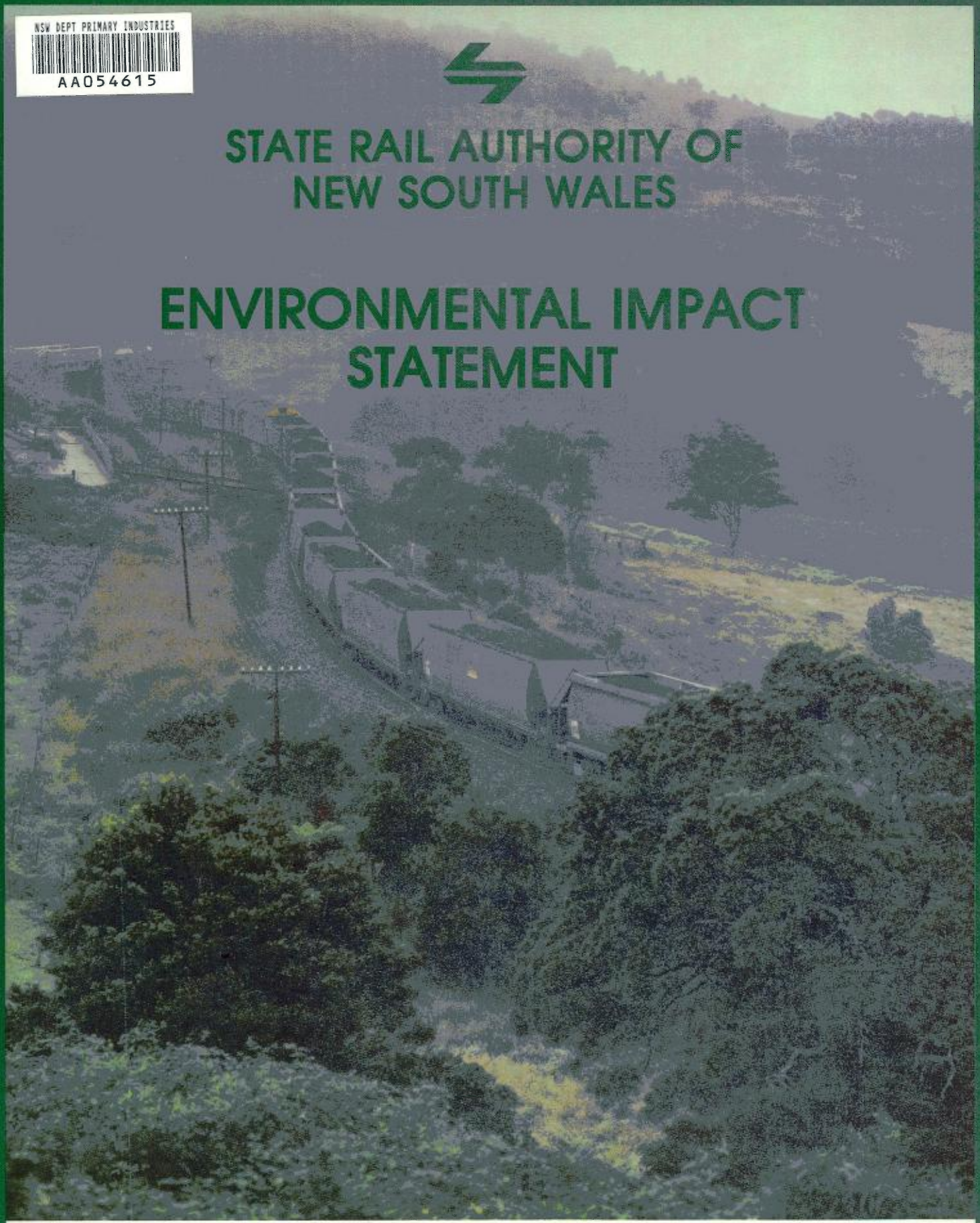
NSW DEPT PRIMARY INDUSTRIES
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STATE RAIL AUTHORITY OF NEW SOUTH WALES

ENVIRONMENTAL IMPACT STATEMENT



MALDON-DOMBARTON-PORT KEMBLA RAILWAY

EIS 209

Dames & Moore

VOLUME I
OCTOBER 1983

M83/3850

ENVIRONMENTAL IMPACT STATEMENT
MALDON - DOMBARTON - PORT KEMBLA RAILWAY

CERTIFICATE

This Environmental Impact Statement has been prepared in accordance with clauses 57 and 58 of the Environmental Planning and Assessment Act 1979 - Regulation.

Warren J. Atkinson
Principal-in-Charge
DAMES & MOORE

NSW Dept of Primary Industries
Maitland
Library Network

Points to address

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EXTRACTION CONDITIONS

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P. 12. LENGTH OF ROUTE: 35.2 Km

P. 23: EASEMENT 40m.

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LIST OF ABBREVIATIONS

D&M	:	Dames & Moore
EIS	:	Environmental Impact Statement
GHD	:	Gutteridge, Haskins & Davey Pty Ltd,
MSW&DB	:	Metropolitan Water, Sewerage and Drainage Board
NSW	:	New South Wales
SCS	:	Soil Conservation Service
SKP	:	Sinclair Knight & Partners Pty Ltd
SPCC	:	State Pollution Control Commission
SRA	:	State Rail Authority
WHO	:	World Health Organisation

TECHNICAL ABBREBIATIONS

m	:	metres
cm	:	centimetres
km	:	kilometres
NNE	:	north north east
SSW	:	south south west
WWN	:	west west north
EES	:	east east south
NW	:	northwest
SE	:	southeast

1.0 INTRODUCTION

This Environmental Impact Statement has been prepared for the State Rail Authority of New South Wales in respect to the construction and operation of the Maldon - Port Kembla Railway. The Statement has been compiled in three volumes.

Volume I contains an assessment of the environmental impact of the construction and operation of the Maldon to Dombarton section of the Railway.

Volume II contains an assessment of the environmental impact of the proposed duplication of the existing Moss Vale to Unanderra Railway between Dombarton and Unanderra and of the existing line between Unanderra and the Port Kembla Coal Loader.

Volume III comprises technical appendices, on which basis the Impact Statement has been prepared.

The Environmental Impact Statement has been prepared in accordance with the requirements of the Environmental Planning and Assessment Act 1979.

2.0 SUMMARY

This Environmental Impact Statement presents the results of the evaluation of the environmental viability of constructing and operating a new railway line from Maldon (near Picton) to Dombarton.

Dombarton is located on the Moss Vale to Unanderra line, identifiable by a "loop", which passes along the Illawarra escarpment.

The State Rail Authority of N.S.W. (SRA) proposes to construct this new line from the Main Southern Line at Maldon. The line then traverses rural land, passing the township of Wilton, and entering the Metropolitan Catchment Area south of Wilton. The line then follows the ridgeline along which fire roads numbers 6A and 6B are in existence. From the ridge-line the proposed railway route drops down to enter the western tunnel portal. The line passes through the Dombarton tunnel, joining the Moss Vale - Unanderra line at the Dombarton Loop. The SRA plan to duplicate the Moss Vale - Unanderra line from Dombarton to Port Kembla.

The Metropolitan Catchment Area is an area of relatively undisturbed native vegetation, controlled by the Metropolitan Water, Sewerage and Drainage Board (MWS&DB).

The construction period of the proposed new line and duplicated line is estimated to be about 3 years.

The single line section, Maldon to Dombarton has a capacity for 24 trains per day in each direction but this track capacity will not be reached until after the year 1990.

On current projections, the number of coal trains using the Maldon Port Kembla Railway, pre 1991 will average eight or nine trains per day in each direction, giving a total haulage of 6 to 6 1/2 million tonnes/annum.

Of these coal trains, one or two would load at West Bellambi (if operating) with a further one or two from Tahmoor and the remainder from the Burragorang and western coal fields.

As well as coal trains, the section from Dombarton to Unanderra would carry the trains proceeding to and from Moss Vale.

The line will be electrified from Maldon to Port Kembla. The majority of trains travelling on the line will be electric, however some will be diesel-electric. Figure 2-1 illustrates a typical diesel tracked coal train in the Maldon area.

The existing environment is reported on in terms of both the physical and social elements of the environment. The areas examined include geology, land evaluation, land use, soils, hydrology, water quality, climate and air quality, vegetation and wildlife, bushfires, archaeology, visual considerations, ambient noise, social and economic considerations and the local community.

The environmental impacts were assessed for both the construction and operational phases of the project. The majority of impacts occur during the construction phase and are relatively short term impacts. The main areas of impact are increased noise, soil erosion and drainage control, fires, vegetation and wildlife, land use and the local community. Impacts, mitigations and management programmes are discussed in Section 7.0.

The need for an improved coal transportation system to Port Kembla and options to meet this need have been the subject of numerous studies over the past seven years.

Coal from the Western District, Burragorang Valley District and South Coast is exported through Port Kembla and Balmain.

The export of this coal is limited in part by the capacity of the Port Kembla Coal Loader. The background to the development of the coal loader is contained in the Environmental Impact Statements prepared by the Maritime Services Board (MSB) for Stages I and II of the loader.

Planning has proceeded for the construction of a new transport system to link the coal mines in the Western and Burragorang Valley Districts and some mines from the South Coast District, to the loader.

In October 1982, after detailed evaluation of alternative land transport proposals for export coal and after consultations with the South Coast Labour Council and the coal industry, the Government decided in principle that a new rail link from Maldon to Dombarton would be constructed.

FIGURE 2–1

3.0 GEOGRAPHICAL SETTING

The regional setting of the proposed railway is shown in Figure 3-1. The line will pass through two distinct physical regions: tablelands and escarpment. From Maldon the line will traverse an elevated plateau which has been deeply dissected by headwaters of the Nepean River System. This plateau rises gently to the south east to end abruptly at the steep Illawarra Escarpment. The plateau's foremost resource is water. Its dissected valleys have been dammed by the Cataract, Cordeaux, Avon and Nepean Wiers. Their surrounding catchments have been largely preserved in their natural condition.

Downstream of these reservoirs, land has been cleared primarily for grazing and hobby farms. Urban development is confined to several small rural townships including Wilton.

The only other major land use is coal mining. Below the surface of this area are the Illawarra Coal Measures which have been mined by underground techniques for many years. New underground mines have recently commenced operations or are planned in this area.

Other local land uses include a cement works at Maldon and a parachute club airstrip and target area at Wilton.

The Wilton area has coincidently been the interaction point of a number of developments. These include the F5 Freeway, Trunk Road 95, the MSW&DB underground channel from Pheasants Nest to Broughton Bass, an underground natural gas pipeline, several electric power transmission lines and a proposed methane gas drainage development project.

The transport and communication system between the plateau and the coastal region and the centre of Wollongong are poor. Trunk Road 95 is the major transportation corridor. The only rail connection is the single track line between Moss Vale, south of the reservoirs, and Unanderra, which links the Main Southern and South Coast lines. This line is located with steep gradients and tight curves and has limited capacity.

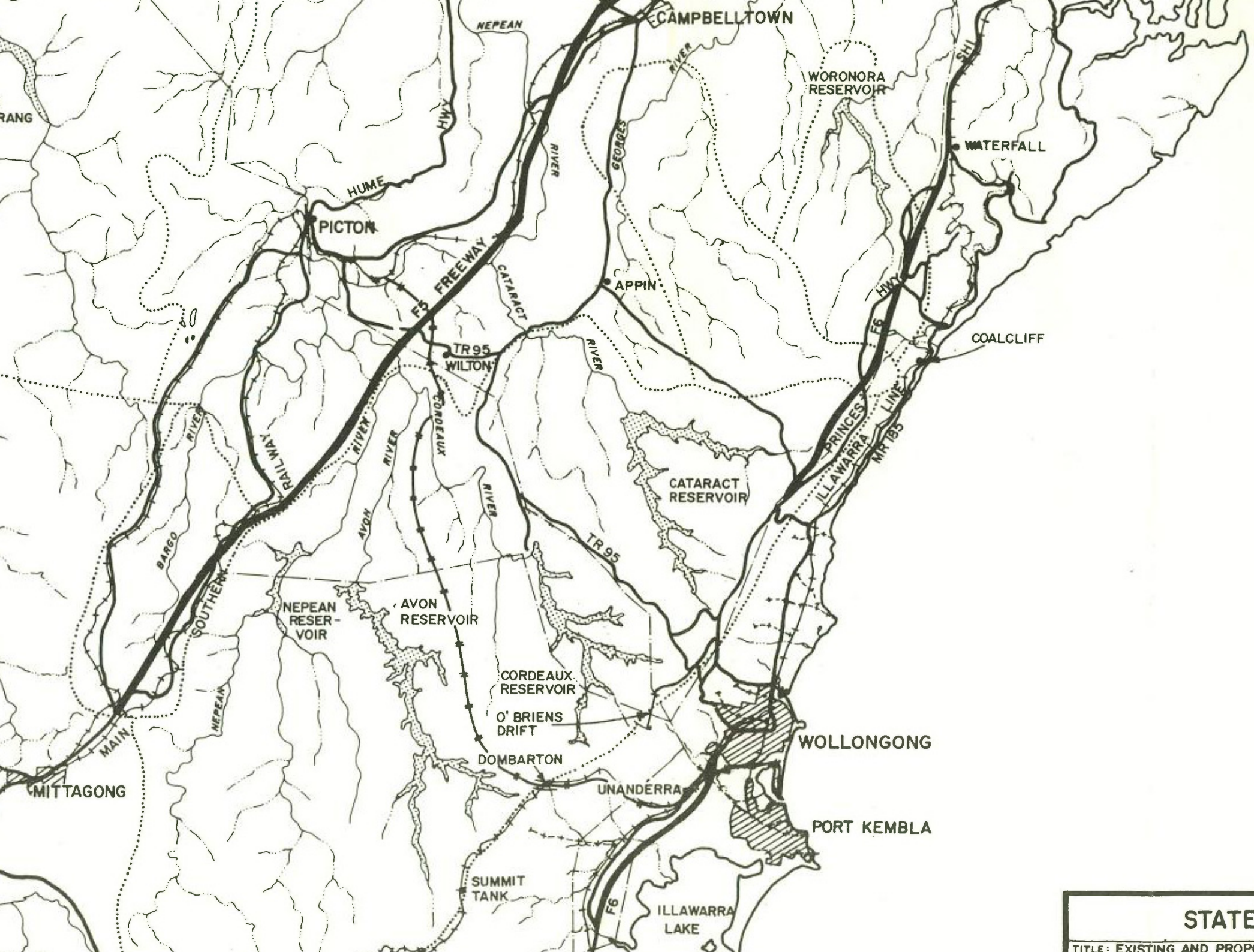
Socioeconomic relationships between the residents of the plateau and coastal region are poor, probably because of the attracting influence of Sydney and the past poor transportation and communication links between the plateau and the coast. People in the Wilton area work and shop in Picton, Campbelltown and Wollongong. Major local employment is in the

coal mining industry. Current economic and business problems in the steel and coal industries and Wollongong generally have reduced the link with that centre.

