunnyside
5 410000mN
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41°30'
LEGEND
Uniform textured soils
Deep gradational soils
Shallow gravelly gradational soils
Duplex soils
SCALE
1000 0 1000 2000 3000
Metres
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CSR Limited
Coal Division
EXPLORATION AND EVALUATION GROUP
CSR
DRAWING
DATE
DRAWN C. J.
Nov. '83
CHECKED
REVISED
ROSEVALE COALFIELD
SOIL TYPES
SCALE
FIGURE 5·5
DRAWING No. 70020-184

066

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The interburden consists of inferior lignite and ligneous clays with an ash content in excess of 50% (dry basis). Most of the overburden and interburden slakes readily and will decompose rapidly when exposed during mining.

Detailed investigations of chemical and physical properties of overburden and interburden have not been conducted to date.

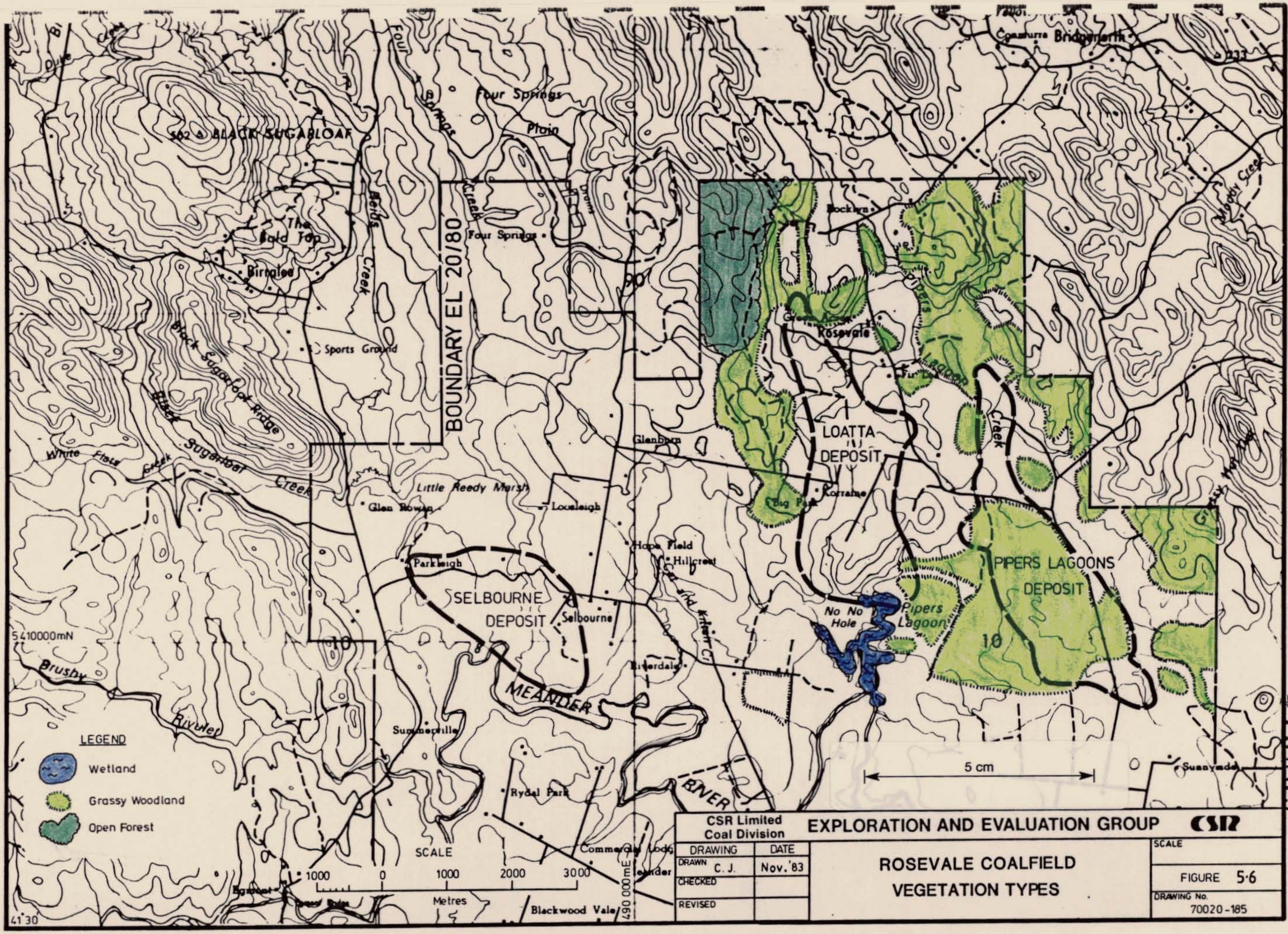
5.8 Vegetation

Three major natural vegetation types have been identified. Figure 5.6. All have been disturbed to some degree by the agricultural activities in the area. They are grassy woodland, open forest and wetland.

i) Grassy Woodland

This is the most widespread vegetation type throughout the area and covers or adjoins parts of Loatta and Pipers Lagoons deposits. The sequence of species varies between the well drained dry sites on the slopes surrounding the deposits to poorly drained sites over part of Pipers Lagoons.

Vegetation types are Eucalypt amydalina, E. viminalis. E. pauciflora. E. ovata.



CSR Limited Coal Division	EXPLORATION AND EVALUATION GROUP	CSR
DRAWING / DATE	ROSEVALE COALFIELD VEGETATION TYPES	SCALE
DRAWN C. J. / Nov. '83		FIGURE 5·6
CHECKED		DRAWING No. 70020-185
REVISED		

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ii) Open Forest

Open forest is restricted to the slopes to the north west of the Loatta deposit. Species are Eucalyptus obliqua, E. viminalis and E. amygdalina.

iii) Wetland

The margins of Pipers Lagoon and the poorly drained flats along Pipers Lagoon Creek are the only examples of this vegetation type in the immediate project area.

It supports wide variety of wetland communities which include leptospermum lanigrum scrub, reed swamp, sedgelands aquatic and marginal herblands, surrounded by tussock grassland and open heath. Pipers Lagoon and its outlet stream are extremely rich in aquatic macrophyte species and unusual species assemblages. Because of this the locality is considered to have conservation value. As eleocharis acuta sedgeland is present here and is currently unrepresented in the State Reserve system, the value of the area for conservation purposes is increased.

5.9 Fauna

The natural wildlife in the area is typical of that in Northern Tasmania. Because of the extensive rural activity over many years the area does not represent a significant natural habitat.

Studies will, however, be required in the wetlands.

5.10 Land Use

Agricultural land use is discussed by Pinkard (1980) and John Miedecke and Partners (1983) (5). Much of the area to be disturbed by mining at the Loatta deposit has been cleared for grazing and cropping.

Grazing of sheep and cattle is the most widespread land use with carrying capacities up to 9 ewe equivalents per hectare on improved pastures of rye and sub-clover. Forage crops of oats and barley are grown, with other crops including vegetables, oil poppies and cereals.

Much of the Pipers Lagoon deposit is low lying and can become waterlogged in winter.

Surrounding woodland areas are increasingly being cleared for grazing, and forestry operations have occurred in these areas.

Recently, the Rosevale area has become popular for hobby farming as it is one of the few areas in close proximity to Launceston where small acreages (20 ha) are reasonably priced. In general, it is the poorer land which is being subdivided for this purpose.

5.11 Aboriginal Heritage

Preliminary work undertaken by the National Parks and Wildlife Service indicates that the probability of finding a significant archaeological site in the Rosevale area is low. The area has been extensively cleared and cultivated and this will have disturbed most sites.

No site work has hitherto been undertaken in the area so a superficial archaeological reconnaissance was carried out over the less disturbed parts of the area of the Loatta and Pipers Lagoons deposits and the immediately adjacent lands.

This reconnaissance found some evidence of aboriginal occupation and six sites were noted. One is within the Loatta deposit boundary, one to the north of the deposit and the other four around the Pipers Lagoon. Locations are shown on Figure 5.7. Artifacts found range from isolated flakes to extensive scatters of retouched tools; the latter indicating site usage on a semi-permanent basis.

While none of the sites are believed to be of major significance, further survey will be required, particularly of the undisturbed areas and of the site in the Loatta deposit which is considered to be more important than the others.

5.12 National Estate

A survey of the existing records was undertaken.

There are no buildings or features on the Register of the National Estate or listed with the National Trust.

5.13 Acoustic Environment

Rosevale is a rural area and background noise levels will be low. Except for windy periods, the major noise generation will be from motor vehicles and farm equipment.

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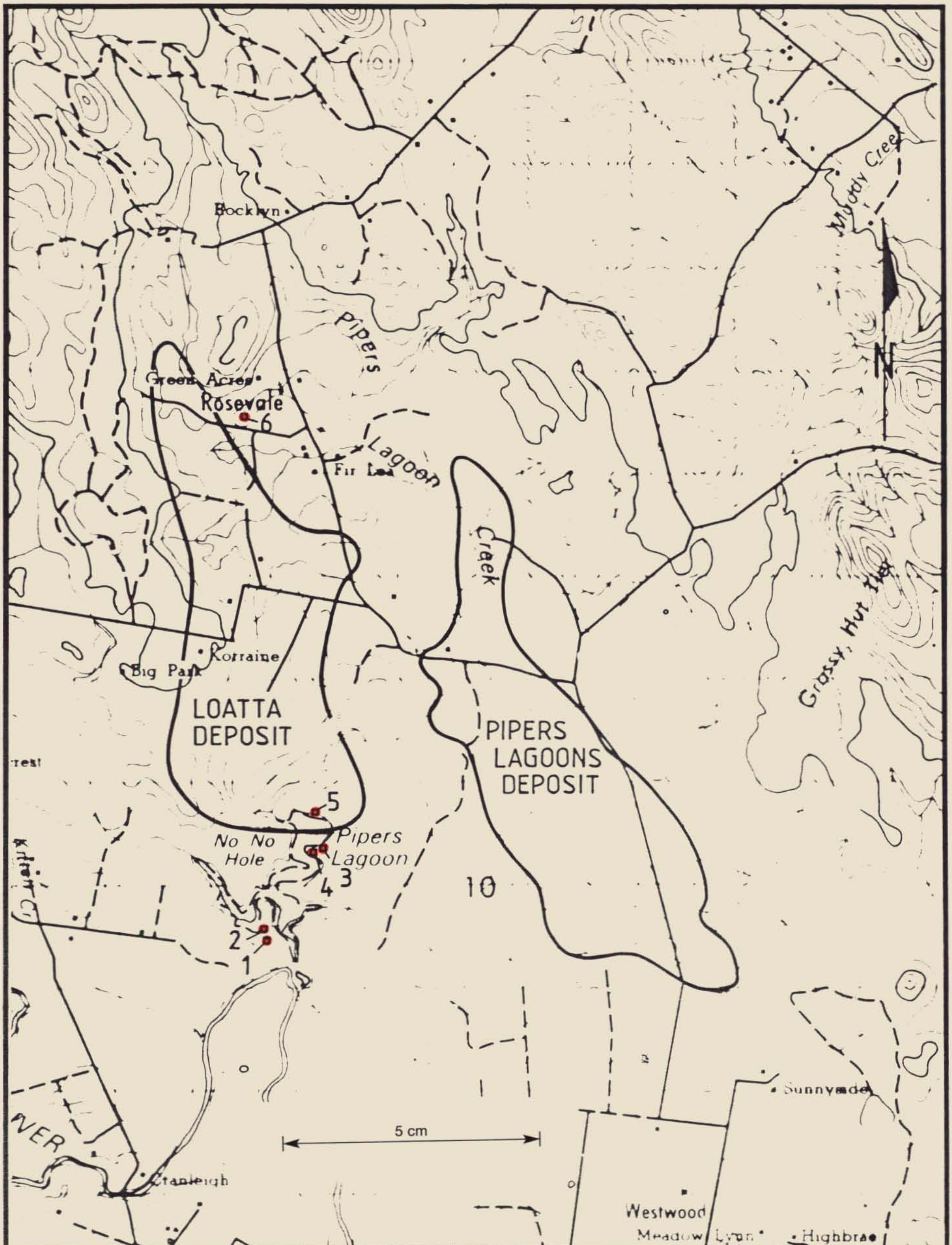


● 2 Aboriginal Heritage Site

SCALE

0 1·0 2·0 km

CSR Limited Coal Division	EXPLORATION AND EVALUATION GROUP CSR	
DRAWING / DATE		
DRAWN M.R.N. NOV. '83	ROSEVALE COALFIELD	1:50000
CHECKED	ABORIGINAL HERITAGE SITES	FIGURE 5·7
REVISED		DRAWING No 70020 - 183

6. IMPACTS

6.1 Environmental Impact Assessment

At this point in time it is too early in the project planning process to meaningfully undertake an in-depth environmental impact assessment of the project. It is CSR policy, however, to address environmental parameters in the planning of its projects, and to this end a start has been made on the establishment of an environmental databank and on deriving environmentally-based design standards. From the information collected, it is possible to identify, albeit in a preliminary and qualified manner, likely areas of environmental impact and requisite management procedures.