Expansion of urban communities from Sydney to centres such as Campbelltown and Mittagong will encourage industrial and commercial development. Part of the area through which the proposed railway line passes is included in planning for light industrial development by the Macarthur Development Board as part of this expansion.

The residential areas in the Maldon - Wilton - Douglas Park district are also planned for expansion. The proposed location of the line will not significantly limit the extent of this expansion. In the longer term, the potential use of the line for purposes other than the transport of coal will facilitate the development of this area.

The Draft Illawarra Regional Plan, prepared by the former Planning and Environment Commission advocates the accommodation of coal industries as a primary economic policy. The Plan also identifies coal transportation by road as one of the most significant environmental problems in the Region. Rail transportation of coal is seen as a means of preserving the Region's economic base while reducing environmental impacts of coal transport. The Plan recommends that a corridor be retained through the Metropolitan Catchment Area to link the coast and plateau region. The proposed new railway line is consistent with the aims of the Plan.


CAMPBELLTOWN
NEPEAN
RIVER
WORONORA RESERVOIR
GEORGES
RIVER
WATERFALL
HUME
HWY
PICTON
F5 FREEWAY
CATARACT
RIVER
APPIN
HWY
F6
COALCLIFF
TR 95
WILTON
CORDEAUX
RIVER
PRINCES
ILLAWARRA
LINE
MR 185
CATARACT RESERVOIR
RAILWAY
AVON
RIVER
BARGO
SOUTHERN
NEPEAN RESER-VOIR
AVON RESERVOIR
CORDEAUX RESERVOIR
O' BRIENS DRIFT
DOMBARTON
WOLLONGONG
UNANDERRA
PORT KEMBLA
MAIN
MITTAGONG
SUMMIT TANK
ILLAWARRA LAKE
STATE RAIL

4.0 BACKGROUND TO PROPOSED DEVELOPMENT

4.1 HISTORICAL BACKGROUND

The need for an improved coal transportation system to Port Kembla and options to meet this need have been the subject of numerous studies over the past seven years.

Coal is currently exported from New South Wales at three main points:

- Newcastle;
- Sydney (Balmain);
- Port Kembla.

Minor amounts have also been exported from Catherine Hill Bay, south of Newcastle, Balls Head in Sydney and loaders at the B.H.P. Company steelworks at Newcastle and Port Kembla.

Coal from the Western District, Burragorang Valley District and South Coast is exported through Port Kembla and Balmain.

The export of this coal is limited in part by the capacity of the Port Kembla Coal Loader.

In 1977, after receiving the recommendations of the Botany Bay Port and Environmental (Simblist) Inquiry, the Government announced that a new coal loader would be developed at Port Kembla and the Balmain loader would be upgraded.

The background to the development of the coal loader is contained in the Environmental Impact Statements prepared by the Maritime Services Board (MSB) for Stages I and II of the loader.

As a result of the 1977 announcement, planning has proceeded for the construction of a new transport system to link the coal mines in the Western and Burragerang Valley Districts and some mines from the South Coast District to the loader.

4.2 NEED FOR THE PROPOSED DEVELOPMENT

The requirement for a rail link from Maldon to Dombarton and duplication to Port Kembla was established following detailed Government consideration as outlined below.

In the mid to late 1970's the Government decided, on the basis of coal export forecasts available at the time, to construct additional port capacity at Balmain and Port Kembla. Following this decision, Balmain was upgraded to a nominal 5 mtpa throughput capacity and Port Kembla to a nominal Stage I throughput capacity of 14 mtpa. Balmain is serviced exclusively by rail. Port Kembla has nominal capacity to receive up to 12 mtpa by rail and approximately 4 mtpa by road. There is some interaction between rail and road receival facilities at Port Kembla so operating capacity (14 mtpa) is less than the sum of rail and road.

By 1980 it had become apparent that detailed consideration needed to be given to the transport of coal to Port Kembla so as to optimise some development and minimise environmental impacts.

Accordingly the Government appointed a Task Force on Port Kembla Coal Transport in 1980 to assess the available future options for transporting coal to Port Kembla.

A number of options were examined by the Task Force, including:

- rail transport of Western coal via Ulan to Newcastle;
- rail transport of western coal via Strathfield to Newcastle;
- upgraded Illawarra line supplemented by upgraded Moss Vale-Unanderra line;
- construction of a Douglas Park-Helensburgh rail link;
- construction of a Maldon-Port Kembla rail link;
- construction of a Maldon-Dombarton rail link;
- construction of a Lend Lease conveyor from Wilton to Port Kembla;
- construction of a Lend Lease conveyor from edge of escarpment to Port Kembla;
- construction of a dedicated road from Wilton to Five Islands Rd., Unanderra, as put forward in a proposal prepared by Longworth and MacKenzie.

The options were evaluated on a range of criteria for the periods 1985-1990, and 1985-2000, these being:

- ability to cope with forecast coal tonneages;
- overall cost;
- financial performance (return to Government sector and financial impact on industry);
- environmental impact (noise from coal trains and households affected; road haulage on public roads and through built-up areas against cost of upgrading and maintaining those roads to heavy truck standard);
- employment aspects;
- sterilisation of coal reserves;
- other relevant factors, for example, technical feasibility.

Sensitivity tests were conducted in terms of variations in forecast tonneages and construction, rolling stock and operating costs.

The Task Force eliminated the less promising options from further consideration as evaluations were progressively completed. By November 1981 a stage had been reached where just four options for long term coal transport were under detailed consideration, these being:

- a combination of an upgraded, electrified Illawarra line plus upgraded Moss Vale-Unanderra line, with no electrification beyond Campbelltown;
- full duplication of the Moss Vale-Unanderra line;
- a new rail link from Maldon to Dombarton, with full duplication from Dombarton through Unanderra to Port Kembla;
- a new rail link from Maldon to Wilton then conveyor from Wilton to Port Kembla, generally referred to as the Lend Lease conveyor option.

In early 1982, detailed feasibility studies were prepared by the SRA and by the Lend Lease Corporation (for the conveyor part of its proposal) for more detailed evaluation by the Task Force. The final evaluation of this information was completed in mid-1982 and the Task Force's recommendations were submitted to Government shortly afterwards.

In October 1982, after consultation with the South Coast Labor Council and the Coal Industry, the Government decided in principle that a new rail link from Maldon to Dombarton would be constructed. The decision was announced by the Premier, at that time, as an integral part of the long term coal transport strategy for export from Port Kembla.

The Government decision was consistent with Task Force advice that options based on upgrading existing rail lines would run out of capacity in the long term and would not be as environmentally attractive as the other two options. The choice of a Maldon-Dombarton rail link over Lend Lease conveyor was based principally on its lesser cost under a range of sensitivities, as well as an expressed industry preference for this option.

Construction of the line would have the very important benefit of job creation. Some 1500 jobs would be generated-500 directly on site and 900 indirectly - mostly in the Illawarra region.

The proposed line, in addition, will have significant long-term benefits including:

- the diversion of some road hauled export coal to rail;
- the diversion of coal traffic from the Illawarra line, thus relieving the environmental effects of coal freight through the Southern suburbs of Sydney and relieving pressure on passenger train schedules;
- the provision of substantial rail capacity from the mid 1980's to facilitiate substantial future increases in coal exports through Port Kembla that can be expected when overseas economic conditions improve;
- the Dombarton to Port Kembla section would be used for wheat trains should a grain terminal be built at Port Kembla;

- a direct rail link between the Illawarra region and the developing Campbelltown/Camden region.

4.3 ALTERNATIVES

The Government's decision in principle of October 1982, to proceed with the construction of a rail link followed detailed assessment of alternative land transport proposals as outlined above.

The alternative of not constructing the proposed line would be in conflict with the Government's decision and would:

- impose a capacity constraint on coal exports from Port Kembla in the long term;
- potentially result in increased use of road transportation;
- remove the flexibility in the transport infrastructure servicing Port Kembla generated by the proposed line;
- constrain the use of the Dombarton to Port Kembla section by wheat trains should a grain terminal be constructed at Port Kembla; and,
- remove the opportunity of providing a direct rail link between the Illawarra Region and the growth centres of Campbelltown, Camden and Appin.

Alternative railway routes between Maldon and Dombarton are discussed in Appendix A of this Impact Statement.

4.4 ENVIRONMENTAL ASSESSMENT PROCEDURES

This Environmental Impact Statement is submitted pursuant to Clauses 57 and 58 of the Environmental Planning and Assessment Regulation, 1980. The N.S.W. State Government is preparing enabling legislation for the construction of the proposed new railway line and the proposal is subject to assessment under

Part V of the Environmental Planning and Assessment Act, 1979 with the State Rail Authority as Determining Authority.

Following consultation with the Director of the Department of Environment and Planning, the requirements of the Director were issued in respect to matters to be considered in this Impact Statement. These requirements have been taken into account in the preparation of this document.

Consultations have been held with officers of the Department of Environment and Planning, State Pollution Control Commission, Soil Conservation Service, Metropolitan Water Sewerage & Drainage Board, National Parks and Wildlife Service, Maritime Services Board, Ministry of Transport, Macarthur Development Board and Local Government Authorities in the course of preparation of this Impact Statement.

5.0 PROPOSED RAILWAY DEVELOPMENT

A full description of the proposed railway development is contained in Appendix A. This section summarises those aspects which are pertinent to the assessment of environmental impact.

5.1 ROUTE DESCRIPTION

Figure 5-1 indicates the proposed rail route.

The proposed railway links the Main Southern Line and the Moss Vale - Unanderra Railway from Maldon to Dombarton below the Illawarra Escarpment. It will be a single track line with four passing loops. Except for bridge design, there is no provision for duplication at this time.

The total route comprises 9.5 km new construction between the Main Southern Line to Wilton and 25.7 km new construction between Wilton to Dombarton. Duplication of the existing railway between Dombarton and Port Kembla to maintain flow of increased train traffic is also proposed. This is discussed in Volume II. TOTAL 35·2 Km

In general, the selected route leaves the Main Southern Line near Maldon and crosses the Nepean River north of the new Maldon road bridge. The line traverses generally open grazing country for approximately 9 km between the Nepean River and Wilton. This portion of the route crosses under the South Western Freeway (F5) and Wilton Road (Trunk Road 95).

At Wilton the route enters the Metropolitan Catchment Area passing to the south of Thorntons Hill and crossing the Cordeaux River about 23 km south of the junction of the Cordeaux and Avon Rivers.

Within the Metropolitan Catchment Area the route generally follows the existing alignment of fire roads numbered 6A and 6B, along the ridge line which separates the Cordeaux River and Avon River catchment areas.

The route passes through a series of cuttings. It then enters a 3.5 km long tunnel about 2 km north east of the upper Avon pumping station (western portal) and emerges near the Dombarton crossing facility on the Moss Vale - Unanderra Railway (eastern portal).

Four passing loops are located along the line. Preliminary locations for the loops have been identified.

The preliminary design of a balloon loop has been prepared. It will provide rail access to the proposed West Bellambi Colliery. The layout provides for minimum earthworks, access from both directions on the main line, and minimal impact on the proposed colliery pit top works. This preliminary design is currently being reviewed by the colliery development personnel, and will form part of their development.

The major items of work for the new section of line from Maldon to Dombarton include two major bridges, a tunnel and 35 kilometres of single rail track. Electrification would be completed from Glenlee through to Dombarton. The estimated cost of this work is $160 million, at March 1983 prices. This estimate of cost is based on preliminary study work and is estimated to have an accuracy of +25% to -15%.

5.2 ROUTE SELECTION

The examination of route options was based primarily on three main factors: engineering feasibility, economics and environmental aspects. Route verification will follow thorough field investigations during the detailed design stage of the project.

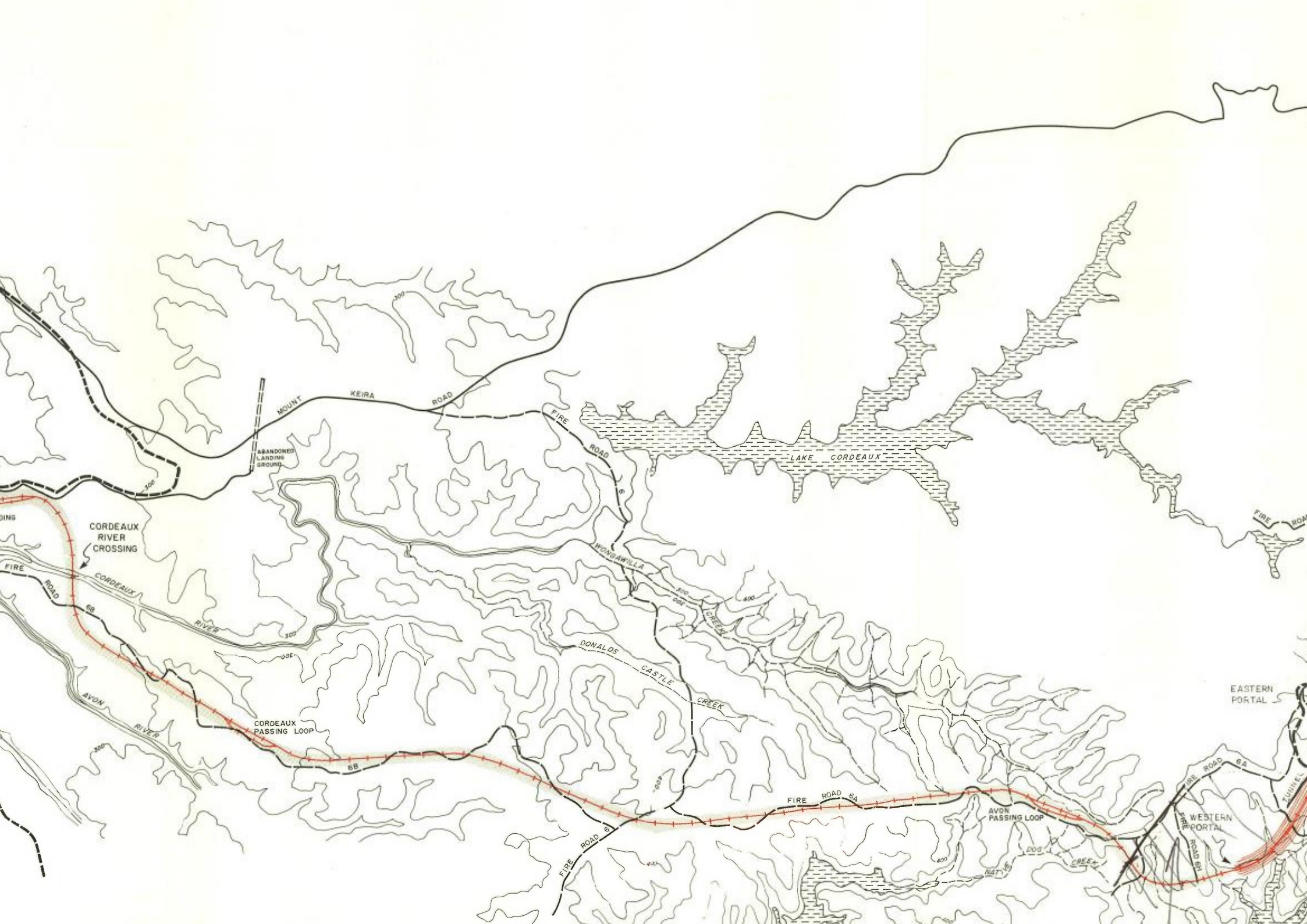
A number of partial route alternatives were developed during the course of this study. These alternatives fall into two location categories:

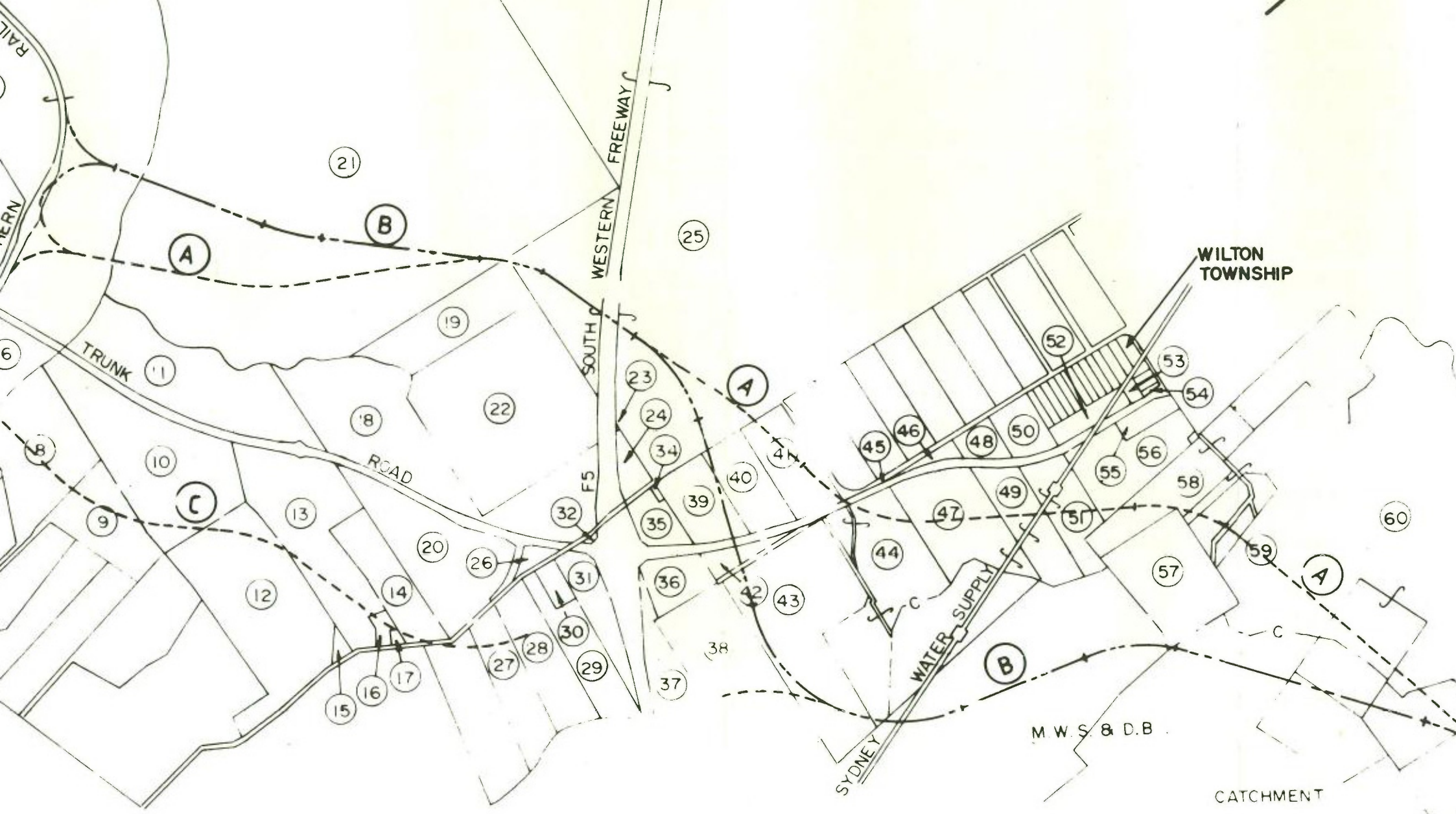
- the Main Southern Line connection to the MWS&DB Catchment Area;

- approximately 3-4 km west of the tunnel entrance.

Few alternatives were available for the location of the eastern tunnel portal.

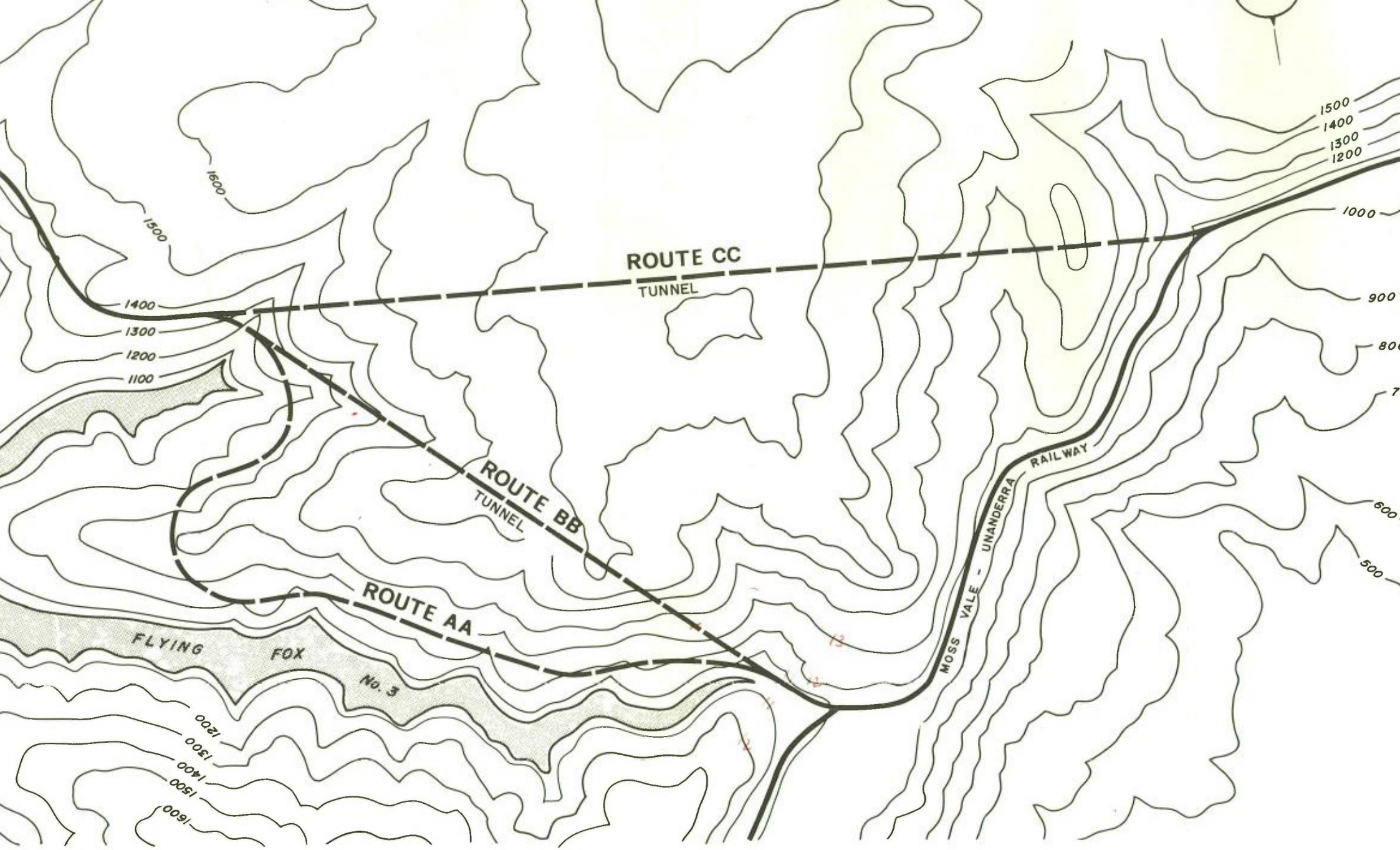
Through the Catchment Area the most suitable route basically follows along the plateau area already occupied by Fire Roads No.6A and 6B. The eastern portal is located unobtrusively in the re-entrant in the Escarpment face with suitable geological conditions for portal construction.


MOUNT KEIRA ROAD
ABANDONED LANDING GROUND
FIRE ROAD 6
LAKE CORDEAUX
CORDEAUX RIVER CROSSING
FIRE ROAD 6B
CORDEAUX RIVER
AVON RIVER
CORDEAUX PASSING LOOP
WONGAWILLA CREEK
DONALDS CASTLE CREEK
FIRE ROAD 6A
AVON PASSING LOOP
DOG TRAP CREEK
EASTERN PORTAL
WESTERN PORTAL
FIRE ROAD 6H
FIRE ROAD 6G



NOTE : SEE LANDHOLDERS NEXT PAGE

STATE RAIL AU



STATE RAIL AUT

The alternatives considered for the route from the Main Southern Line to Wilton either involve an underpass at the F5 Freeway or a bridge.