The following discussion examines the project as currently defined in terms of its likely and/or potential environmental effects within the informational constraints previously described, and indicates operational procedures likely to be employed to asist in impact management.

6.1.1 Potential Mine Impacts

6.1.1.1 Topographic Changes

Reconstruction of the pre-mining landscape will not be possible in general, due to a negative mass balance after mining, the need for initial out-of-pit dumping, and the need to maintain the post-mining surface several metres above the expected post-mining water table. At this stage, a modified landscape which gently rises away from the initial excavation areas is envisaged. The land will then fall quickly to the final voids which will become bodies of water. The spoil dumps are to be contoured revegetated and stabilised.

6.1.1.2 Climate and Air Quality

The air quality around the mine will be affected by dust from excavation, loading and tranportation of both the overburden and the coal and by limited blasting. Dust associated with the mine will be tempered by the moisture content of overburden (except for periods during December to March), and the moisture content of the coal. It is proposed to use water trucks and spray devices where required to reduce the dust impact to acceptable levels at these times.

6.1.1.3 Acoustic Impact

The mine will have an impact on the acoustic environment of the area, and the mining machinery, conveyors and blasting will combine to increase background noise level.

Most equipment used at the mine will be electrically driven (eg., BWE conveyors) and noise impact will occur mainly from internal combustion engines (associated with smaller auxillary equipment) and from conveyors.

Blasting will only be carried out during daylight hours and will be controlled to lessen air blast and vibration impact to a required standards.

6.1.1.4 Groundwater

Groundwater drawdown about the open cut operation, whether by natural drainage through the floor and pitslopes or by pumped well installations, will result in steep cones of depression in close proximity to the pit. Provided depressurisation of deep aquifers to control floor heave can be effected without extracting large volumes of water, it can be assumed that insignificant groundwater lowering will occur beyond the mining lease area. A maximum inflow of 20 to 30 ML/a is indicated from current knowledge of transmissivity and hydraulic gradients of groundwater in coal measure aquifers. Quality testing indicates a maximum salinity of 1,400 mg/l from such aquifers, and at such low annual rates of inflow, utilization in a power station or by local minesite use (dust control) are feasible methods of disposal.

Dewatering the deeper aquifer may have much more significant impacts and this option requires further study. Possible effects are:

- artesian conditions in the vicinity of well sites being removed
- significant modification to groundwater flow gradient and direction.

The impact of thse eventualities will be a function of deep aquifer continuity, local groundwater resource, utilisation and proximity of any borefield to the Meander River.

Siting of any borefield to supplement cooling water requirements, will need to be isolated (hydraulically) from the Meander River and from zones of groundwater recharge feeding aquifers. These replenish surface dams from local springs fed by artesian groundwater flow.

6.1.1.5 Surface Water

Surface hydrology will be altered significantly with the mine construction interrupting Pipers Lagoon Creek and its tributaries. The flows will be diverted and retained in retention ponds for settling of particulates and then discharge or reuse.

The retention ponds for water management will be constructed with impervious clay liners (where required) for control of stream waters, runoff water from waste areas, and stormwater collection from controlled areas such as mine maintenance buildings, administration and parking areas.

Water management procedures and structures will be introduced to the mine to enable:

- the re-use of all suitable water
- the treatment or disposal of any poor quality water in accordance with required standards. The majority of this water could be of reasonable quality except for suspended particulates and the use of retention ponds for settling should allow re-use of the majority of this surface water.

Proposals for managing surface water around the mine area are described below and illustrated in Figures 5.8 and 5.9. These are preliminary and a detailed study will be undertaken to finalise the management plan.

Loatta Deposit Surface Water Control

There are three phases of the surface water control in the Loatta Deposit.

- Western Cut-off Drain

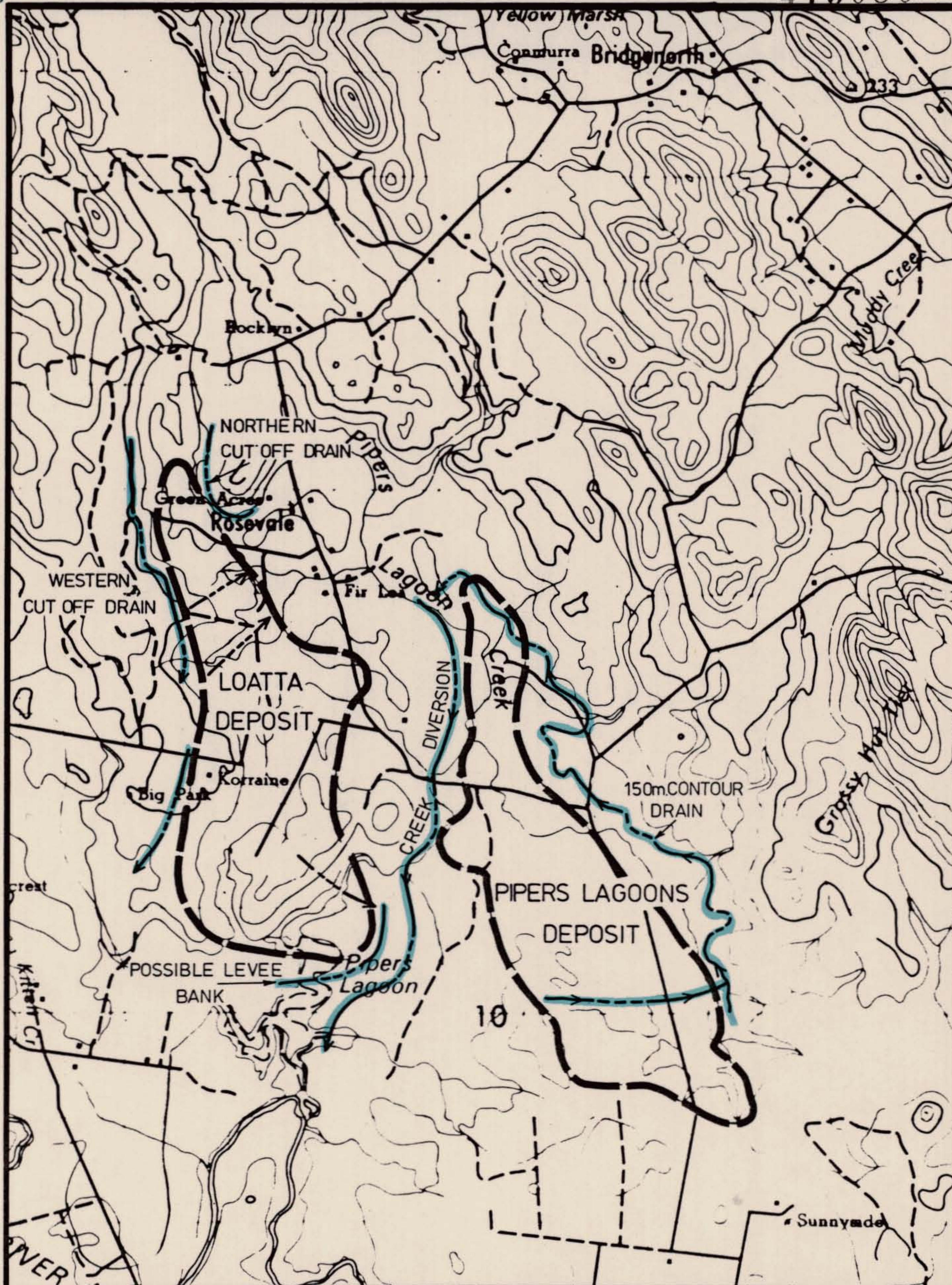
  A contour drain would be excavated along the western side of the deposit along the 200m contour to intercept any surface water flowing from higher ground down into the mine area. The discharge from the contour drain would flow into a retention pond just south of Big Park.

- Northern Cut-off Drain

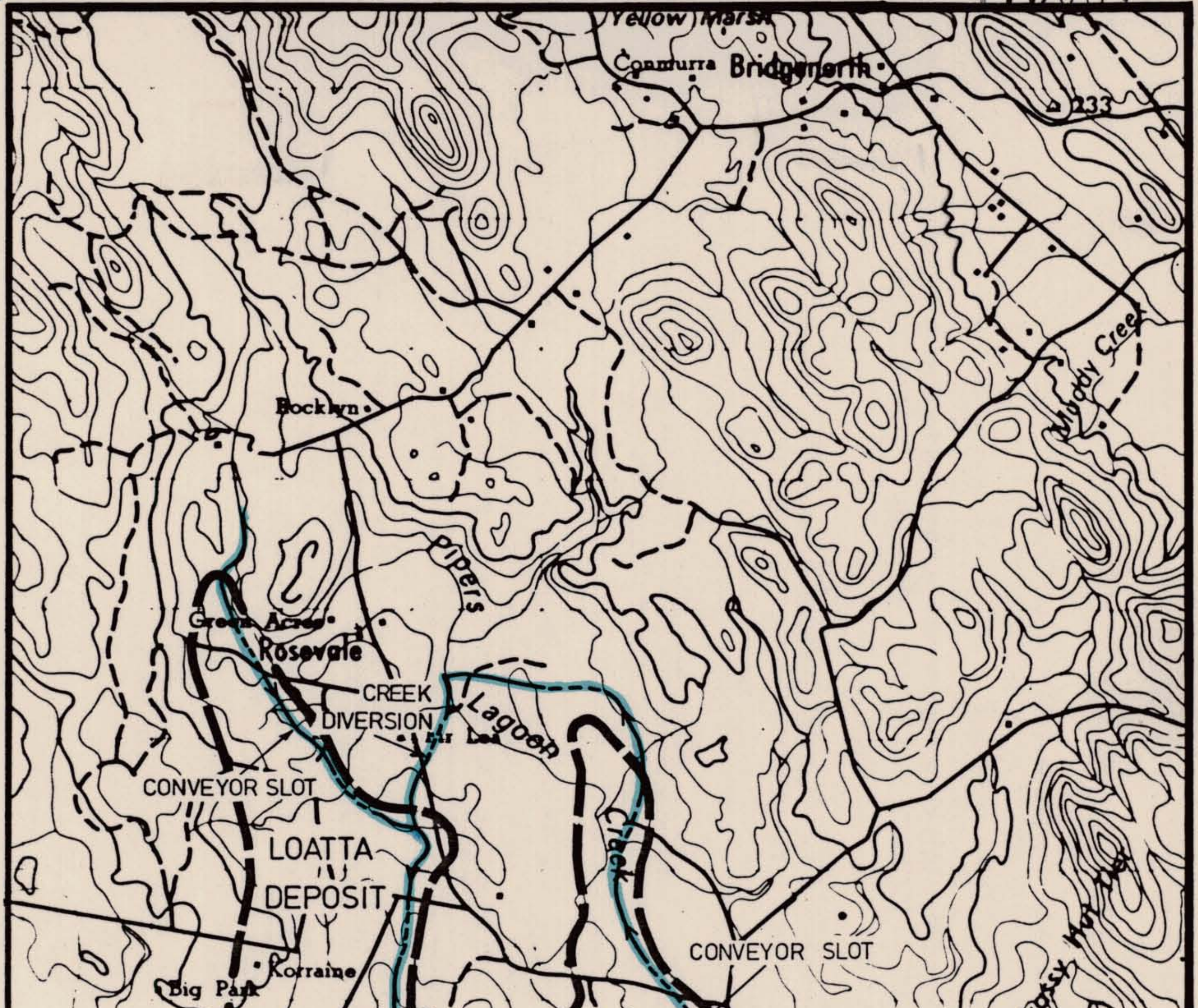
  A tributary of Pipers Lagoon Creek flows through the northern end of the Loatta Deposit and it will be necessary to divert it away from the deposit to avoid the conveyor alignment exiting the mine.