5.2.1 MALDON TO CATCHMENT AREA

Three basic alternative routes, shown as A, B & C in Figure 5-2 were investigated in this area. Details of the routes and the environmental considerations are provided in Appendix A.

All routes would create some visual impact and noise in the general area. Route B effects fewer residences and has little effect on the township of Wilton. It passes under the F5 Freeway, the Old Wilton Road and Trunk Road 95 and proceeds from that point in a cutting to the other side of Thorntons Hill and away from Wilton. It passes close to the northwestern end of Janderra Lane and will cross that road by means of an overpass or underpass.

All routes will disrupt local drainage patterns and require major bridges over the Nepean and Cordeaux Rivers. Route A and Route C cause disruption to catchment areas of seven dams, whereas Route B only effects three. Route A will directly effect three dams, Route C, five and Route B, only one dam.

Route B affects fewer properties and of those affected that are used for agricultural purposes, subdivision should not significantly disrupt grazing activity or management.

The ruling grade against loaded coal trains going to Port Kembla is 1 in 70 (1.43%). This grade was chosen to equal the steepest grade between Sydney and Maldon. Route B is the only one of the three to permit this grade to be economically achieved. Routes A and C permit a steeper than 1 in 60 grade (1.67%).

All routes are consistent with current local planning. However Routes B and C, because they are located further away from Wilton township, would place less restriction on future development of the township. They are also more in accord with the attitudes and wishes of the town residents.

Appendix I discusses these residents attitudes. During the process of meetings, interviews and consultations undertaken

for the study, the major concern expressed by townspeople was the proximity of the proposed line to Wilton. Route A would pass within less than one kilometer of the town. People were concerned about the loss of amenity this would cause, increased noise levels and reduced property values. They were strongly opposed to this option and expressed preference for routes located to the south of Thorntons Hill.

On this basis and in conjunction with engineering and economic studies, Route B was selected as the preferred route.

Three alternative tunnel routes were examined for the proposed rail route near the Avon reservoir. These are shown in Figure 5-3.

The first route examined was Route AA, which generally follows the contours in the area. For about 1.5 km, the route lies between 70 and 150 metres from the foreshore of Lake Avon.

The terrain is all sidling country with average cross slopes of about 2 to 1 with sections of up to 1 to 1 and steeper. Railway construction would consequently need to be mostly in-cut and it would be virtually impossible to achieve this without significant destruction of the adjacent vegetation, resulting in erosion and the movement of material into the adjacent dam.

The second alternative considered is Route BB which avoids the sidling terrain by a tunnel 1.7 km long. It is 0.9 km shorter than Route AA and minimises the problems associated with the steep slopes, vegetation removal and potential erosion.

Both Routes AA and BB join the Moss Vale - Unanderra Line near the 100 km point. The line at that location passes through difficult terrain and duplication is judged not to be feasible.

To overcome this constraint, it is necessary to locate the junction of the new line with the Moss Vale - Unanderra Line at a point where duplication is possible. Route C meets this requirement joining the Moss Vale Line 0.8 km from Dombarton. Duplication of the track to Unanderra is feasible from this point.

Route CC passes through a tunnel of 3.5 km. The tunnel presents no serious engineering problems nor any environmental difficulties. It was selected as the preferred option.

Alternative routes from the ridgeline to the western tunnel portal were also examined.

A final route was selected which is set back as far as possible from the Avon Dam shoreline. It passes through three cuttings/tunnel before entering the tunnel. The tunnel portal is located to minimise damage to rainforest. Two wetlands areas are partially traversed. The line will be constructed over culverts at these locations to ensure continued drainage flow to and through the wetland areas. Some fill will be necessary but this will be minimised. This matter is discussed further in Appendix E.

5.3 DESIGN

The line will be constructed with continuous welded rail on concrete sleepers. It will be constructed by modern engineering methods and in accordance with accepted design criteria. These criteria are summarised in Appendix A.

5.3.1 ELECTRIFICATION

The new railway line will be electrified. The system is illustrated in Figure 5-4 and is described in Appendix A. No decision has been made on the voltage or type of current. It will be either 1,500 V d.c. to suit the existing network or 25 KN a.c. Studies are being conducted on this option.

The advantages of the electrification of the complete railway from Maldon to Port Kembla including the Main Southern Railway between Glenlee and Maldon Junction are as follows:

- completes the electrification network between the Main Southern Railway and the Illawarra Line to allow through-running of electric locomotives;

- allows through-running of electric-hauled coal trains from Lithgow to Port Kembla via Maldon without the need for changing to diesel traction at Enfield or Campbelltown;

A locomotive exchange in the Campbelltown area would require exchange sidings, staff to operate it and tie-up of locomoties waiting for trains.

Exchanging locomotives at Endfield would mean diesel traction running under electric overhead wires from Endfield to Glenlee.

Also, noise levels from the diesel locomotive would be greater than the electric locomotive through the south western suburbs;

- electric locomotives are presently being built to haul coal to Port Kembla;

- electric locomotives are more environmentally acceptable due to quieter and cleaner operating. These locomotives are also more energy efficient.

The SRA has been allocated supply from the State Electricity Commission at two points - one at Glenlee and one at Port Kembla.

From Glenlee, the aerial supply lines will follow existing lines from the Electricity Commission sub-station at Glenlee overland to Glenlee Junction. From there, the supply aerials will generally follow the boundary of the proposed and existing railway reserves. Cable will be used through the tunnel. Aerials will be supported by single poles and no metal towers will be required.

Sub-stations will be located at 4 to 5 km intervals for the d.c. system. The exact location depends on detailed design.

Figure 5-5 indicates the general appearance of the sub-station. Figure 5-6 illustrates typical mast design. Distance between masts varies depending on the route and terrain. However, in general masts are located 30 - 40 metres apart.

Access is required to the electrificiation system for construction, maintenance and repair/replacement.

General construction access is similar to that required for line construction and is outlined in Section 5.4. Maintenance of sub-stations will require access by four wheel

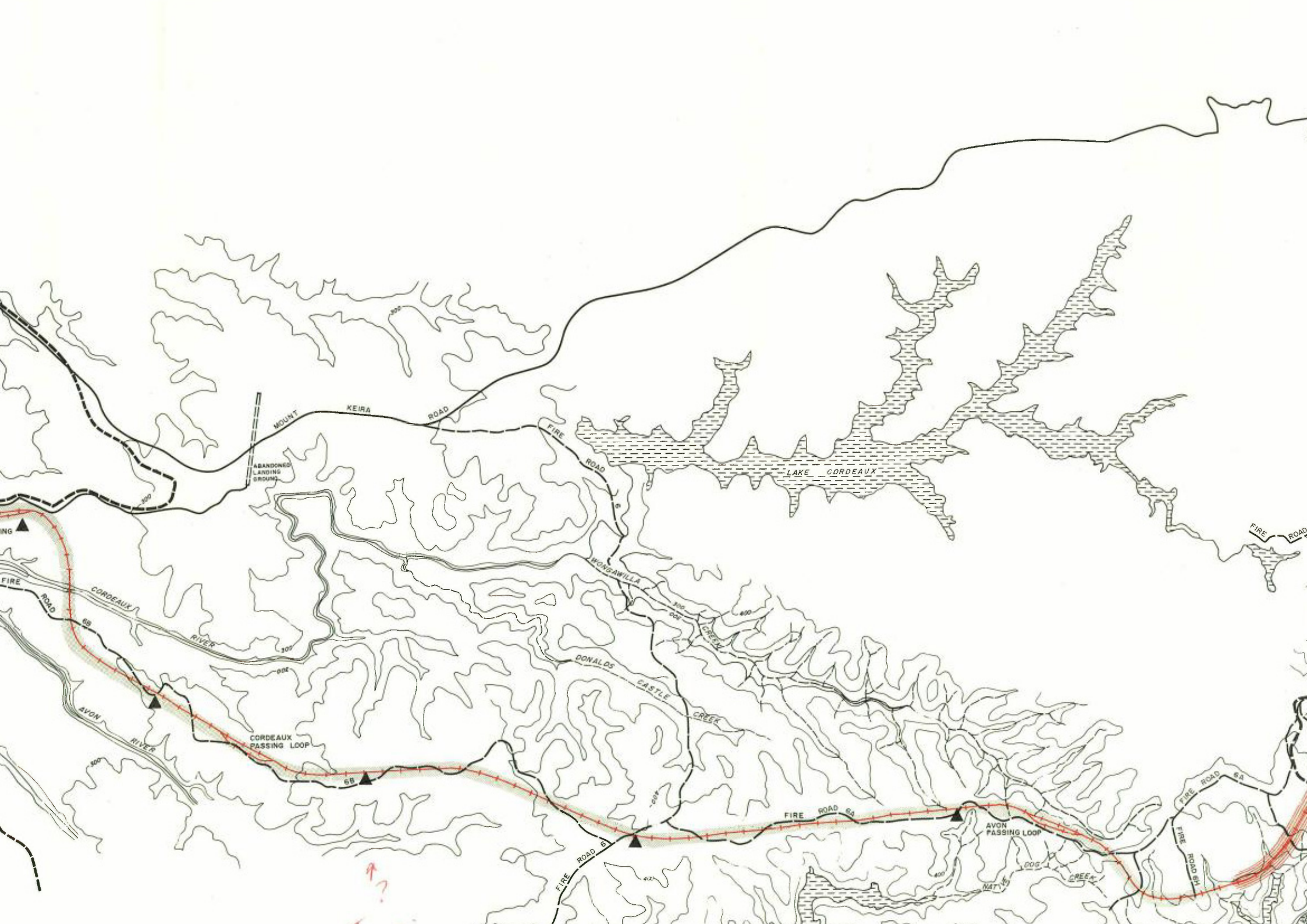
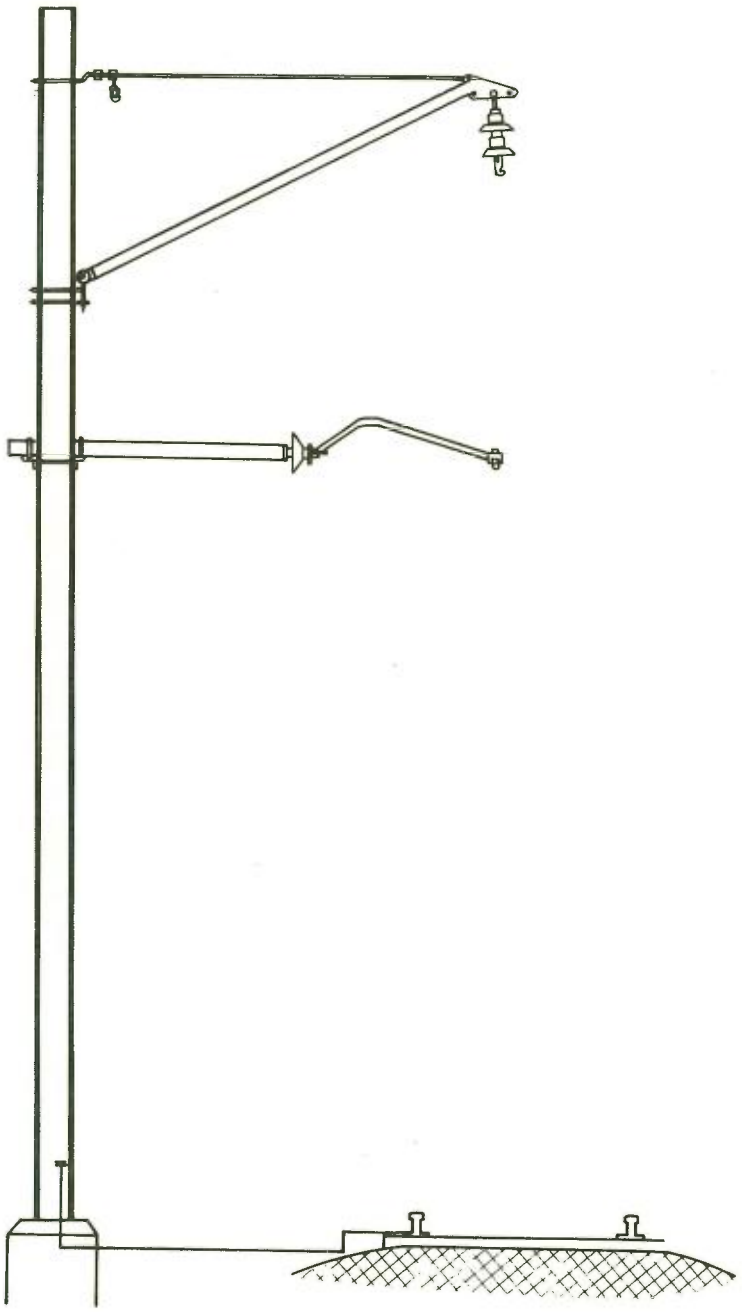

MOUNT KEIRA ROAD
ABANDONED LANDING GROUND
FIRE ROAD 6
LAKE CORDEAUX
FIRE ROAD
WONGAWILLA
DOG CREEK
CORDEAUX RIVER
FIRE ROAD 6B
DONALDS CASTLE CREEK
AVON RIVER
CORDEAUX PASSING LOOP
6B
FIRE ROAD 6A
AVON PASSING LOOP
FIRE ROAD 6H
NAT



FIGURE 5–5



STATE RAIL AUTHORITY		
TITLE : OVERHEAD WIRING - TYPICAL CROSS SECTION LOCATION : MALDOM - DOMBARTON ROUTE		FIGURE 5–6
SCALE		FILE No. : 09886-004-70 DATE : MAY 1983
REF. : SRA		Dames & Moore

drive or station wagon type vehicle. However, if the replacement of a transformer is required, a low loader and crane will have to be used.