- Pipers Lagoon Creek and Pipers Lagoon

  Pipers Lagoon covers part of the lower section of the Loatta Deposit and a section of this lagoon will have to be drained before this area can be mined. This would be achieved by diverting Pipers Lagoon Creek around the deposit from Bridgenorth road to south of Pipers Lagoon and pumping water from the affected section of Pipers Lagoon.



CSR Limited Coal Division EXPLORATION AND EVALUATION GROUP CSR		
DRAWING / DATE	ROSEVALE COALFIELD	SCALE 1:50 000
DRAWN OCT. '83	SURFACE DRAINAGE	FIGURE 5·8
CHECKED	PRE-MINING	DRAWING No. 70020 - 180
REVISED		



5 cm

CSR Limited Coal Division EXPLORATION AND EVALUATION GROUP		CSR
DRAWING / DATE	ROSEVALE COALFIELD	SCALE 1:50 000
DRAWN OCT. '83	SURFACE DRAINAGE	FIGURE 5·9
CHECKED	POST-MINING	DRAWING No. 70020-181
REVISED		

- Post Mining

  After mining has been completed in the Loatta Deposit, Pipers Lagoon Creek could be diverted to flow along the trunk conveyor slots thereby diverting away from the Pipers Lagoon deposit.

Pipers Lagoons Deposit Surface Water Control

There are two areas of the Pipers Lagoons deposit requiring runoff control.

- Eastern Cut-off Drain

  A cut-off drain will be excavated along the eastern side of the deposit on the 150 contour line to prevent ingress of water from ephemeral streams to the east. An extension of this drain would cut across the southern part of the deposit preventing ingress from the south.

- Pipers Lagoon Creek Diversion

  Pipers Lagoon Creek flows through the northern section of the Pipers Lagoons deposit and will be diverted to the west of the deposit prior to mining commencing in this area. The diversion would link up with the diversion around the Loatta Deposit, south of Bridgenorth road.

- Post Mining

  After mining is completed the trunk conveyor slot in the Pipers Lagoons deposit could be used as a catchment for water ingressing from the east, and it then could be directed into Pipers Lagoon Creek, creating a more efficient drainage pattern than now exists.

6.1.1.6 Flora and Fauna

Loss of remnant vegetation over the mine area due to clearing will have a significant impact on the flora and fauna habitats of the district but the magnitude of this affect has not been established. Similarly, further work is required to determine the significance of the vegetation types associated with the sites wetland areas.

The interuption to natural drainage by the mine development and the noise and vibration created by the mine operation will result in the migration of most native fauna away from the site to areas of less activity.

6.1.1.7 Soil

For rehabilitation to achieve, at least in part, pre-mining land capabilities, soil horizons will need to be handled. Adequate soil volumes appear to exist within the site to enable routine topsoiling procedures to take place. If the rehabilitation goal is to establish improved pastures and cropping, selective handling of soil horizons is most likely to be required. Soil handling can be scheduled to minimise the duration of stockpiling. No definitive information is yet available to enable comment on the handling of overburden and interburden materials.

The major limitation to topsoiling operations will possibly be the high moisture content of the soils at various times of the year. Flexible scheduling of operations to allow stripping of soils when dry is proposed to lessen their structural degradation.

6.1.1.8 <u>Land Use Impact</u>

Mining is likely to result in a reduced area of land available for agricultural persuits due primarily to the creation of final voids, which subsequently will become bodies of water. Post-mining landform and the effectiveness of topsoiling operations will largely determine post-mining land use.

6.1.2 <u>Potential Power Station Impact</u>

6.1.2.1 <u>Visual Effects</u>

The power station with its boiler house, cooling tower and stack will be prominent in the immediate area. Depending upon the final location and natural screening, parts of these major structures could be visible from points along the Bass Highway from Carrick to Westbury.

6.1.2.2 <u>Air Quality</u>

It is envisaged that appropriate equipment will be installed in the power station to keep emissions within regulatory standards.

6.1.2.3 Acoustic Impact

The major sources of noise from the power station will principally be related to commissioning and start-up procedures, with respect to steam safety - safety valve setting, and blowing out of pipes to remove foreign matter, etc. Following startup the power station will emit a continuous hum from the turbine room and fans. The coal conveyor, boiler fans and pulverisers will be additional sources of noise from the power station area.

6.1.2.4 Groundwater

Blowdown and any ash sluicing water can be contained in lined ponds which will prevent contamination of groundwater. Ash disposal strategies will be developed in conjunction with groundwater studies with a view to ensuring that leachates from the ash do not contaminate groundwater. If necessary, ash could be dumped in area sealed with an impervious clay barrier.

6.1.2.5 Surface Water

The power station is not likely to have any unacceptable adverse effects on surface water quality of the local streams or the Meander River as any release of waste water must comply with the Department of the Environment discharge licence standards.

Ash disposal strategies will be developed in conjunction with surface studies to ensure that suspended matter or leachates from the ash do not contaminate surface water.

The construction of a power station and associated facilities is not likely to have a significant impact on soil erosion, as stormwater management will involve collection and retention of all runoff waters from operational areas.

6.1.2.6 Flora and Fauna

Fauna should not be directly affected by the power station construction and operation due to their mobility. Indirectly some habitat loss may result through clearing but the adjoining bushland areas could help reduce this effect.

6.2 Social and Community Effects

The proximity of the project to the existing major population centre of Launceston with its commercial and industrial base should enable the project to be established with a lesser amount of social disruption, than would be the case in a smaller community.

As yet no studies have been undertaken to assess the magnitude of these effects, or on which sectors of the community they will fall. It is proposed to carry out such studies once the project is more fully defined.

6.3 Environmental Costs

Environmental costs associated with the mining operation are included in (6), "Indicative Pricing and Commercial Aspects 400 MW Case".

6.4 Environmental Studies

6.4.1 Environmental Baseline

Environmental baseline data collection and Environmental Impact Statement preparation will be undertaken during the feasibility study phase of the project.

6.4.2 Environmental Monitoring

It is proposed that an environmental monitoring programme will continue on from the baseline study programme encompassing the construction phase, and expanding as the full operation phase progresses. It is envisaged that monitoring for the operational phase of the mine will include examinations of:

- local meteorology at ground level and at altitude
- dust dispersion and deposition
- surface and groundwater quality and hydrology
- noise
- soil and overburden characteristics.

6.4.3 Rehabilitation

Planning for rehabilitation is undertaken as part of the normal mine planning process. To provide the requisite design parameters it is proposed to undertake studies to determine the nature of the materials to handled, their potential to erode, and their ability to support and sustain various vegetation types. In addition, design studies will be undertaken to determine the most appropriate final land surface and drainage patterns.

It is envisaged that the waste material from the proposed trial pit excavation will be utilised to conduct field trials relating to the above considerations.

6.4.4 Socio-economic

As mentioned earlier it is proposed to undertake a series of socio-economic studies to ascertain the likely project impacts on the local population, heritage and economy, and to use the information so gained in the project design process. It is envisaged that a communication system will be established to enable the local community's concerns to be fully taken into account. Further, it is proposed to establish a monitoring procedure to measure progress as the project proceeds.

7. LEGISLATION AND GOVERNMENT AUTHORITIES

7.1 State Legislation

The current exploration activity at Rosevale is covered by Exploration Licence, EL 20/80 which also gives the company priority to apply for a mining lease over the area.

Application for this mining lease would be made to the Director of Mines under the provisions of the Mining Act, 1929. The Director is then responsible for the notification of the relevant government departments including:

Department of Lands
Department of the Environment
Forestry Commission
National Parks and Wildlife Service
Rivers and Water Supply Commission.

Environmental Legislation

There is no legislative requirement for an Environmental Impact Statement as such.

However, a mine at Rosevale is subject to the Environmental Protection Act 1973, and would require a licence from the Director of Environmental Control.

The application for this licence requires detailed information that would amount to and is best presented as an environmental impact statement.

Acceptance of this application would be followed by issue of the licence. This would cover the environmental aspects of the project and include specific conditions for:

- the control of pollution and noise
- compliance with standards for air and water emissions, waste disposal and noise
- monitoring
- rehabilitation

7.2 Local Government

The relevant local government authorities are:

Municipal Council of Westbury
Tamar Regional Master Planning Authority (TRMPA)

Municipal Council of Westbury

Most of the project is within the Westbury Council area. The project site at Rosevale is classified rural and is not subject to a statutory planning scheme.

Tamar Region Master Planning Authority

The Tamar Regional Master Planning Authority is made up of representatives of the City of Launceston, the Municipalities of Beaconsfield, George Town, Lilydale, Longford, St. Leonards, Westbury, Evandale and the Port of Launceston Authority.

The Authority has a statutory responsibility under the Tasmanian Local Government Act to prepare master plan for regional development and local town planning schemes. It also acts as a consultant town planner for member municipalities.

The proposed coal mine/power station development at Rosevale is compatible with the present planning scheme and represents the type of regional development this authority encourages.

8. REFERENCES

1.	CSR	"Preliminary Mining Study. 400 MW Case", October, 1983.
2.	ERM Consultants	"Review of Rosevale Power Station Siting Issues"' October, 1983.
3.	Australian Ground-water Consultants Pty. Ltd.	"Loatta Deposit Groundwater Study, Northern Tasmania" November, 1983.
4.	Gutteridge, Haskins and Davey	"Appraisal of Some Infrastructure Facilities", October, 1983.
5.	John Miedecke and Partners	"Preliminary Environmental Assessment", November, 1983.
6.	CSR	"Indicative Pricing and Commercial Aspects. 400 MW Case", October, 1983.

APPENDIX 1

Stockpiling

Progress Report from Rheinbraun Consulting

18.11.83

Telefax Message

CSR Coal Division
Brisbane, Australia

Attn.: Mr. Peter Cameron

Re.: Rosevale Stockpiling.
Further Comments for your Discussions:

1. Analysis of coal sample showed much higher ash content and therefore lower heating value than RHEINBRAUN Lignite. A test on self-ignition tendency shows results in the range of RHEINBRAUN Lignite. A test on degradation shows the Rosevale coal much more stable than our lignite.

2. Climatic data for Rosevale are similar to those in the Rhineland.

3. Although both coals are in the category of being subject to self-ignition, Rosevale coal is at least not more, probably less prone to self-ignition than RHEINBRAUN Lignite. The latter has never shown any tendency to self-ignition.

4. It is believed that with this type of coal, an equilibirium between heat development and heat dissipation will be reached after some time of storage. If self-ignition does not occur within a few months then long term storage may be possible. It is suggested to test this in a small long term test pile at the beginning of operation.

Long term storage has the advantage of economical dust prevention by seeding the coal with certain types of grass.
For short term dust prevention, stockpiles must be sprayed with water.

It is also suggested to try to locate the stockpile in a valley or in an excavated area of the mine rim below the surface. Stockpile area is approx. 600 x 260 m.