5.3.2 CROSSINGS & STRUCTURES

The major crossings are the Nepean River Crossing, the Cordeaux River Crossing, the South Western Freeway (F5) underpass, the Trunk Road 95 and Wilton Road underpasses and other road crossings and the tunnels, which are described below. The detailed designs of these structures have not been finalized.

5.3.3 RIVER BRIDGES

Engineering and economic evaluation during detailed design will determine whether the bridges will be built of steel or concrete. Current trends suggest that concrete will be adopted, with batching either from established developments, e.g., Campbelltown or a plant on-site for the Nepean site. The Cordeaux site will probably require the establishment of an on-site batching plant. Specialised design consultants are about to be appointed to do these evaluations.

The Nepean River Crossing may be achieved by constructing a three span single cell prestressed box girder bridge. Pier heights will be about 50 metres. A plan of the bridge is provided in Figure 5-7.

A single span bridge is proposed for the Cordeaux River crossing supported by an arch. A plan of this bridge is shown in Figure 5-8. Further details of the bridges and their construction are provided in Appendix A.

Although preliminary investigations reveal no severe foundation problems at these sites, further studies are planned in the detailed investigation and design stages. Adequate safety provisions will be made for a small extent of subsidence due to the possible partial extraction of underlying recoverable coal and for earthquakes.

5.3.4 ROAD CROSSINGS

A cut and cover "cast in situ" concrete underpass (53 m long) is proposed at the crossing of the South Western Freeway (F5). It has the advantage of having a lesser visual impact than a bridge.

Construction will be staged to maintain continuity of vehicular through traffic on the Freeway.

Similar, although shorter, underpasses are proposed at Trunk Road 95 and Old Wilton Road. The line is in cuttings at these points and structure design is not complex.

5.3.5 TUNNELS

A tunnel was selected as the only acceptable means of establishing a railway connection over approximately 92 metres elevation difference at the steep and prominent Illawarra Escarpment.

The proposed tunnel is 3.5 km long and has over 100 metres of cover for much of its length. The western portal is located in the gully of Flying Fox No.1 Creek and the eastern portal in the valley of a small creek alongside the Moss Vale -Unanderra Railway, 0.8 km west of the Dombarton Crossing Loop.

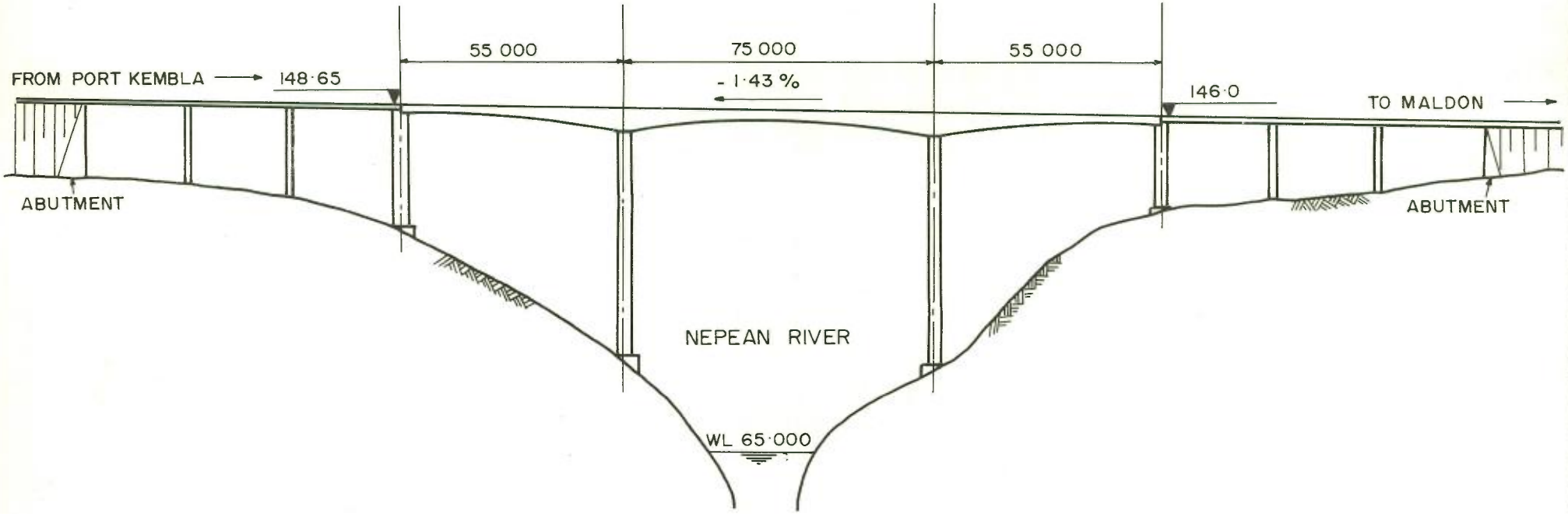
Because of the environmental sensitivity of major fills in Flying Fox Creek, due to the close proximity to the Avon Dam waters, the railway route and grading provides for minimial earthworks. A small structure to carry the rail over the creek with adequate water way opening will be provided.

The most likely tunnel construction method is by road-heading tunnelling machine excavating the tunnel by the heading and bench method with drill and blast back-up for dolerite dykes and the occasional strongly cemented sandstone. Allowance will be made in the tunnel design for the passage of the tunnel through ground subsidence associated with past mine workings.

The tunnel will be lined with pneumatically applied mortar and will have reinforced concrete portals. The bed of the tunnel will be track on concrete slab or flexible ballast trackwork on a concrete blinding layer.

The tunnel will be designed so as to reduce noise and air pressure effects on train crews.

During construction, the tunnel and approach cut areas at the portals will be adequately drained to a low point within the workings. This water will be pumped to a settlement area

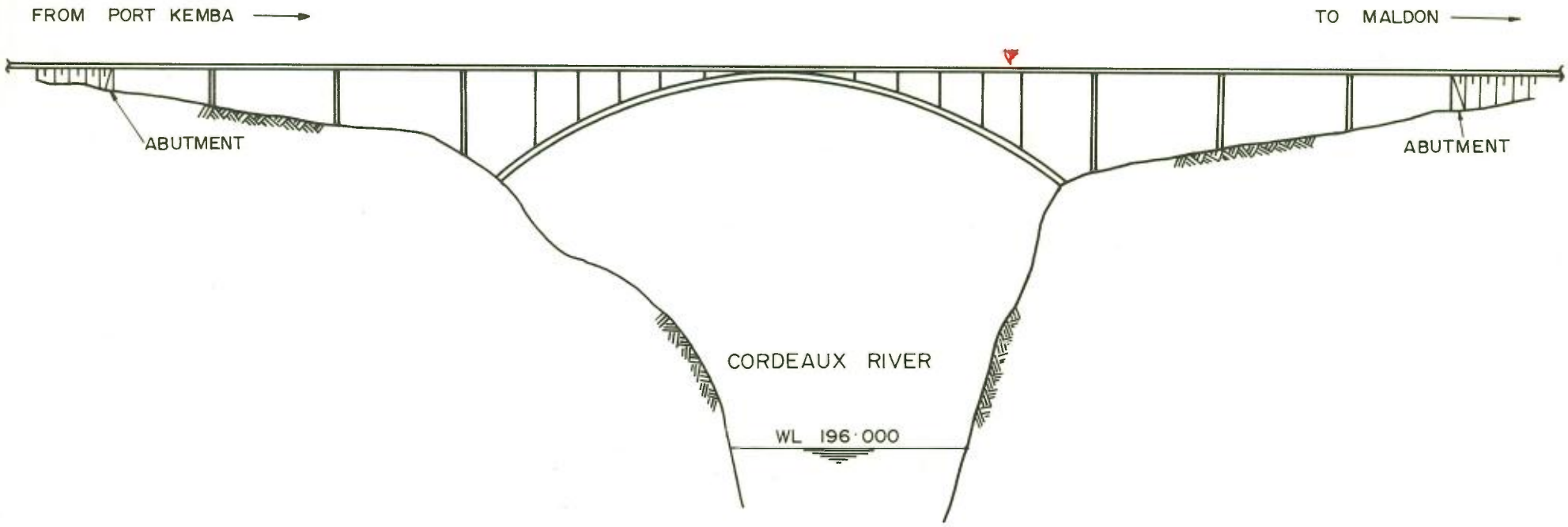


ELEVATION

SCALE 1:1000

STATE RAIL AUTHORITY

TITLE: NEPEAN RIVER BRIDGE CROSSING LOCATION: MALDON - DOMBARTON ROUTE	FIGURE 5–7
SCALE: AS SHOWN	JOB No: 09886-004-70 DATE: May , 1983
REF: S.R.A.	Dames & Moore



ELEVATION
SCALE 1:1000

STATE RAIL AUTHORITY

TITLE: CORDEAUX RIVER BRIDGE CROSSING LOCATION: MALDON-DOMBARTON ROUTE	FIGURE 5-8
SCALE: AS SHOWN	JOB No: 09886-004-70 DATE: May, 1983
REF: S.R.A.	Dames & Moore

from which clean water will be decanted. Runoff from surrounding areas will be diverted from those tunnel workings.

During detailed design a study of the ventilation needs of the tunnel will be undertaken.

5.3.6 EARTHWORKS

There are a series of large cuts located near the western portal. These are shown in Figure 5-9. There are several other large cuts and fills which have a height to 20 metres. However, along much of the route, earthworks do not require cuttings or embankments in excess of 15 metres.

5.3.7 TRACK STRUCTURE

The track structure comprises rails, sleepers, fastenings and crushed rock ballast. The typical structure is as shown in Figure 5-10 and illustrated in Figures 5-11 and 5-12.

Australian Standard rail will be used. The rails will be manufactured at Whyalla, South Australia and transported to the site by rail. They will be welded into 110 metre lengths at the SRA depot at Chullora and laid into standard gauge prior to being continuously welded.

The sleepers will be pre-stressed concrete manufactured off the site, probably in Demman, N.S.W. They will betransported by rail to a major stacking area in the Campbelltown - Douglas Park district or at Maldon Junction. This area will be about one hectare in size with a rail siding access. Rails will also be stored in this area. Both sleepers and rails will be loaded at this point onto wagons and transported by rail to the track laying machine on-site.

The ballast consists of crushed rock under and around the sleepers to distribute vertical and horizontal loads from the sleepers. This will be obtained from existing ballast quarries in the Moss Vale area where loading facilities exist and will be transported to the site by rail.

5.3.8 STATIONS AND SIDINGS

No railway passenger stations will be provided along the new line.

Passing loops will be provided at Maldon Junction, Wilton, Cordeaux, and Avon. The loops will be 650 metres clear in length. The route of the line has been planned to enable any future balloon loop from the proposed West Bellambi Colliery to be connected to the new line.

5.3.9 SIGNALLING SYSTEM

The signalling system for the proposed line and duplication section will be track - circuited automatic colour light signals and will form part of the SRA Centralised Traffic Control (CTC) Network.

The Network will be dual controlled. The Campbelltown Centre will control the working of trains between Campbelltown and Wilton. The Wollongong Centre will control the section from the exchange siding at Wilton to Port Kembla.

Power supply to signalling will be fed by two supply systems, a main and back-up.

Cables along both sections of the line will be located underground and will be installed concurrently with line construction.

5.3.10 FENCING

The proposed new railway line will be fenced except where special considerations apply. The line will not be fenced in the Catchment Area.