5. Numbers on storage time and uncovered coal in our telex of Nov. 4 were based on your max. capacities.

   An investigation of the more likely average demand of 60 % shows that some of the 500,000 t security stock will remain in the piles for approx. 4 months, but required uncovered coal in the mine is reduced to 507,000 t.

6. The most economical equipment solution for the six parallel piles are three combined bucket wheel stacker/reclaimers, normally two used for stacking, one for reclaiming. By-passing the stockpile is also possible.
   Initially, two stacker/reclaimers will be sufficient for the first phase.
   This type of equipment is in use in many stockpile operations in the world.

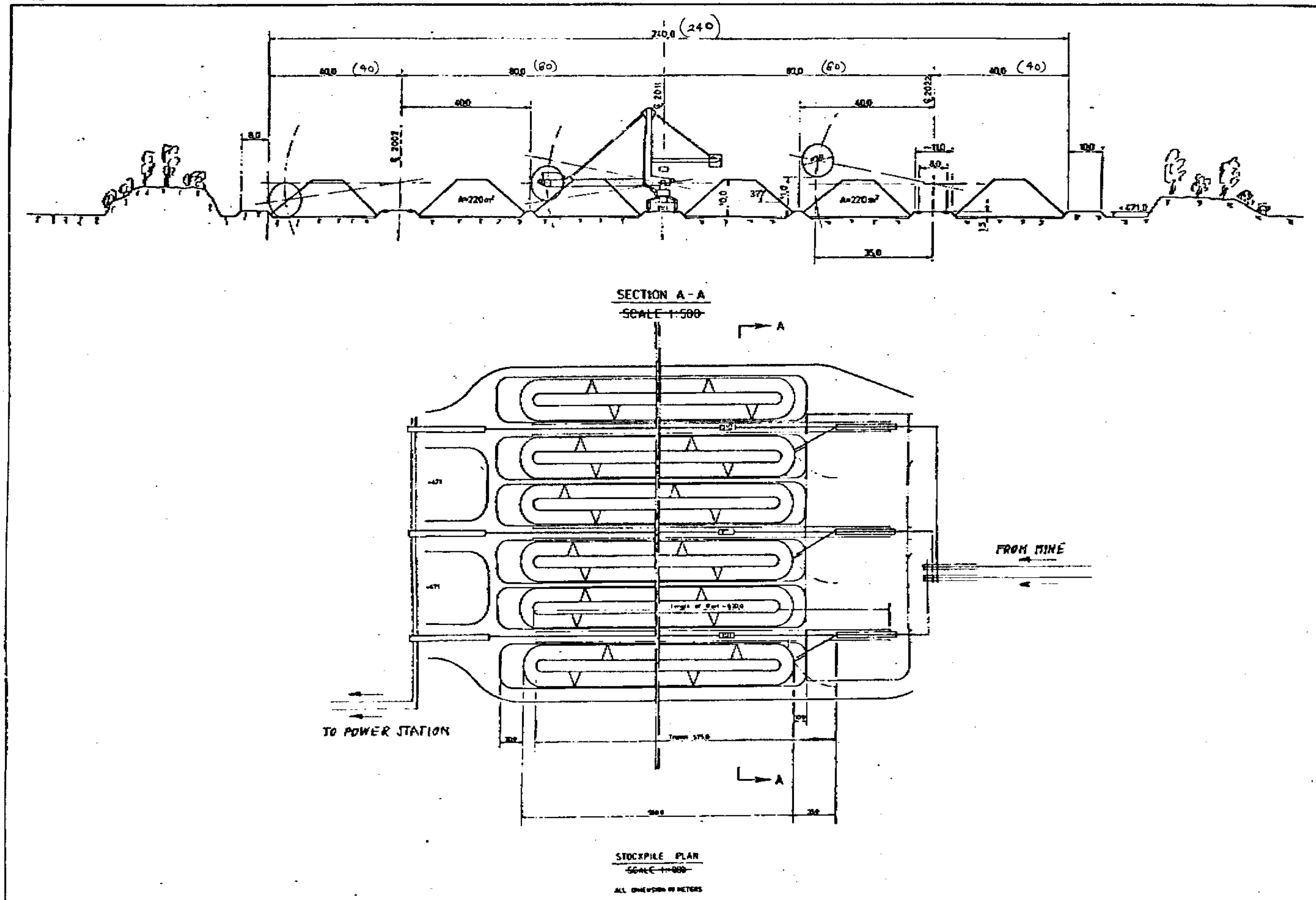
7. Stockpiles should be above-ground, open, long row piles for low cost operation. Such installations for similar lignite have been in operation at all RHEINBRAUN mines and Megalopolis with no tendency to self-ignition.
   Self-ignition has occured at high-sulfur lignite (3%) in Puentes, Spain, and Mae Moh, Thailand. Fire hazards have been prevented by monitoring the piles for heat and steam development and isolating such spots by excavating with front-end loader. A sketch of the stockpile is attached.

Our study is in the last stages and will be completed next week.

With best regards,
H. van Leyen H. van Leyen

RHEINBRAUN-Consulting GmbH

095



- Page 3 -

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Fig. 9

APPENDIX 2

List of Assumptions in Estimating
Mine-generated Employment, Population and Housing

APPENDIX 2

ASSUMPTIONS USED IN ESTIMATING MINE-GENERATED EMPLOYMENT, POPULATION AND HOUSING.

1. Direct Employment Component

a) Construction Phase:

i) Construction workforce is composed entirely of males

ii) Local recruits married: single ratio = 63:37

iii) Local recruits require no accommodation

iv) 65% of the workforce is recruited locally

v) All external recruits require accommodation

vi) External recruits married: single ratio = 25:75

vii) Family size - local recruits = 2.8 children per household

- external recruits = 2.0 children per household

viii) All married external recruits and families will live in caravan park accommodation

ix) All single external recruits will live in construction camp accommodation.

b) Operational Phase:

i) Operational workforce male : female ratio = 95:5

ii) Local recruits married : single ratio = 63:37

iii) External recruits sex/marital status ratios are as follows:

64% married males

31% single makes

3% married females

2% single females

iv) Family size - local recruits + 2.8 children per household

- external recruits = 2.0 children per household

v) 65% of the operational workforce is recruited locally

vi) Married female workers do not require accommodation

vii) All single externally recruited workers require accommodation

2. Indirect and Flow-On Employment Component

i) All consequential jobs are filled by newcomers to the district

ii) Married/single workforce ratio = 63:37

iii) Male/female workforce ratio = 63:37

iv) Married female workers do not require accommodation

v) All single workers require accommodation

vi) Family size = 2.0 children per household

vii) All workers generated by the mine's construction phase will require temporary accommodation only

vii) The multipliers used in calculating consequential employment are as follows:

- construction phase = 1.125
- operational phase = 1.73

APPENDIX 3

Climatic Data from Launceston Airport

Reference: Bureau of Meteorology,
Launceston Airport, 091104.

TABLE A3.1

RAINFALL

Monthly and Yearly Rainfall

BUREAU OF METEOROLOGY REPORT OF MONTHLY AND YEARLY RAINFALL BY M.I.S.S. 16/ 3/83 PAGE 338

'+' = RAINFALL BETWEEN 0.1 & 0.4 MM '-' = MISSING OBSERVATION ROUNDED TOTALS

STATION : 091104 LAUNCESTON AIRPORT AMO 41 33 S. 147 13 E 171.0 M ELEV

Year		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Total
1931	RAINFALL (MM)	-	-	-	-	-	-	-	96	122	31	62	0	-
1931	NO OF RAINDAYS	-	-	-	-	-	-	-	15	16	9	7	0	-
1932	RAINFALL (MM)	27	28	82	75	5	70	40	92	67	83	48	71	688
1932	NO OF RAINDAYS	5	9	11	10	2	13	13	17	12	19	8	8	127
1933	RAINFALL (MM)	15	7	57	66	59	33	27	44	106	97	46	20	577
1933	NO OF RAINDAYS	6	4	7	7	7	11	8	11	13	14	7	9	104
1934	RAINFALL (MM)	37	20	15	90	10	12	118	51	108	103	80	48	692
1934	NO OF RAINDAYS	5	4	7	12	1	4	8	14	12	17	11	8	103
1935	RAINFALL (MM)	30	81	50	116	86	55	75	45	36	28	32	27	661
1935	NO OF RAINDAYS	6	15	7	16	12	8	15	14	11	12	14	8	138
1936	RAINFALL (MM)	34	5	37	45	39	-	-	229	55	63	31	46	-
1936	NO OF RAINDAYS	3	2	9	11	13	-	-	20	11	18	8	11	-
1937	RAINFALL (MM)	104	28	61	16	60	23	64	58	71	75	26	113	699
1937	NO OF RAINDAYS	10	5	9	5	14	8	12	16	16	12	5	16	128
1938	RAINFALL (MM)	76	123	30	78	47	181	22	44	56	52	58	45	812
1938	NO OF RAINDAYS	13	13	12	17	12	16	12	13	14	11	12	9	154
1939	RAINFALL (MM)	3	92	42	69	66	89	41	181	67	74	75	47	846
1939	NO OF RAINDAYS	4	8	8	16	24	20	14	24	21	16	15	11	181
1940	RAINFALL (MM)	51	20	27	35	38	65	132	29	30	14	30	93	564
1940	NO OF RAINDAYS	12	9	11	11	15	17	27	14	14	12	9	11	162
1941	RAINFALL (MM)	27	14	66	11	30	66	84	38	58	65	42	31	532
1941	NO OF RAINDAYS	8	3	15	7	11	22	21	15	14	15	-	8	-
1942	RAINFALL (MM)	44	27	21	21	100	107	157	95	95	59	9	54	789
1942	NO OF RAINDAYS	7	9	8	6	22	22	25	24	17	9	4	10	163
1943	RAINFALL (MM)	38	52	8	64	32	53	121	29	69	25	53	18	562
1943	NO OF RAINDAYS	12	9	9	12	12	20	22	15	15	15	8	6	155
1944	RAINFALL (MM)	112	38	18	33	54	20	144	35	52	58	38	95	697
1944	NO OF RAINDAYS	8	10	9	13	13	10	18	14	15	15	14	21	160
1945	RAINFALL (MM)	80	105	15	9	31	87	67	143	54	18	14	27	650
1945	NO OF RAINDAYS	9	13	6	6	13	12	13	25	19	12	13	8	149
1946	RAINFALL (MM)	85	101	106	28	52	25	193	80	49	23	41	84	867
1946	NO OF RAINDAYS	16	9	14	10	17	13	29	20	10	16	15	12	181
1947	RAINFALL (MM)	34	24	55	29	81	118	137	99	58	163	51	87	936
1947	NO OF RAINDAYS	9	4	13	7	20	23	23	17	17	21	9	12	175
1948	RAINFALL (MM)	24	35	24	37	56	29	70	55	71	71	71	52	595
1948	NO OF RAINDAYS	6	10	11	8	16	18	23	26	19	19	14	14	184
1949	RAINFALL (MM)	45	57	33	22	77	33	50	42	38	136	93	21	647
1949	NO OF RAINDAYS	8	10	12	6	13	11	24	21	7	27	17	9	165
1950	RAINFALL (MM)	47	49	34	22	59	27	71	75	63	98	72	59	676
1950	NO OF RAINDAYS	13	8	8	12	18	5	24	22	18	17	13	9	167
1951	RAINFALL (MM)	24	31	57	111	84	29	95	52	30	57	71	63	704
1951	NO OF RAINDAYS	7	4	13	15	18	6	23	15	13	13	14	9	150

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'*' = RAINFALL BETWEEN 0.1 & 0.4 MM '-' = MISSING OBSERVATION ROUNDED TOTALS