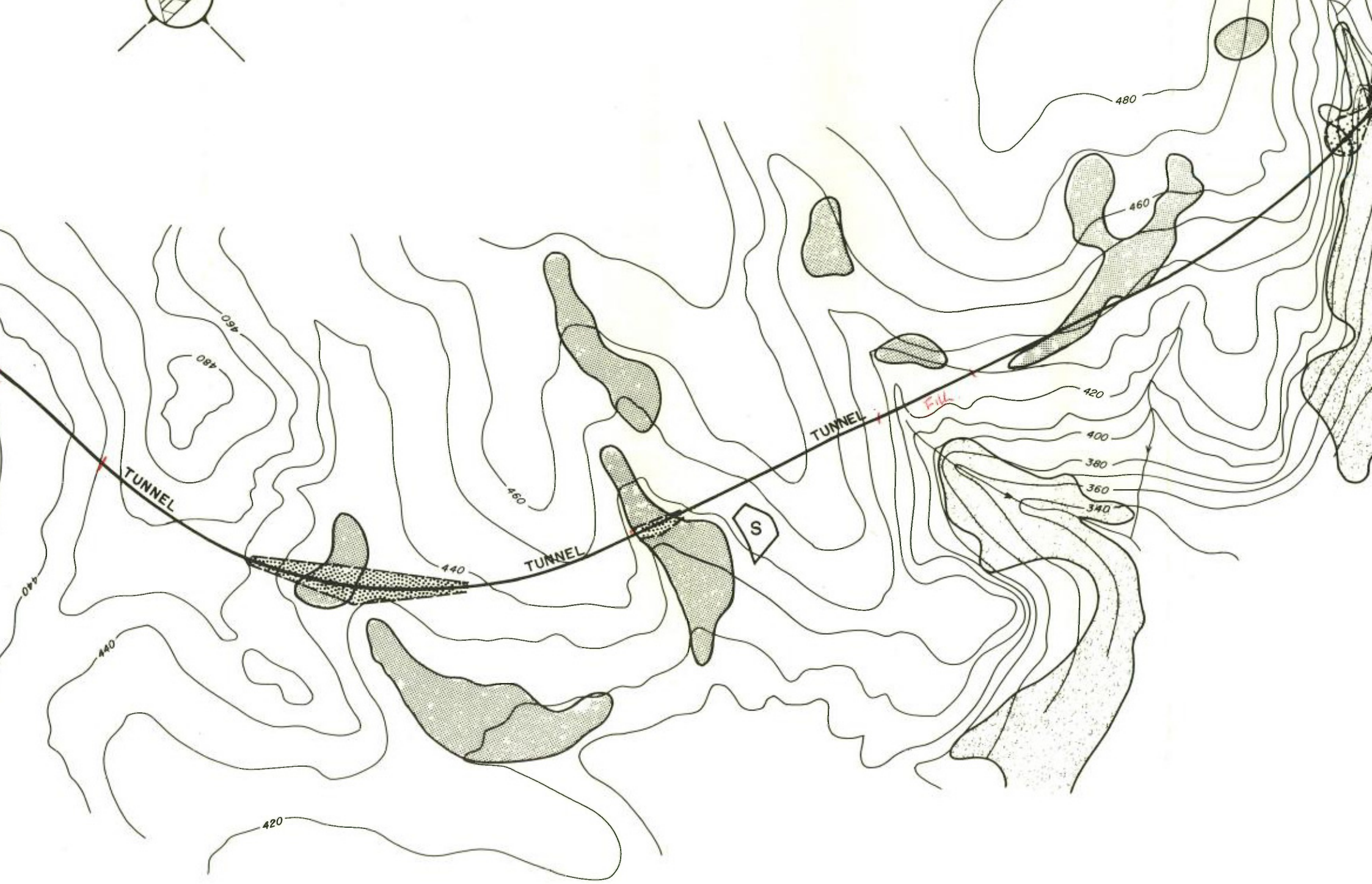
Permanent fencing will normally be at a standard to contain stock. Land users will be consulted prior to construction work commencing regarding fencing and gates for any level crossings.

5.4 RAILWAY CONSTRUCTION

5.4.1 SCHEDULE AND EMPLOYMENT

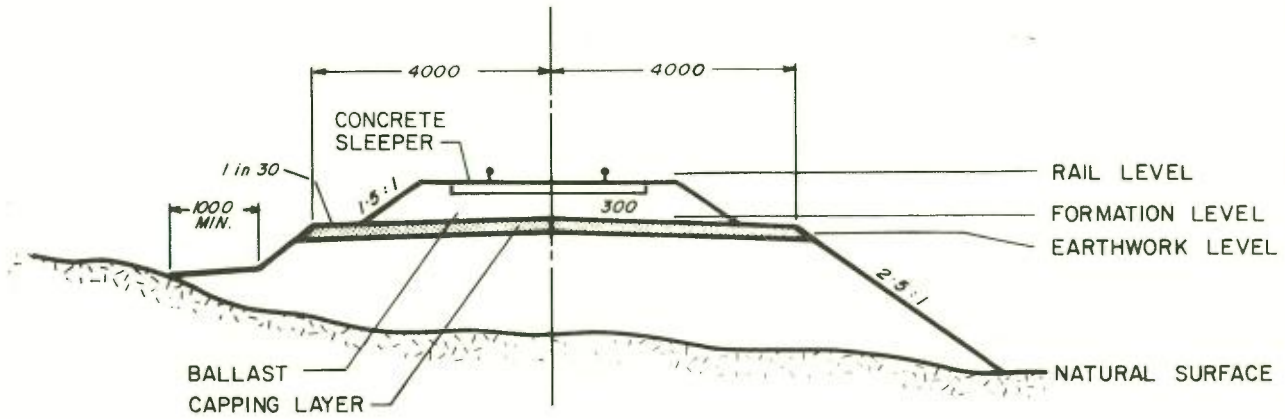
The construction programme as shown in Figure 5-13 indicates a desirable construction period of about 3 years.

Current planning allows for the design and construction of the total railway. This would enable a greater proportion of

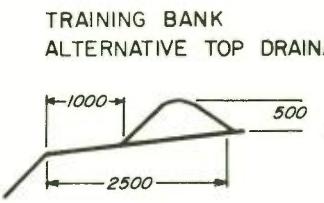


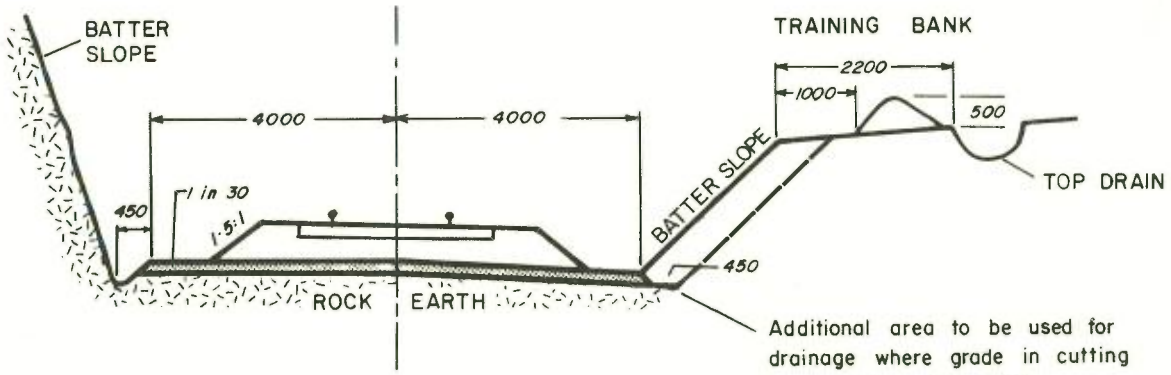
S SUBSTATION

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EMBANKMENT





CUTTING

NOTE : All dimensions are in millimetres unless other wise shown.

STATE RAIL AUTHORITY		
TITLE :	SINGLE TRACK - STANDARD SECTION	FIGURE 5–10
LOCATION :	MALDON - DOMBARTON ROUTE	
SCALE	0 — 5000mm	JOB No. : 09886-004-70
		DATE : MAY 1983
REF. :		



FIGURE 5–11

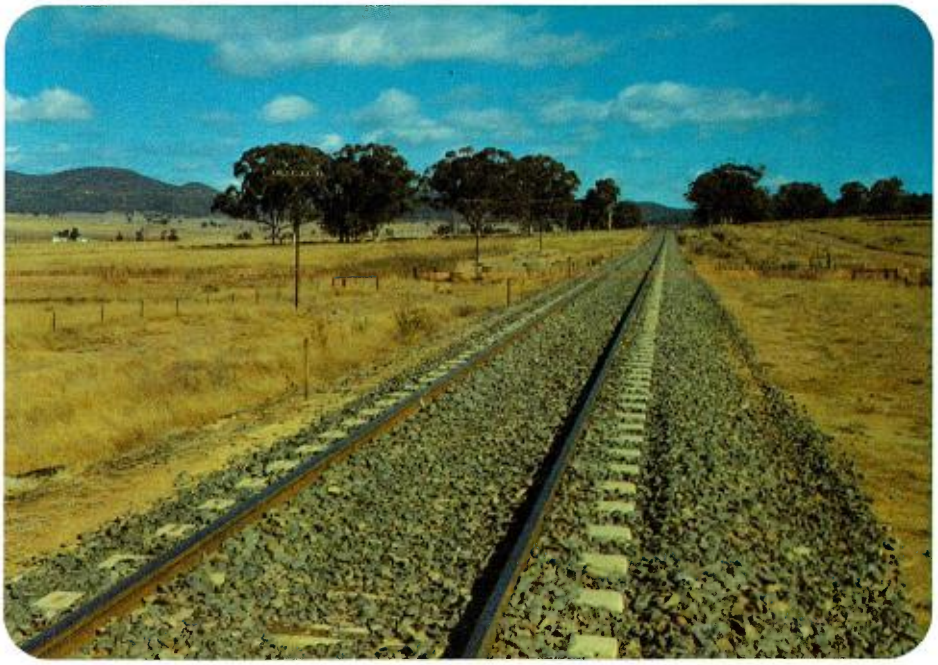
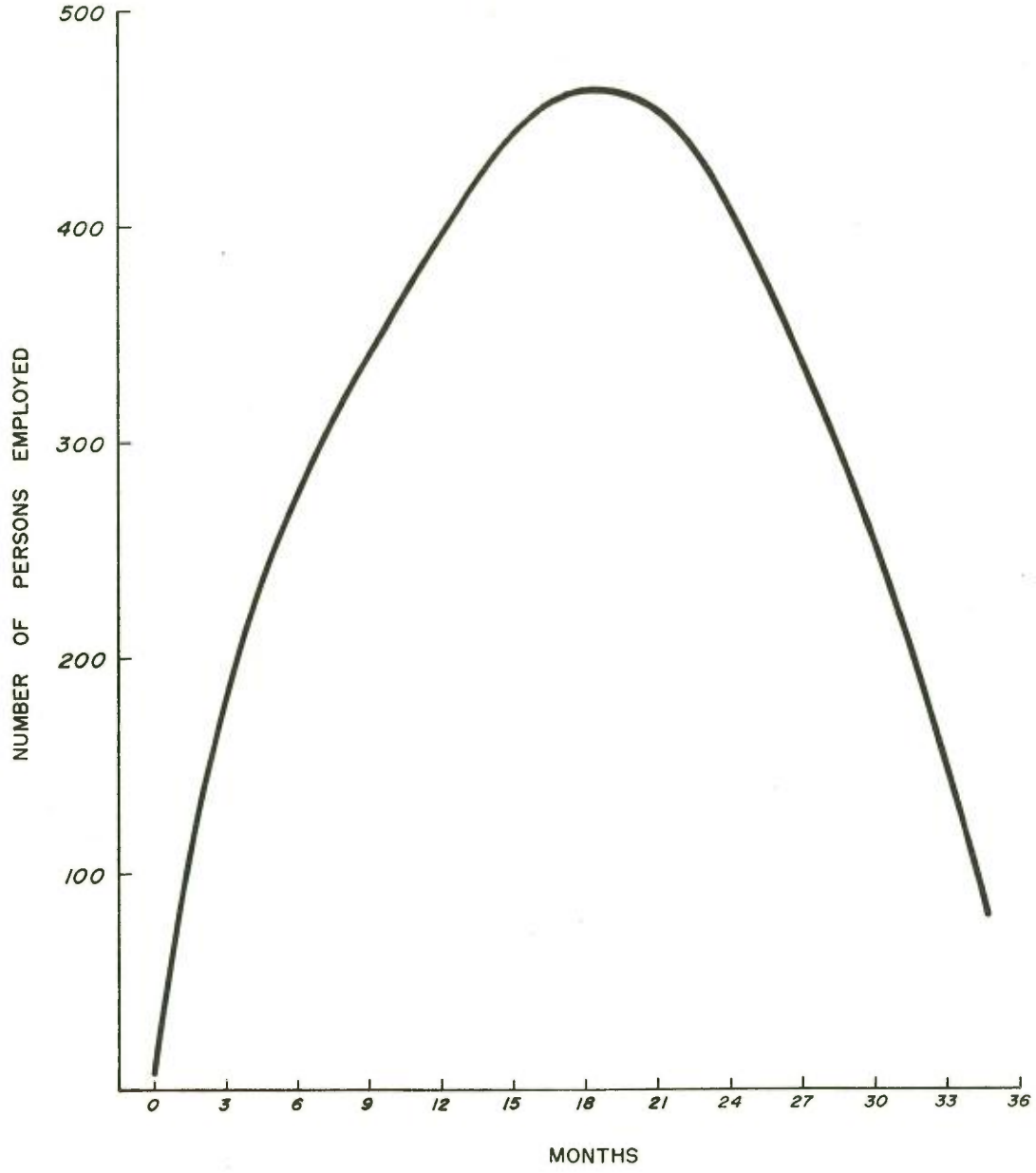


FIGURE 5–12



STATE RAIL AUTHORITY	
TITLE: ON-SITE CONSTRUCTION WORKFORCE LOCATION:	FIGURE 5-13
SCALE:	JOB No: 09886-004-70 DATE: September, 1983
REF: S.R.A.	**Dames & Moore**

western and southern coalfield coal to proceed by rail to the Coal Loader.

To get the greatest benefits from construction funds, preliminary planning indicates that the project should be constructed and commissioned in the following stages:

- single line construction from West Bellambi to Dombarton,

- Maldon to West Bellambi plus duplication of the Dombarton to Port Kembla section of railway. This will complete the project and allow for re-routing of western coalfields coal and enable Tahmoor coal to be railed to Port Kembla.

Figure 5-13 sets out approximate employment levels during this construction period. It is anticipated that construction workers will be drawn from local areas, Campbelltown and Wollongong.

Construction operations will not require the erection and maintenance of construction camps for living quarters. Most of the construction workforce will come from nearby areas or will be able to reside in nearby urban areas.

However, contractor's working and storage areas will be required along the route. These will be fenced and catch drains provided to intercept dirty run-off water. The location of these areas will be decided in consultation with local landholders and other appropriate Authorities.

Once contractors have become active in the Catchment Area and adjacent to the State Recreation Area near Dombarton, controlled access points will be established to each site.

The SRA will retain an environmental control officer on the project management team to ensure that environmental management is effective throughout the duration of the railway design and construction.

During the construction of the railway, the SRA will maintain constant supervision of the works undertaken by the construction contractors.

5.4.2 CLEARING

All large vegetation, stumps, logs, and property improvements within the 40 metre railway easement will be removed. Substantial trees which do not effect driver visibility or could not fall onto the lines can be left. Any of this material which is combustible will be removed to disposal areas and burnt. Smaller material can be used as mulch. Further details are provided in Appendix A.

Alternatively, where appropriate, timber will be cut into reasonable lengths and stacked neatly for future use by the MWS&DB in the picnic area fire places. Foliage and unusable timber would be reduced to ashes by burning, with excess matter being removed to a tip. Vegetation outside the Catchment Area will be burnt and excess disposed of at the local tips.

Topsoil along the route will normally be stripped to a line about three metres outside the toes of the embankments or tops of cuttings. It will be retained and used for rehabilitation of disturbed areas.

5.4.3 BRIDGES

Detailed engineering design for the major bridges and crossings have not been completed at this time. Consequently a detailed outline of the construction activities associated with these works cannot be provided.

The SRA do not envisage any major disruption to existing traffic flows during construction of bridges and crossings.

5.4.4 EARTHWORKS

To maintain the required design gradients along the railway route, a considerable amount of earthwork must be conducted in the form of cut and fill. Heavy earth moving equipment will be used for this purpose. As far as practicable, this equipment will be restricted to the route during the construction period. Details of proposed earthworks are provided in Appendix A.

Excavating techniques used will be suited to the geological formation being excavated. The Sydney Water Supply Tunnel which crosses under the proposed line in the Wilton area

is an inclined rock tunnel and is sensitive to blasting. No blasting will be undertaken in the vicinity of this tunnel.

No blasting will be undertaken in the Wilton area or in the vicinity of houses except for minor "popping" of any floating boulders encountered.

Excavated material from the cuttings and tunnel will be used as fill for embankments. The excess material will be placed on embankment batters to flatten their angle and so reduce the erosion potential.

During the detail design phase, refinements in earthworks will occur to achieve a balance in the earthworks, with the railway cuts and fills being balanced economically where possible.

Details of spoil and borrow areas have been defined in the MWS&DB Area where balances in adjacent earthworks cut/fills is not possible due to the design ruling grade. Between Maldon and the Cordeaux River Crossing, cut and fill areas will, if possible, be adjusted in width to ensure balance. The details of the balance at this stage are however not available, as they will be dependent on detailed designs. A preliminary evaluation is given in Appendix A.

Excavated material from the tunnel is required to be disposed of from both ends of the tunnel. It is proposed to fill some areas of SRA land around the Dombarton Loop with excavated material.

The cut and fill balance and the requirement for disposal of material from the tunnel within the MWS&DB Catchment Area indicates there will be surplus fill near the tunnel portal and a deficit at the Wilton end. Material will be transported to minimise the need for borrow areas and spoil disposal areas. Areas, indicated in Figure 5-14 have been identified for the location of spoil disposal and possible borrow areas.

The new track will be constructed by a mechanised track-laying procedure based on large machines handling rails, sleepers and fastenings. The work will be carried out only during daytime. Rails and sleepers are loaded onto the track laying machines directly from rail wagons positioned on

the recently laid line behind the laying machine. These wagons will have transported the rails from the major stacking area at Campbelltown - Douglas Park, described in Section 5.3.7.

5.4.5 DRAINAGE AND EROSION CONTROL

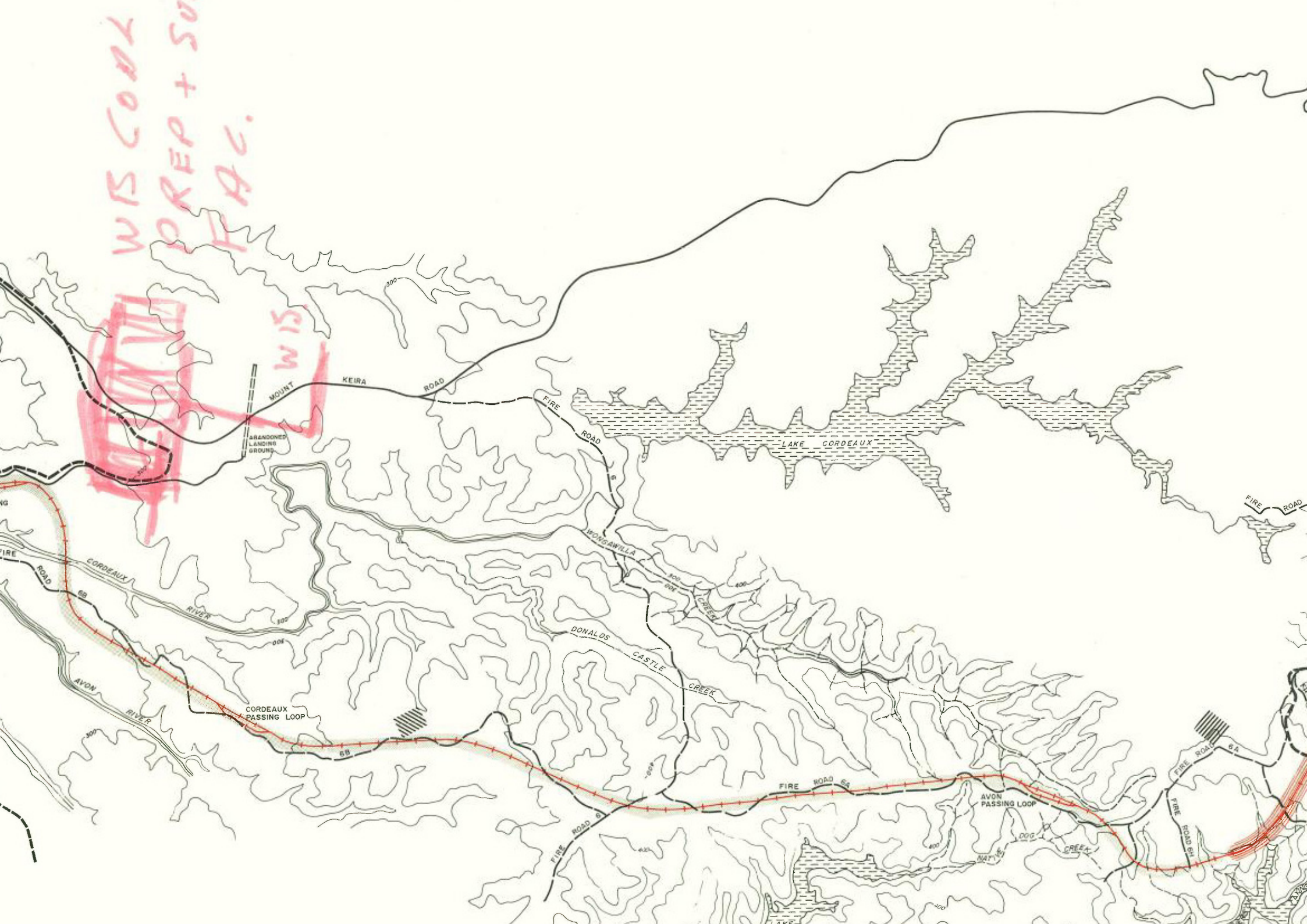
Construction and operation of the proposed railway must be within the requirements regarding water quality of the SPCC and MWS&DB. Consultations have been held with officials of both organisations concerning these requirements. The environmental control officer on the project management team will be required to liaise with the civil design team and relevant Authorities to ensure that drainage and erosion control are to acceptable environmental criteria and standards. The Soil Conservation Service will be consulted in respect to soil erosion control.

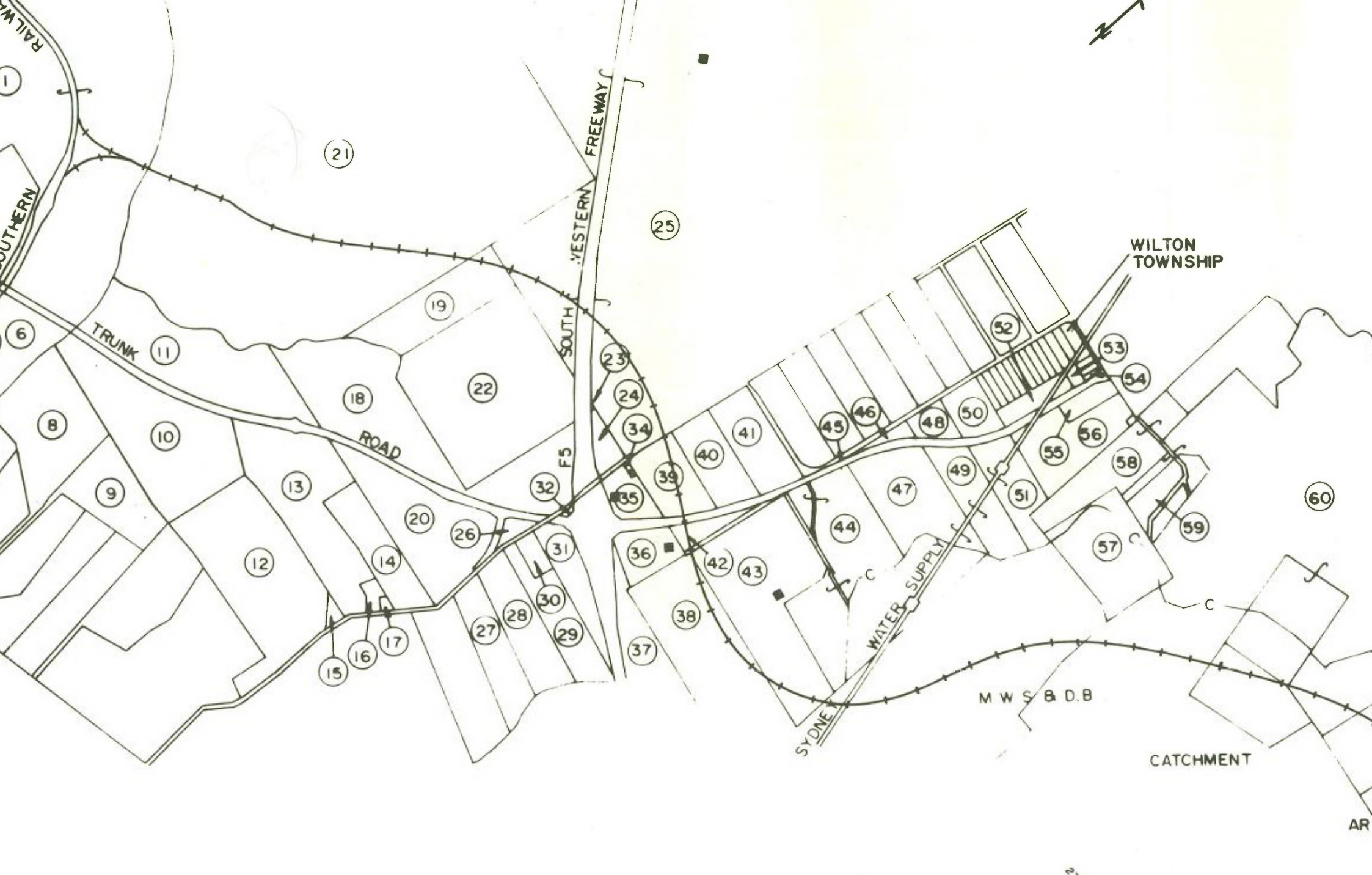
Throughout the entire works, a drainage system will be established which at all times will drain water directly off or keep water away from all disturbed areas. Areas once cleared of vegetation will be susceptible to erosion. Erosion control measures and drainage diversion will be implemented at the commencement of clearing to minimise soil movement.

Apart from provision of adequate drainage to channel water away from exposed earth, soil erosion measures will also include grassing of all earth-faced embankments and cuttings, and all major earth drains and levee banks. Details of the proposed measures are discussed in Appendix A.

Within the MWS&DB boundary, the SRA will examine the feasibility of using native grasses and plants to vegetate the exposed earth in order the eliminate the introduction of exotic species into the large area of predominantly natural habitat. No mulch material will be introduced into the area which could contain weeds or exotic plant species. Small native vegetation cleared from the area before construction will be used as mulch.