STATION : 091104 LAUNCESTON AIRPORT AMO 41 33 S. 147 13 E 171.0 M ELEV

Year		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	
1952	RAINFALL (MM)	41	19	7	109	90	79	97	56	149	128	122	20	917
1952	NO OF RAINDAYS	10	6	7	13	14	16	19	14	17	19	18	7	160
1953	RAINFALL (MM)	59	2	22	41	47	113	103	77	99	76	78	69	786
1953	NO OF RAINDAYS	6	2	7	10	13	21	15	18	13	12	11	15	143
1954	RAINFALL (MM)	20	76	31	79	48	43	69	99	42	28	43	43	621
1954	NO OF RAINDAYS	5	7	12	20	12	20	12	19	13	9	12	10	151
1955	RAINFALL (MM)	29	44	12	78	90	66	91	146	58	148	84	80	926
1955	NO OF RAINDAYS	8	9	6	11	14	11	17	20	14	22	16	13	161
1956	RAINFALL (MM)	76	53	49	154	69	136	85	86	73	61	56	55	953
1956	NO OF RAINDAYS	13	8	9	20	11	18	14	23	11	19	10	15	171
1957	RAINFALL (MM)	16	40	37	90	104	64	13	42	69	51	67	47	640
1957	NO OF RAINDAYS	4	7	5	15	12	13	10	12	16	11	16	7	128
1958	RAINFALL (MM)	7	55	32	47	184	45	80	76	28	115	63	64	796
1958	NO OF RAINDAYS	4	7	9	6	23	6	15	15	9	17	10	11	132
1959	RAINFALL (MM)	17	96	18	47	7	51	42	104	47	45	22	141	637
1959	NO OF RAINDAYS	4	9	5	8	2	11	11	15	10	11	9	18	113
1960	RAINFALL (MM)	37	52	18	183	124	59	122	51	68	68	65	2	849
1960	NO OF RAINDAYS	5	6	8	18	15	9	16	14	11	13	13	1	129
1961	RAINFALL (MM)	8	38	11	90	32	64	51	57	27	67	20	40	505
1961	NO OF RAINDAYS	6	6	7	11	12	9	11	10	8	10	7	11	108
1962	RAINFALL (MM)	44	37	30	33	74	96	54	93	42	98	46	39	686
1962	NO OF RAINDAYS	8	6	8	6	12	17	11	14	10	17	11	7	127
1963	RAINFALL (MM)	79	31	40	5	25	34	108	75	90	66	31	33	617
1963	NO OF RAINDAYS	12	9	10	4	8	10	14	12	13	9	9	12	122
1964	RAINFALL (MM)	18	150	88	36	56	128	122	63	101	63	50	58	933
1964	NO OF RAINDAYS	7	11	8	9	13	17	16	12	14	15	11	16	149
1965	RAINFALL (MM)	32	2	35	113	122	46	41	35	73	21	53	39	612
1965	NO OF RAINDAYS	12	3	10	12	15	12	10	13	14	7	8	13	129
1966	RAINFALL (MM)	10	45	62	54	55	32	160	66	71	41	29	54	679
1966	NO OF RAINDAYS	6	5	10	13	10	12	14	14	16	7	9	13	129
1967	RAINFALL (MM)	31	19	25	14	16	26	124	115	29	34	20	41	494
1967	NO OF RAINDAYS	6	2	3	7	6	12	15	16	11	10	8	10	106
1968	RAINFALL (MM)	13	55	79	73	119	73	94	138	51	103	97	20	915
1968	NO OF RAINDAYS	3	3	8	16	13	7	13	19	8	14	15	8	127
1969	RAINFALL (MM)	56	164	63	32	95	22	92	83	77	28	44	50	806
1969	NO OF RAINDAYS	5	9	7	10	14	8	21	16	12	6	14	10	132
1970	RAINFALL (MM)	55	52	54	62	45	61	109	103	60	49	54	128	832
1970	NO OF RAINDAYS	7	8	10	10	9	13	19	17	11	16	9	9	140
1971	RAINFALL (MM)	55	15	29	119	83	102	21	102	88	133	100	93	940
1971	NO OF RAINDAYS	12	4	5	11	13	17	8	23	20	18	13	14	158
1972	RAINFALL (MM)	39	26	2	33	16	60	70	89	26	29	21	*	411
1972	NO OF RAINDAYS	6	7	3	-	3	10	16	18	13	4	8	1	-

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'*' = RAINFALL BETWEEN 0.1 & 0.4 MM '-' = MISSING OBSERVATION ROUNDED TOTALS

STATION : 091104 LAUNCESTON AIRPORT AMO 41 33 S. 147 13 E 171.0 M ELEV

Year		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Total
1973	RAINFALL (MM)	64	37	66	73	103	104	36	88	92	72	28	88	851
1973	NO OF RAINDAYS	7	7	14	11	21	13	10	15	16	10	10	9	143
1974	RAINFALL (MM)	40	27	72	96	53	66	134	66	107	56	63	94	874
1974	NO OF RAINDAYS	6	5	10	15	10	13	18	13	12	11	12	11	136
1975	RAINFALL (MM)	49	3	100	25	66	62	188	67	87	41	92	39	819
1975	NO OF RAINDAYS	6	2	13	8	18	13	23	15	12	12	16	6	144
1976	RAINFALL (MM)	52	10	44	14	46	46	26	90	28	28	51	86	521
1976	NO OF RAINDAYS	8	5	10	7	12	13	10	14	10	15	12	17	133
1977	RAINFALL (MM)	44	64	97	13	126	57	33	91	17	30	49	11	632
1977	NO OF RAINDAYS	8	9	13	7	17	13	9	15	8	10	12	8	129
1978	RAINFALL (MM)	25	85	29	64	70	33	53	72	59	50	75	77	692
1978	NO OF RAINDAYS	9	13	9	10	14	7	17	11	11	10	9	8	128
1979	RAINFALL (MM)	61	27	30	55	51	47	52	62	90	103	19	18	615
1979	NO OF RAINDAYS	9	6	10	10	8	13	18	15	19	14	6	10	138
1980	RAINFALL (MM)	19	18	29	99	33	40	70	87	68	56	35	43	597
1980	NO OF RAINDAYS	7	6	9	13	13	14	12	19	17	10	10	10	140
1981	RAINFALL (MM)	26	8	63	25	34	74	92	163	30	73	36	28	652
1981	NO OF RAINDAYS	7	6	11	11	11	17	20	24	10	9	7	9	142
1982	RAINFALL (MM)	27	21	31	49	41	54	29	13	61	18	-	-	-
1982	NO OF RAINDAYS	9	4	8	9	14	9	12	9	13	9	-	-	-

MEANS AND MEDIANS FOR THE PERIOD 1931 TO 1982 USING ALL AVAILABLE DATA

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Total
MEAN RAINFALL (MM)	41	45	42	58	63	62	83	80	65	65	52	53	709
MEDIAN RAINFALL (MM)	37	37	34	49	56	58	78	75	62	60	50	47	687
NO. OF RAINFALL OBS.	51	51	51	51	51	50	50	52	52	52	51	51	49
MEAN NO. OF RAINDAYS	8	7	9	11	13	13	16	16	13	13	11	10	140
NO. OF RAINDAY OBS.	51	51	51	50	51	50	50	52	52	52	50	51	

TABLE A3.2

EVAPORATION

Class A Pan Evaporation

CLASS "A" PAN EVAPORATION

STATION : 091104 LAUNCESTON AIRPORT AMO 41 33 S, 147 13 E 171.0 M ELEV

MONTHLY TOTALS OF EVAPORATION (IN MM)

YEAR	NO. OF OBS.	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1967	363	209.9	211.2	159.2	82.6	67.1	27.0	39.6	64.7#	89.6	173.1	199.0	229.3	1552.3#
1968	366	284.8	233.7	140.4	80.2	58.0	50.6	45.4	67.2	107.0	152.7	178.0	215.8	1613.8
1969	363	246.3	162.5#	145.3	93.1	66.6	49.4	59.9	79.7	129.2	157.8	171.9	218.7	1578.4#
1970	365	216.1	202.5	150.7	85.9	49.4	24.2	41.9	48.2	80.9	122.4	175.4	212.7	1410.3
1971	365	203.6	193.2	170.6	87.1	47.5	22.5	23.9	44.3	81.1	107.1	144.1	188.0	1313.0
1972	366	196.0	197.0	181.0	100.6	54.0	24.9	34.0	48.4	106.2	150.3	186.1	282.7	1561.2
1973	365	255.9	207.9	146.9	87.2	50.7	28.6	30.6	59.4	79.4	116.7	166.0	213.7	1443.0
1974	365	234.4	209.2	142.1	56.9	45.6	34.0	32.1	45.2	71.6	112.6	146.5	182.4	1312.6
1975	365	202.4	208.6	137.2	81.4	40.9	26.5	30.9	37.0	59.6	100.2	110.0	183.6	1218.3
1976	366	205.2	182.8	124.8	87.0	43.8	42.9	33.2	46.5	74.8	93.7	123.2	158.2	1216.1
1977	365	196.4	166.2	125.5	77.8	41.2	26.1	31.2	52.9	78.2	128.3	171.5	225.6	1320.9
1978	359	239.4	165.6	145.2	77.8	45.2	22.8#	29.1	45.4	69.0	117.0	145.2	162.8	1264.5#
1979	364	207.3	182.0	129.1	76.2	45.0	29.8	34.6	52.2	62.4#	98.6	164.4	228.4	1308.0#
1980	366	226.2	212.2	156.7	79.4	34.6	20.2	22.0	50.6	87.8	111.7	152.0	191.0	1344.4
1981	365	246.1	182.5	129.6	90.2	51.4	22.8	32.0	31.8	83.2	113.4	143.4	202.8	1329.2
1982	336	240.4	0.0#	153.0	94.8	49.2	26.6	22.6#	59.9	72.2	129.4	212.5	224.2	1284.8#
1983	59	218.8	208.6	0.0#	0.0#	0.0#	0.0#	0.0#	0.0#	0.0#	0.0#	0.0#	0.0#	427.4#
LONG TERM TOTAL		3829.2	3125.7#	2337.3#	1338.2#	786.2#	478.9#	543.0#	833.4#	1332.2#	1985.0#	2589.2#	3319.9#	22498.2#
		527	450	496	480	496	474	495	494	479	496	480	496	5863

TRUE TOTAL OF EVAPORATION MAY BE GREATER THAN THIS

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
MEAN	225	197	146	84	49	30	35	51	85	124	162	207	1395

(excluding possibly incorrect values)

TABLE A3.3

SURFACE WIND ANALYSIS

at 0900 hrs and 1500 hrs Daily

BUREAU OF METEOROLOGY - SURFACE WIND ANALYSIS

PERCENTAGE OCCURRENCE OF SPEED VERSUS DIRECTION BASED ON 45 YEARS OF RECORDS

STATION : 091104 LAUNCESTON AIRPORT AMO 41 33 S, 147 13 E 171 0 M ELEV

JANUARY 0900 HOURS LST — SPEED (KM/HR) — CALM 12

DIRN	1 TO 5	6 TO 10	11 TO 20	21 TO 30	31 TO 40	41 TO 50	51 & UP	ALL
N	2	5	8	5	2	*	*	21
NE	1	2	*	*				3
E	1	1	*		*			2
SE	2	3	6	3	1	*	*	15
S	1	3	3	2	*	*	*	11
SW	1	1	1	1	*			4
W	1	2	1	1	*			5
NW	2	5	9	8	2	1	*	26
ALL	10	20	30	19	6	1	*	

NO OF OBS 1357

FEBRUARY 0900 HOURS LST — SPEED (KM/HR) — CALM 15

DIRN	1 TO 5	6 TO 10	11 TO 20	21 TO 30	31 TO 40	41 TO 50	51 & UP	ALL
N	3	4	6	3	1	1	*	18
NE	1	1	1					3
E	1	*	*	*	*			1
SE	2	4	5	3	1	*	*	16
S	3	4	7	2	1	*	*	17
SW	1	1	1	1	*			4
W	1	1	1	*	*			3
NW	2	3	8	6	2	1	*	22
ALL	13	18	31	16	5	2	*	

NO OF OBS 1236

MARCH 0900 HOURS LST — SPEED (KM/HR) — CALM 22

DIRN	1 TO 5	6 TO 10	11 TO 20	21 TO 30	31 TO 40	41 TO 50	51 & UP	ALL
N	2	4	8	5	1	*	*	20
NE	1	1	1		*			3
E	*	1	*					1
SE	2	3	5	2	1	*		14
S	3	4	5	2	1	*		15
SW	1	1	1	*	*			4
W	*	1	1	1	*			3
NW	1	3	8	6	1	*	*	19
ALL	12	17	28	15	4	1	*	

NO OF OBS 1314

APRIL 0900 HOURS LST — SPEED (KM/HR) — CALM 25

DIRN	1 TO 5	6 TO 10	11 TO 20	21 TO 30	31 TO 40	41 TO 50	51 & UP	ALL
N	3	4	8	4	2	*	*	21
NE	1	*	*		*			2
E	1	*	*					1
SE	2	2	4	2	1	*		11
S	4	5	4	2	1	*		15
SW	2	1	1	*	*			3
W	*	*	1	*	*	*		2
NW	1	3	7	6	2	*	*	20
ALL	14	15	25	15	5	1	*	

NO OF OBS 1320

JANUARY 1500 HOURS LST — SPEED (KM/HR) — CALM 4

DIRN	1 TO 5	6 TO 10	11 TO 20	21 TO 30	31 TO 40	41 TO 50	51 & UP	ALL
N	1	2	6	8	5	2	*	24
NE	*	1	1	*	*			2
E	*	*	*	*				1
SE	*	1	2	2	1	*		8
S	*	1	2	1	*	*		5
SW	*	1	2	1	*	*		4
W	*	1	3	3	2	1		10
NW	1	3	11	15	8	3	*	40
ALL	4	11	26	31	17	6	1	

NO OF OBS 1331

FEBRUARY 1500 HOURS LST — SPEED (KM/HR) — CALM 5

DIRN	1 TO 5	6 TO 10	11 TO 20	21 TO 30	31 TO 40	41 TO 50	51 & UP	ALL
N	1	2	8	8	3	1	*	23
NE	*	1	1	*	*			3
E	*	1	1	1	*			3
SE	*	1	3	3	1	*	*	9
S	*	1	3	2	1	*	*	7
SW	1	1	2	2	1			6
W	*	1	2	2	1	*	*	7
NW	1	3	12	13	6	3	1	38
ALL	4	10	31	31	13	4	1	

NO OF OBS 1219

MARCH 1500 HOURS LST — SPEED (KM/HR) — CALM 7

DIRN	1 TO 5	6 TO 10	11 TO 20	21 TO 30	31 TO 40	41 TO 50	51 & UP	ALL
N	1	3	8	8	5	2	*	25
NE	1	1	1	*		*		2
E	*	*	1	*	*	*		2
SE	*	1	3	3	1	*		8
S	1	2	2	2	1	*		7
SW	*	1	1	1	*	*		5
W	1	1	2	2	1	*		8
NW	1	3	12	11	6	2	*	35
ALL	5	12	29	28	14	4	*	

NO OF OBS 1322

APRIL 1500 HOURS LST — SPEED (KM/HR) — CALM 8

DIRN	1 TO 5	6 TO 10	11 TO 20	21 TO 30	31 TO 40	41 TO 50	51 & UP	ALL
N	2	2	7	8	3	1	*	24
NE	*	1	*	*	*			1
E	*	*	*	*	*			1
SE	1	1	2	3	1	*		8
S	1	1	4	3	1	*		9
SW	*	1	1	2	*			5
W	1	1	3	2	1	*	*	7
NW	2	3	12	12	4	2	*	35
ALL	7	12	30	29	11	3	*	

NO OF OBS 1319

* OCCURRED BUT LESS THAN 0.5 PERCENT

BUREAU OF METEOROLOGY - SURFACE WIND ANALYSIS

PERCENTAGE OCCURRENCE OF SPEED VERSUS DIRECTION BASED ON 45 YEARS OF RECORDS

STATION : 091104 LAUNCESTON AIRPORT AMO 41 33 S, 147 13 E 171 0 M ELEV

MAY 0900 HOURS LST

CALM 28

DIRN	SPEED (KM/HR) 1 TO 5	6 TO 10	11 TO 20	21 TO 30	31 TO 40	41 TO 50	51 & UP	ALL
N	3	4	7	3	1	*	*	18
NE	1	1	*		*			2
E	*	*	*	*				*
SE	1	2	2	1	*	*		7
S	4	6	6	2	*	*		18
SW	2	2	1	*				6
W	*	*	*	*				1
NW	2	3	8	4	1	1	*	20
ALL	13	18	25	11	3	1	*	

NO OF OBS 1363

JUNE 0900 HOURS LST

CALM 27

DIRN	SPEED (KM/HR) 1 TO 5	6 TO 10	11 TO 20	21 TO 30	31 TO 40	41 TO 50	51 & UP	ALL
N	2	4	6	3	1	1	*	17
NE	1	*	*	*	*			1
E	*	*	*					*
SE	1	2	3	2	*	*	*	8
S	5	7	7	2	1	*	*	21
SW	2	3	1	*	*			7
W	1	*	*	*	*			2
NW	2	3	7	3	1	1	*	18
ALL	13	20	25	9	4	2	*	

NO OF OBS 1318

JULY 0900 HOURS LST

CALM 28

DIRN	SPEED (KM/HR) 1 TO 5	6 TO 10	11 TO 20	21 TO 30	31 TO 40	41 TO 50	51 & UP	ALL
N	3	3	8	4	2	*	*	20
NE	1	*	*	*	*			2
E	*	*	*					*
SE	1	1	2	1	*			6
S	4	4	5	1	*	*		15
SW	3	2	1	*		*		6
W	*	*	*	*	*			1
NW	2	4	10	5	2	1	*	22
ALL	14	16	27	11	4	1	*	

NO OF OBS 1360

AUGUST 0900 HOURS LST

CALM 23

DIRN	SPEED (KM/HR) 1 TO 5	6 TO 10	11 TO 20	21 TO 30	31 TO 40	41 TO 50	51 & UP	ALL
N	3	4	8	5	1	*	*	22
NE	1	1	*	*	*			2
E	*	*	*					1
SE	1	1	3	1	*	*		7
S	4	5	6	2	*	*		17
SW	1	2	1	*				4
W	*	*	1	*	*			2
NW	1	3	10	6	2	1	*	24
ALL	12	15	29	15	4	2	*	

NO OF OBS 1363

MAY 1500 HOURS LST

CALM 9

DIRN	SPEED (KM/HR) 1 TO 5	6 TO 10	11 TO 20	21 TO 30	31 TO 40	41 TO 50	51 & UP	ALL
N	2	3	8	7	2	1	*	23
NE	*	*	*	*	*			1
E	*	*	*	*				1
SE	1	1	3	3	1	*		10
S	2	3	5	3	1	*		12
SW	2	2	2	1	*		*	7
W	1	1	2	1	*	*		5
NW	1	3	14	9	3	1	*	31
ALL	9	14	34	24	8	2	*	

NO OF OBS 1362

JUNE 1500 HOURS LST

CALM 15

DIRN	SPEED (KM/HR) 1 TO 5	6 TO 10	11 TO 20	21 TO 30	31 TO 40	41 TO 50	51 & UP	ALL
N	2	3	8	5	2	1	*	22
NE	1	*	*	*	*			1
E	1	*	*	*				1
SE	1	2	5	2	1	*		12
S	2	4	3	2	1	*		13
SW	2	2	1	1	*	*		6
W	1	1	2	1	*	*		5
NW	1	2	10	7	3	1	*	25
ALL	11	15	29	19	8	3	*	

NO OF OBS 1319

JULY 1500 HOURS LST

CALM 11

DIRN	SPEED (KM/HR) 1 TO 5	6 TO 10	11 TO 20	21 TO 30	31 TO 40	41 TO 50	51 & UP	ALL
N	2	3	8	7	3	1	*	25
NE	1	1	*	*				2
E	*	*	*	*				1
SE	1	2	3	2	1	*		8
S	2	2	4	2	*	*		10
SW	2	2	2	1		*		7
W	1	1	2	2	*	*	*	5
NW	1	3	10	11	4	1	*	31
ALL	10	14	29	25	9	2	*	

NO OF OBS 1364

AUGUST 1500 HOURS LST

CALM 9

DIRN	SPEED (KM/HR) 1 TO 5	6 TO 10	11 TO 20	21 TO 30	31 TO 40	41 TO 50	51 & UP	ALL
N	1	2	7	8	4	1	*	24
NE	*	*	1	*	*			2
E	*	1	*	*				1
SE	1	2	3	2	1	*		9
S	2	2	3	2	1	*		9
SW	1	1	2	1	*	*		6
W	1	1	3	2	1			7
NW	1	2	10	11	6	2	*	33
ALL	7	11	29	27	12	4	1	

NO OF OBS 1363

* OCCURRED BUT LESS THAN 0.5 PERCENT

PRODUCED BY M I S S 20/ 5/83

BUREAU OF METEOROLOGY - SURFACE WIND ANALYSIS

PERCENTAGE OCCURRENCE OF SPEED VERSUS DIRECTION BASED ON 45 YEARS OF RECORDS

STATION : 091104 LAUNCESTON AIRPORT AMO 41 33 S, 147 13 E 171.0 M ELEV

SEPTEMBER 0900 HOURS LST

SPEED (KM/HR) — CALM 16

DIRN	1 TO 5	6 TO 10	11 TO 20	21 TO 30	31 TO 40	41 TO 50	51 & UP	ALL
N	3	4	8	8	3	1	*	26
NE	1	1	*	*				2
E	*	*	*	*				1
SE	1	2	3	2	1	*	*	9
S	3	2	4	2	1	*	*	12
SW	2	1	1	1	*	*		4
W	*	1	1	1	*			2
NW	1	2	10	10	3	2	*	28
ALL	11	12	26	23	8	3	*	

NO OF OBS 1319

OCTOBER 0900 HOURS LST

SPEED (KM/HR) — CALM 12

DIRN	1 TO 5	6 TO 10	11 TO 20	21 TO 30	31 TO 40	41 TO 50	51 & UP	ALL
N	2	4	8	6	2	1	*	23
NE	1	1	*	*				2
E	*	*	*	*	*	*		1
SE	1	2	5	3	1	*		12
S	2	3	4	2	1	*		11
SW	1	1	1	*	*	*		4
W	*	1	2	1	*	*		4
NW	1	3	9	11	3	1	*	29
ALL	9	15	30	24	8	3	*	

NO OF OBS 1348

NOVEMBER 0900 HOURS LST

SPEED (KM/HR) — CALM 11

DIRN	1 TO 5	6 TO 10	11 TO 20	21 TO 30	31 TO 40	41 TO 50	51 & UP	ALL
N	2	3	8	5	3	1	*	22
NE	1	1	*	*	*	*		3
E	1	*	*	*	*			1
SE	2	2	5	4	1	*	*	14
S	1	2	4	2	1	*	*	10
SW	1	1	1	1	*			4
W	1	1	2	2	*	*		6
NW	1	3	10	10	3	1	*	28
ALL	9	14	31	24	8	2	1	

NO OF OBS 1308

DECEMBER 0900 HOURS LST

SPEED (KM/HR) — CALM 9

DIRN	1 TO 5	6 TO 10	11 TO 20	21 TO 30	31 TO 40	41 TO 50	51 & UP	ALL
N	2	4	8	6	2	1	*	22
NE	1	1	*	*				2
E	1	1	*	*	*			2
SE	1	3	5	3	1	*		12
S	2	3	5	2	*	*	*	12
SW	1	2	1	1	*			5
W	1	2	3	1	1	*		7
NW	2	4	11	9	3	1	*	30
ALL	10	18	33	22	6	2	*	

NO OF OBS 1342

SEPTEMBER 1500 HOURS LST

SPEED (KM/HR) — CALM 6

DIRN	1 TO 5	6 TO 10	11 TO 20	21 TO 30	31 TO 40	41 TO 50	51 & UP	ALL
N	1	2	6	9	5	2	*	25
NE	*	1	*	*	*			2
E	*	1	*	*	*			1
SE	1	1	2	2	1	*	*	8
S	1	1	2	2	1	*		8
SW	*	1	1	1	*	*		4
W	*	1	3	3	1	*		9
NW	1	2	9	14	8	3	1	38
ALL	5	10	25	32	16	6	1	

NO OF OBS 1319

OCTOBER 1500 HOURS LST

SPEED (KM/HR) — CALM 5

DIRN	1 TO 5	6 TO 10	11 TO 20	21 TO 30	31 TO 40	41 TO 50	51 & UP	ALL
N	1	1	6	7	5	2	*	23
NE	*	1	1	*	*	*		2
E	*	1	1	*	*			2
SE	1	1	3	2	1	*	*	8
S	1	1	2	2	1	*	*	7
SW	1	1	2	2	1	*		6
W	*	1	2	4	2	*		9
NW	1	2	9	13	8	3	*	38
ALL	4	9	26	30	18	7	1	

NO OF OBS 1349

NOVEMBER 1500 HOURS LST

SPEED (KM/HR) — CALM 5

DIRN	1 TO 5	6 TO 10	11 TO 20	21 TO 30	31 TO 40	41 TO 50	51 & UP	ALL
N	1	2	4	8	6	3	1	24
NE	1	1	1	*	*	*		2
E	*	*	1	*	*			2
SE	*	1	3	2	1	*		8
S	*	1	3	2	1	*	*	7
SW	*	1	2	2	1	*		5
W	*	1	2	4	2	*		9
NW	1	3	8	15	7	3	1	38
ALL	3	10	22	33	18	7	1	

NO OF OBS 1298

DECEMBER 1500 HOURS LST

SPEED (KM/HR) — CALM 3

DIRN	1 TO 5	6 TO 10	11 TO 20	21 TO 30	31 TO 40	41 TO 50	51 & UP	ALL
N	*	2	5	9	6	2	*	24
NE	*	1	1	*	*			2
E	*	*	1	*				1
SE	*	1	3	2	1	*	*	8
S	1	2	2	1	1	*	*	7
SW	*	1	2	2	1	*	*	6
W	*	1	2	4	2	1	*	10
NW	*	2	9	16	10	4	*	40
ALL	3	9	24	33	19	7	1	

NO OF OBS 1350

* OCCURRED BUT LESS THAN 0.5 PERCENT

PRODUCED BY M I S S 20/ 5/83

TABLE A3.4

TEMPERATURE

Mean Daily Maximum and Mean Daily Minimum Temperature

MEAN DAILY MAXIMUM TEMP C . UNITS: DEGREES CELSIUS DEPARTMENT OF SCIENCE BUREAU OF METEOROLOGY

STATION 091104 LAUNCESTON AIRPORT AMO LAT 41 33 S LONG 147 13 E ELEVATION 171.0 M

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUM
1939				18.3	15.7	11.5	10.6	11.5	13.1	16.3	18.1	19.4	-
1940	21.5	20.7	23.0	16.9	13.7	11.7	10.7	12.8	14.6	17.7	18.8	22.0	17.0
1941	23.3	23.4	19.4	17.7	14.5	10.8	10.4	12.2	14.4	15.6	19.0	22.4	16.9
1942	22.4	22.9	21.4	17.5	13.1	11.7	10.6	12.7	14.6	17.2	19.5	21.8	17.1
1943	23.1	22.6	22.0	16.6	12.7	10.8	10.2	11.5	13.4	16.7	19.4	21.9	16.7
1944	23.7	21.6	21.1	15.2	13.4	11.9	10.7	11.8	14.1	16.3	19.0	20.8	16.6
1945	21.5	20.3	18.0	16.3	13.5	11.8	10.2	12.3	13.6	17.3	20.6	22.6	16.5
1946	21.8	22.1	19.6	15.8	13.6	9.8	11.1	11.3	13.2	14.9	17.6	21.5	16.0
1947	23.6	24.6	20.7	18.0	15.7	11.6	11.0	11.8	14.2	15.2	17.8	21.0	17.1
1948	23.2	23.0	19.2	17.5	13.1	11.0	9.7	12.4	14.8	15.0	17.4	21.0	16.4
1949	22.6	19.0	20.3	16.4	13.2	10.7	11.6	12.4	14.9	16.3	18.3	19.3	16.1
1950	20.2	22.5	20.0	17.6	12.9	11.7	11.8	12.3	15.4	17.4	18.8	22.8	16.9
1951	24.3	23.6	21.8	15.1	14.0	10.7	10.7	11.3	14.6	17.7	17.7	21.0	16.9
1952	22.1	21.1	21.8	16.1	13.4	11.3	10.4	11.4	13.9	16.1	17.9	20.8	16.4
1953	23.0	24.3	21.8	18.2	14.5	10.4	10.3	11.5	13.8	16.4	17.9	19.2	16.8
1954	25.4	21.5	19.4	17.6	13.6	11.0	10.6	11.7	15.2	16.6	18.5	22.6	17.0
1955	24.2	22.8	21.7	17.7	13.2	10.3	10.8	11.6	13.7	16.2	16.9	20.6	16.6
1956	22.0	24.4	21.8	17.5	13.7	10.9	10.8	11.5	14.0	15.5	17.3	18.6	16.5
1957	21.7	22.5	19.5	16.7	13.4	12.8	10.6	12.7	14.2	16.6	17.2	20.9	16.6
1958	21.7	22.9	19.9	17.8	13.4	11.9	9.7	11.9	14.0	14.8	20.0	20.1	16.5
1959	25.9	22.8	21.0	17.7	13.8	12.2	11.2	12.3	13.7	16.0	20.7	20.2	17.3
1960	24.8	22.1	21.3	16.3	12.7	10.7	10.8	11.5	13.8	16.4	16.9	21.4	16.8
1961	26.7	24.7	21.8	17.7	13.7	12.3	10.9	12.6	14.9	17.9	19.4	22.0	17.9
1962	23.7	22.7	21.0	17.8	13.6	12.5	11.3	11.4	13.7	14.1	18.3	21.2	16.8
1963	22.9	21.3	20.8	17.1	13.6	10.8	10.4	11.4	14.6	19.0	18.6	21.8	16.9
1964	21.5	20.2	18.6	17.1	13.2	10.8	10.0	12.1	13.7	15.7	18.4	18.0	15.8
1965	21.2	24.2	20.2	15.5	13.4	11.3	10.6	12.2	14.4	17.4	18.0	22.5	16.7
1966	24.2	22.7	21.5	16.1	13.7	10.7	10.3	12.1	14.2	16.6	18.8	20.2	16.8
1967	21.6	24.7	20.9	18.2	14.4	12.6	10.6	12.4	13.6	16.5	18.5	19.7	17.0
1968	24.1	23.9	20.4	16.4	12.2	11.0	10.6	11.3	13.5	15.3	16.1	19.7	16.2
1969	23.2	22.2	20.8	16.0	13.4	10.7	11.2	12.7	12.8	17.6	19.1	19.6	16.7
1970	22.9	22.9	20.5	18.0	13.3	11.4	11.2	11.1	11.9	15.6	18.9	20.2	16.5
1971	23.0	24.9	23.2	18.8	13.3	10.9	10.9	10.8	13.2	14.9	17.4	19.7	16.7
1972	22.5	25.8	21.6	18.9	15.4	11.8	10.6	12.6	14.9	17.7	19.8	22.6	17.9
1973	24.6	23.5	19.7	17.9	14.1	10.1	11.2	12.1	13.8	17.0	18.2	22.5	17.1
1974	24.3	24.1	22.9	16.6	14.5	12.0	10.7	11.8	13.3	16.3	17.4	20.0	17.0
1975	20.6	24.0	19.9	16.8	13.9	10.9	11.3	11.8	14.2	15.6	18.2	22.4	16.6
1976	23.5	24.2	21.1	18.2	14.4	12.0	11.2	11.2	13.8	14.5	18.5	19.1	16.8
1977	23.4	23.0	20.5	16.8	13.4	10.9	10.3	12.5	13.8	17.9	18.9	21.6	16.9
1978	23.6	21.7	21.4	17.2	14.4	10.8	10.4	11.1	14.4	16.6	19.2	20.2	16.7
1979	24.1	24.7	21.2	16.8	13.4	12.2	11.3	11.6	13.3	16.3	19.8	22.1	17.2
1980	21.8	23.5	20.7	18.3	15.5	11.9	11.3	12.8	14.6	16.7	19.6	21.8	17.4
1981	26.7	25.5	20.8	17.9	14.6	11.5	10.5	11.3	14.9	16.5	19.1	22.1	17.6
1982	25.3	24.5	22.5	17.9	14.1	10.8	9.8	13.9	13.8	16.5	21.3	21.6	17.7
1983	21.8	25.5											-
AVERAGE	23.2	23.1	20.9	17.2	13.8	11.3	10.7	11.9	14.0	16.3	18.6	21.0	
HIGHEST	26.7	25.8	23.2	18.9	15.7	12.8	11.8	13.9	15.4	19.0	21.3	24.4	
LOWEST	20.2	19.0	18.0	15.1	12.2	9.8	9.7	10.8	11.9	14.1	16.1	18.0	
NO OF ENTRIES	44	44	43	44	44	44	44	44	44	44	44	44	

MEAN DAILY MINIMUM TEMP C . UNITS: DEGREES CELSIUS DEPARTMENT OF SCIENCE BUREAU OF METEOROLOGY

STATION 091104 LAUNCESTON AIRPORT AMO LAT 41 33 S LONG 147 13 E ELEVATION 171.0 M

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUM
1939				8.2	7.0	3.2	1.4	4.1	4.7	4.8	7.5	6.4	-
1940	8.5	7.4	8.7	5.4	3.2	2.5	2.7	3.1	4.6	5.1	5.9	9.8	5.6
1941	10.9	10.3	9.1	8.1	3.7	3.0	2.5	2.4	4.0	5.1	6.9	9.0	6.3
1942	9.7	10.2	8.7	5.7	4.9	4.6	3.3	4.1	5.3	6.1	7.9	9.0	6.6
1943	9.9	9.2	8.3	5.5	3.9	2.8	2.1	1.7	3.4	5.8	7.9	9.1	5.8
1944	10.7	9.5	8.2	5.3	5.7	2.6	2.9	1.6	4.5	5.2	6.8	9.2	6.0
1945	8.9	9.6	6.7	5.7	3.2	3.6	1.5	4.3	3.5	5.9	8.1	8.7	5.8
1946	10.0	9.7	10.1	6.3	4.7	2.2	3.6	3.0	3.3	4.4	6.8	8.3	6.0
1947	9.2	10.6	9.8	6.9	6.0	3.3	2.9	2.0	3.4	5.6	6.8	9.7	6.3
1948	9.8	10.4	6.4	6.9	4.2	2.1	1.4	3.4	4.6	5.1	6.0	8.5	5.7
1949	9.4	7.3	8.2	4.5	4.0	2.1	3.3	2.3	3.5	6.4	7.9	6.8	5.5
1950	7.8	9.9	9.4	6.5	4.6	1.4	3.1	2.8	5.2	6.9	7.5	9.0	6.2
1951	11.6	10.4	9.6	4.5	4.6	3.2	3.2	1.9	4.6	4.9	6.2	8.4	6.1
1952	8.0	8.5	9.1	5.3	5.0	3.5	2.3	1.8	4.5	6.5	7.0	8.4	5.8
1953	10.3	9.9	8.0	6.8	5.3	2.0	1.9	3.4	3.3	5.8	6.7	7.5	5.9
1954	10.9	9.9	7.1	6.5	4.6	4.3	1.7	3.0	3.9	5.6	6.9	9.4	6.1
1955	10.3	10.4	9.3	6.9	3.9	2.0	2.3	3.6	4.0	6.8	5.6	9.5	6.2
1956	10.3	12.9	10.9	8.1	6.4	3.1	1.0	2.9	4.1	5.3	6.3	7.4	6.6
1957	7.7	8.7	7.7	6.1	4.2	4.3	1.0	2.9	3.5	4.2	6.3	7.9	5.4
1958	8.2	10.1	8.3	4.9	5.2	3.1	1.2	3.6	3.2	5.4	8.1	8.4	5.8
1959	10.8	11.1	9.4	7.5	2.4	3.5	3.0	2.8	2.7	4.8	8.1	9.5	6.3
1960	11.4	8.5	8.6	7.0	4.6	2.3	3.0	2.3	4.8	5.4	5.7	9.7	6.1
1961	12.0	11.0	9.4	7.9	4.1	4.0	2.3	2.9	4.5	6.8	8.2	10.4	7.0
1962	11.0	11.0	10.5	6.7	5.0	4.9	3.3	2.5	3.6	4.4	6.5	9.3	6.6
1963	11.7	9.4	9.3	5.5	2.7	2.0	2.9	2.4	4.1	7.5	7.2	9.6	6.2
1964	9.1	10.6	7.8	8.4	5.0	3.3	3.0	4.4	4.9	6.3	7.0	7.7	6.5
1965	8.9	9.9	8.0	5.5	6.1	3.3	1.7	4.1	5.3	5.8	6.5	10.8	6.3
1966	11.3	11.2	10.8	6.9	5.0	1.8	2.8	2.9	5.7	6.1	7.9	8.9	5.8
1967	10.2	11.5	9.5	6.9	4.7	4.3	2.8	3.1	4.5	6.4	6.6	8.4	6.6
1968	10.8	12.3	11.3	8.7	4.4	3.0	2.0	3.7	4.5	5.3	7.0	9.1	6.8
1969	11.0	12.8	10.1	7.2	5.7	3.0	3.6	4.7	3.5	4.6	7.6	7.0	6.7
1970	10.6	9.5	9.1	7.9	3.4	3.1	3.1	2.7	2.3	4.4	6.9	9.0	6.0
1971	11.8	12.0	9.4	7.6	4.5	2.0	0.2	2.2	3.4	4.8	7.4	9.0	6.2
1972	9.4	11.4	6.7	5.7	2.7	1.3	1.5	3.5	5.6	4.2	6.5	9.0	5.6
1973	10.5	11.4	7.7	8.7	5.8	0.8	1.9	2.2	4.7	6.1	7.2	9.3	6.4
1974	10.7	10.6	11.1	8.1	5.5	3.4	3.3	2.5	3.6	5.3	6.3	7.4	6.5
1975	7.9	9.2	8.1	4.5	4.2	1.6	3.6	2.3	4.6	6.5	8.4	8.9	5.8
1976	9.7	11.2	9.9	5.8	3.2	2.4	0.1	2.0	3.4	3.9	7.2	8.5	5.6
1977	10.3	9.4	9.9	5.5	3.9	1.8	1.0	3.1	3.0	4.7	6.2	7.5	5.5
1978	9.3	10.4	9.5	6.2	6.8	3.6	1.5	2.0	4.1	5.6	7.5	8.3	6.2
1979	10.0	10.9	9.7	5.1	3.2	3.7	2.3	2.3	4.3	5.9	7.4	8.2	6.1
1980	9.6	9.3	8.2	7.4	6.8	2.7	1.9	4.6	5.7	5.4	7.6	9.7	6.6
1981	12.1	12.0	9.4	7.4	4.1	3.1	2.4	3.7	5.4	5.7	7.1	9.0	6.8
1982	10.9	9.8	9.6	6.5	4.9	2.2	-0.1	3.7	2.9	4.1	7.4	8.4	5.9
1983	8.1	11.0											-
AVERAGE	10.0	10.3	9.0	6.6	4.6	2.9	2.2	3.0	4.1	5.5	7.1	8.7	
HIGHEST	12.1	12.9	11.3	8.7	7.0	4.9	3.6	4.7	5.7	7.5	8.4	10.8	
LOWEST	7.7	7.3	6.4	4.5	2.4	0.8	-0.1	1.6	2.3	3.9	5.6	6.4	
NO OF ENTRIES	44	44	43	44	44	44	44	44	44	44	44	44	

TABLE A3.5

MEAN RELATIVE HUMIDITY

0900 hrs and 1500 hrs

MEAN REL HUMIDITY 9 OCLOCK% UNITS: PERCENT DEPARTMENT OF SCIENCE BUREAU OF METEOROLOGY

STATION 091104 LAUNCESTON AIRPORT AMO LAT 41 33 S LONG 147 13 E ELEVATION 171.0 M

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUM
1939				89	92	94	93	93	84	79	71	66	-
1940	68	65	76	84	90	94	92	88	80	70	65	69	78
1941	69	67	79	82	87	92	92	87	78	72	67	64	78
1942	68	71	76	80	89	91	92	91	84	71	65	65	79
1943	61	64	70	77	87	90	89	85	79	73	63	63	75
1944	59	63	64	77	89	83	87	84	76	66	62	61	73
1945	59	68	63	77	83	89	88	87	74	64	56	54	72
1946	55	60	79	80	86	87	88	82	76	67	67	63	74
1947	57	65	75	79	87	85	89	82	75	73	66	66	75
1948	63	61	67	76	82	87	87	90	78	70	67	63	74
1949	56	63	70	73	84	86	88	79	74	77	71	55	73
1950	60	65	69	80	87	91	91	88	79	73	64	62	76
1951	63	60	75	82	90	92	89	85	85	70	66	66	77
1952	65	70	75	83	92	88	90	86	78	74	71	65	78
1953	62	63	69	78	88	87	86	88	81	71	68	65	75
1954	64	71	70	84	85	87	92	88	81	68	63	63	76
1955	59	67	68	81	87	89	89	87	81	73	61	67	76
1956	67	69	76	83	87	88	90	87	79	73	64	66	77
1957	58	69	67	80	85	91	90	87	80	66	67	59	75
1958	58	67	69	80	82	92	90	84	80	73	67	65	76
1959	60	64	72	79	87	89	88	87	75	66	63	67	75
1960	58	64	74	82	86	90	92	88	80	71	63	58	75
1961	59	62	73	81	83	88	84	84	76	74	66	59	74
1962	59	61	70	78	85	89	84	83	77	70	66	59	73
1963	66	65	69	79	86	89	91	88	81	76	64	62	76
1964	59	71	77	84	88	92	89	87	80	71	68	62	77
1965	58	63	70	79	91	89	90	87	79	68	60	64	75
1966	59	66	72	83	89	90	89	86	83	70	64	68	77
1967	65	64	72	82	89	90	89	83	72	64	55	59	74
1968	60	63	77	84	83	85	90	88	76	70	66	68	76
1969	65	75	76	84	85	89	94	89	74	-	-	-	-
1970	-	-	-	-	-	-	-	85	76	-	-	-	-
1971	-	-	-	-	-	-	-	-	81	70	70	71	-
1972	66	65	-	-	-	-	-	-	-	-	-	-	-
1973	-	-	-	-	-	-	-	-	-	-	-	-	-
1974	-	-	-	-	-	91	89	88	81	76	72	76	-
1975	73	76	75	83	92	90	91	88	83	74	78	67	81
1976	67	75	72	78	86	88	92	89	78	70	73	74	79
1977	73	79	78	82	92	89	93	86	78	72	71	65	80
1978	67	82	78	86	89	92	93	88	84	75	72	71	81
1979	71	74	77	78	83	94	91	87	82	81	73	65	80
1980	66	70	69	84	93	94	92	87	78	79	71	70	79
1981	69	72	73	75	88	90	91	91	76	71	72	67	78
1982	68	66	-	84	87	91	93	89	81	69	61	68	-
1983	66	70											-
AVERAGE	63	67	72	81	87	90	90	87	79	71	66	65	
HIGHEST	73	82	79	89	93	94	94	93	85	81	78	76	
LOWEST	55	60	63	73	82	83	84	79	72	64	55	54	
NO OF ENTRIES	40	40	37	39	39	40	40	41	42	40	40	40	

MEAN REL HUMIDITY 15 OCLOCK%   UNITS: PERCENT   DEPARTMENT OF SCIENCE   BUREAU OF METEOROLOGY

STATION 091104   LAUNCESTON AIRPORT AMO   LAT 41 33 S   LONG 147 13 E   ELEVATION 171.0 M

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUM
1939				62	72	79	73	75	68	67	59	58	-
1940	53	47	47	59	65	74	75	68	59	55	54	54	59
1941	49	45	63	62	62	78	76	63	58	56	57	49	60
1942	45	46	46	54	69	79	74	68	64	56	56	54	59
1943	47	47	46	58	65	70	71	60	60	51	47	39	55
1944	41	45	45	58	69	60	69	58	59	51	48	51	55
1945	44	51	47	49	59	68	64	64	60	48	42	38	53
1946	46	63	60	59	67	71	73	65	57	60	56	45	58
1947	37	44	53	52	59	69	68	56	55	61	57	54	55
1948	45	45	45	53	65	71	71	69	60	61	56	48	57
1949	40	48	52	45	62	68	67	59	49	67	56	47	55
1950	45	40	50	49	67	62	69	63	58	59	53	45	55
1951	48	40	55	67	68	76	77	64	66	52	56	52	60
1952	53	54	55	63	71	72	72	59	63	59	64	48	61
1953	47	42	45	55	70	75	71	67	63	55	53	54	58
1954	44	51	50	59	67	75	69	71	52	54	51	48	58
1955	38	51	47	61	69	72	70	69	62	61	55	54	59
1956	53	51	58	63	67	75	66	67	60	60	53	55	61
1957	40	45	49	59	66	74	68	67	64	50	55	42	57
1958	41	45	51	53	71	69	68	69	54	62	54	50	57
1959	41	47	49	55	56	72	68	60	54	51	52	57	55
1960	39	41	51	60	69	71	72	65	61	55	50	39	56
1961	36	37	48	58	63	64	63	62	56	59	51	46	54
1962	42	42	49	53	66	70	68	64	56	59	54	44	56
1963	49	47	50	53	56	68	72	66	59	53	52	45	56
1964	41	57	53	62	72	78	74	67	64	54	49	51	60
1965	40	37	40	53	68	72	65	66	61	45	43	48	53
1966	41	46	49	63	69	72	72	63	59	53	49	56	58
1967	50	37	45	52	63	70	71	59	55	51	39	48	53
1968	41	45	59	70	69	63	74	70	63	58	57	53	60
1969	44	56	57	63	68	68	79	70	58	-	-	-	-
1970	-	-	-	-	-	-	-	69	62	-	-	-	-
1971	-	-	-	-	-	-	-	-	62	59	59	59	-
1972	48	43	-	-	-	-	-	-	-	-	-	-	-
1973	-	-	-	-	-	-	-	-	-	-	-	-	-
1974	-	-	-	-	-	77	78	66	69	60	55	57	-
1975	51	40	54	60	75	73	74	69	66	62	66	50	62
1976	44	48	50	51	63	67	66	66	61	61	54	58	57
1977	47	45	60	59	69	74	73	67	57	57	48	39	58
1978	41	52	52	66	76	78	74	69	66	59	52	58	62
1979	48	45	50	56	63	79	73	67	72	66	55	40	59
1980	41	36	45	54	73	74	70	70	62	62	51	51	57
1981	38	43	52	56	63	76	74	72	57	58	51	42	57
1982	37	37	-	56	68	71	71	64	57	53	39	40	-
1983	42	38											-
AVERAGE	44	45	51	57	67	72	71	66	60	57	53	49	
HIGHEST	53	57	63	70	76	79	79	75	72	67	66	59	
LOWEST	36	36	40	45	56	60	63	56	49	45	39	38	
NO OF ENTRIES	40	40	37	39	39	40	40	41	42	40	40	40	