The land in the Maldon to Wilton area remaining within the 40 metre railway line easement not taken up by the formation or batters will be cleared to serve as a firebreak, as there is a very slight fire risk caused by sparks from the locomotive and wagon brakes.


MOUNT KEIRA ROAD
ABANDONED LANDING GROUND
FIRE ROAD 5
LAKE CORDEAUX
FIRE ROAD
WONGAWILLA CREEK
CORDEAUX RIVER
FIRE ROAD 6B
DONALDS CASTLE CREEK
AVON RIVER
CORDEAUX PASSING LOOP
FIRE ROAD 6A
AVON PASSING LOOP
DOG CREEK
300
400
500


RAIL WAY
SOUTHERN
FREEWAY
SOUTH WESTERN
TRUNK
ROAD
F5
WILTON TOWNSHIP
WATER SUPPLY
SYDNEY
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In the Catchment Area, the extent of clearing will be determined in consultation with the MWS&DB.

Further details are provided in Appendices A and B.

5.4.6 CAPPING AND BALLASTING

After finishing the cut and fill to the required profile and establishment of the formation to the specified grade, a natural or processed gravel capping will be placed on the formation. If suitable capping material cannot be gained from the cutting and tunnelling works, it will be obtained from readily-available commercial sources.

Ballast material will be placed over the capping into which concrete sleepers will be laid.

5.4.7 TUNNELLING

Tunnel construction is envisaged as being driven from the western portal for half the tunnel, the other half driven from the eastern portal in conjunction with trackbed being placed in the western half first. After holing through, trackbed construction would continue into the eastern half of tunnel.

5.4.8 ACCESS ROADS

All-weather access roads to all parts of the route from public roads will be established for both railway line construction and maintenance purposes. Their routes have not yet been finally determined but will be in accordance with the requirements of relevant Authorities.

Within the Catchment Area construction access will be obtained from existing roads and fire trails. These will be upgraded to enable use by heavy equipment. Where roads have been relocated because of construction activity, alternative access will be provided.

New access roads will be required to the Cordeaux River Crossing and the area around the Western Tunnel Portal. Access during construction from the west will be via the Wongawilli Colliery Ventilation Shaft access road and then a short new track generally following grades of less than 10%

to the western portal. Establishment areas would be provided on flat ground near the portal.

Access to the portal at Flying Fox No.1 Creek will be by means of a track extending from the existing tracks under the high voltage power lines to the Avon Pump Station at a grade of about 1 in 8 to the portal area.

If necessary, permission will be sought from landowners to use private roads and tracks to gain access to the construction site.

5.4.9 VIBRATION

During construction, where blasting occurs, seismic monitoring of vibration will be undertaken to keep vibrations at a safe level to avoid architectural and structural damage to nearby cottages and houses. A series of trial charges will establish the maximum level of vibration in a particular location and thus the maximum level of blasting that can occur. Blasting will not occur outside normal daylight working hours.

5.4.10 RELATIONS WITH ADJOINING LAND USERS

During construction of the proposed railway line every effort will be made to avoid causing inconvenience to land users through whose land the line will pass. Construction activities will not conflict with the normal activities of land users adjoining the line. Private rail crossings will be installed where required to permit safe crossing of the site.

Every effort will be taken to prevent pollution of waterways, dams and grass areas, which may in turn affect stock.

5.4.11 LAND ACQUISITION

It will be necessary to acquire land in the Maldon - Wilton area to provide an easement for, and access to, the proposed new railway line.

Figure 5-15 shows property boundaries in the Maldon - Wilton area. Table 5.1 lists property locations of those affected by the preferred route.

Land acquisition cannot take place until approval is granted to construct the line. Acquisition is generally through an offer to purchase and negotiation on price. However, the SRA does have the authority to proceed with resumption where necessary under the Public Works Act. In this case the landholder claims for compensation.

Through the MWS&DB Catchment Area the land on the route will probably be a reservation or easement subject to Board conditions.

A Schedule of Conditions Applicable to The Construction, Operation and Maintenance of Railway Lines on Catchment Areas has been prepared by the MWS&DB. A copy of this Schedule is included as Appendix K.

5.5 RAILWAY OPERATIONS

Enabling legislation in respect to the railway is currently being prepared. The construction programme is expected to commence in December 1983 for completion about 3 years later, subject to satisfactory funding arrangements.

5.5.1 CAPACITY

The capacity of the proposed new railway is based upon its designation as a single link with passing loops. The single line section, Maldon to Dombarton has a capacity for 24 trains per day in each direction but this track capacity will not be reached until after the year 1990. Of these, seven will come from the Tahmoor - Bargo coalfields. Trains will operate during the day and night.

On current projections, the number of coal trains using the Maldon Port Kembla Railway, pre 1991 will average eight or nine trains per day in each direction, giving a total haulage of 6 to 6 1/2 million tonnes/annum.

Of these coal trains, one or two would load at West Bellambi (if operating) with a further one or two from Tahmoor and the remainder from the Burragorang and western coal fields.

As well as coal trains, the section from Dombarton to Unanderra would carry the trains proceeding to and from Moss Vale.

TABLE 5.1

LIST OF LANDHOLDERS : MALDON TO WILTON

LOT NO.	OWNER
1	J NIXON
2	G & A DI FALCO
3	COMMONWEALTH PORTLAND CEMENT CO LTD
4	INGHAMS ENTERPRISES PTY LTD
5	INGHAMS ENTERPRISES PTY LTD
6	INGHAMS ENTERPRISES PTY LTD
7	INGHAMS ENTERPRISES PTY LTD
8	T & P BRAGG
9	H R HOARE PTY LTD
10	H R HOARE PTY LTD
11	CORFARMS PTY LTD
12	H & M MATHIE
13	W & D NOLAN
14	G & W SMITH
15	W & D NOLAN
16	W & D NOLAN
17	W & D NOLAN
18	DALBAR PTY LTD
19	DALBAR PTY LTD
20	DALBAR PTY LTD
21	CORFARMS PTY LTD
22	DALBAR PTY LTD
23	DALBAR PTY LTD
24	DALBAR PTY LTD
25	NILOC PTY LTD
26	DALBAR PTY LTD
27	J DUGAN
28	J DUGAN
29	D & T DAVIS
30	
31	E & C PIPER
32	COMMISSIONER FOR MAIN ROADS
34	J & L ATKINS
35	R & L BOTLON
36	L & M ATKINS
37	COMMISSIONER FOR MAIN ROADS
38	D & B BURGE
39	L & B BIGGS
40	M & C MCCARTHY
41	J & L SHEIL
42	COMMISSIONER FOR MAIN ROADS
43	B BURGE
44	L BANKS
45	COMMISSIONER FOR MAIN ROADS
46	V BOON
47	B & R AUSTEN
48	W LITTLE

TABLE 5.1 (cont)

LOT NO.	OWNER
49	B & R AUSTEN
50	V & E STONE
51	L & R ASHBOLT PTY LTD
52	B & R MALVERN
53	R STROBEL
54	R STROBEL
55	S & K SON
56	PITT SON & BADGERY
57	MWS AND DB
58	PITT SON & BADGERY
59	PITT SON & BADGERY
60	PITT SON & BADGERY
61	PITT SON & BADGERY
62	N & D DEVELOPMENTS PTY TLD
63	N & D DEVELOPMENTS PTY LTD
64	D JOHNSON
65	H & H THOROUGHGOOD
66	L & D LAWSON
67	D YOUMAN, A SIMPSON, J LANG

Coal trains will be comprised of 31 x 100 tonne gross (CHS) wagons hauled by two or three locomotives depending on the type. The total length will comprise about 610 metres.

The new line from Maldon Junction to Dombarton and the two tracks from Dombarton to Port Kembla will be electrified. The existing Main Southern Line from Glenlee to Maldon Junction will also be electrified to match in.

Until electrification is extended south from Maldon Junction, trains from Tahmoor, Bargo and any from Moss Vale using the new line will be hauled by diesel-electric locomotive to Port Kembla.

5.5.2 TRAIN OPERATIONS

Coal trains will be powered by two or three main line locomotives. They will be either diesel/electric or electric depending on origin.

No additional rolling stock will be purchased for the line. The locomotive fleet, both present and future, will be used as required.

Locomotives will be equipped with two braking systems, each individually capable of stopping the train. Further details of the braking system can be found in Appendix A.

The SRA's standing instructions on train braking will apply to this line to ensure safe train operations.

5.5.3 MAINTENANCE

Preventative maintenance of rolling stock will be undertaken at Port Kembla. Other maintenance will be carried out at Lithgow or Enfield depending on the type of work required. No expansion of existing facilities will be required.

As the line is constructed of concrete sleepers, minimum track maintenance will be required. There will be a track maintenance staff of about six employed and based at Unanderra. Longer frequency maintenance will take place at two and four year intervals. The SRA will maintain the boundary fencing and access gates on either side of the line where constructed.

5.5.4 VIBRATION

During the operational phase of the railway, it is not expected that any structural or architectural damage will occur to houses adjacent to the railway.

Measurements of ground vibration resulting from the passage of coal trains of similar size to those proposed have been made at distances of 10 and 22 metres from the line, at sites geologically similar to areas adjacent to the proposed line.

On the basis of these measurements, it is expected that ground vibrations will be below the threshold of perception even at the closest residences and well below levels used by the SPCC to protect sensitive buildings.

Higher levels are experienced by houses in the Sydney metropolitan area adjacent to operating railway lines, without significant effects. Homes in the Maldon to Wilton area are situated further from the line.

Trees can be grown along the railway easement at selected locations, to reduce vibration during train operations. Tree roots reduce ground vibration and the rest of the tree reduces air vibrations.

5.5.5 VEGETATION CONTROL

As part of safety requirements and action taken to minimise bushfire risk, vegetation is controlled adjacent to railway lines. The provision of clear vision and an uninterupted line of sight for the locomotive driver is of prime concern.

Vegetation is controlled chiefly by chemical treatment. An annual control programme will be implemented once construction of the line has been completed. Only chemicals approved by the MWS&DB will be used in or on land adjacent to the Catchment Area. Noxious weed control will be undertaken as appropriate.

5.5.6 BUSHFIRE CONTROL

Fire hazard reduction in or adjacent to urban areas is generally achieved by mowing and cutting vegetation. In rural areas controlled burning-off is the most common practice.

Burning-off practices are carried out in accordance with the Bush Fire Act 1949. Fire control and prevention measures will be developed and implemented in association with local landholders, bushfire Authorities and the MWS&DB.

Sufficient suitable fire fighting equipment will be kept on the site ready for use at all times. Any fire bans will be strictly observed.

In the MWS&DB Catchment Area, existing fire trails will be maintained or replaced. Level crossings will be constructed at appropriate intervals to enable access to both sides of the line. This will be undertaken in consultation with the MWS&DB.

6.0 EXISTING ENVIRONMENT

6.1 GEOLOGY

This section summarises those aspects of geology relevant to the environmental assessment of the proposed development. Details are contained in Appendix B.

6.1.1 STRATIGRAPHY

The generalised geology of the region in which the proposed new railway line is located has been mapped by the Department of Mineral Resources. A generalised stratigraphic sequence is presented in Figure 6-1.

The proposed railway line is located within the southern part of the Sydney Basin. The dominant surface lithology is sandstone of the Hawkesbury Sandstone Formation. Overlying the Hawkesbury Sandstone and capping the crests of hills are the shales and minor siltstones of the Wianamatta Group. Underlying the Hawkesbury Sandstone are the shales, claystones and sandstones of the Narrabeen Group. Underlying this Group are the Illawarra Coal Measures which consist of sandstones, shales and coal seams.

6.1.2 STRUCTURE

Structural interpretation based on drilling results and on the distribution of the Wianamatta Group sediments indicated that the regional bedding of the sedimentary strata of the plateau is relatively uniform, and dips towards the north-northwest with an average dip of two degrees (2°).

Along the Illawarra Escarpment several large and numerous small faults and folds have been identified, both along and at right angles to the escarpment. Two basic dykes within the Wongawilli Seam (1.2 m and 0.9 m wide respectively) cross the tunnel alignment.

6.1.3 SEISMICITY

Although the southern margin of the Sydney Basin over which the proposed railway line will pass is recognised as being one of two areas of high seismic activity within N.S.W., the order of magnitude and frequency of occurrence of earthquake activity is low when compared to other parts of the world with high seismicity. Two earthquakes of signficance have been recorded in relatively close proximity to the proposed

section missed out

This does not make sense

slope and moderate relief (10.2 metres), underlain by Ashfield shale. Further details are described in Appendix B.

6.1.4 DOMBARTON TUNNEL

The proposed alignment passes under the Illawarra Range by means of the Dombarton Tunnel which for much of its length has over 100 metres of cover.

? Bulgo Stanwell Park Claystone

The western portal site is near the bottom of a V-shaped valley with numerous sandstone outcrops.

The eastern portal site is in a vertical face of Scarborough Sandstone beside a small creek alongside the Moss Vale - Unanderra Railway. The rail cutting immediately east of the portal will be widened to give access to the open flat land between this cut and the Dombarton Loop. The sequence of strata likely to be encountered in the tunnel is shown in Figure 6-2.

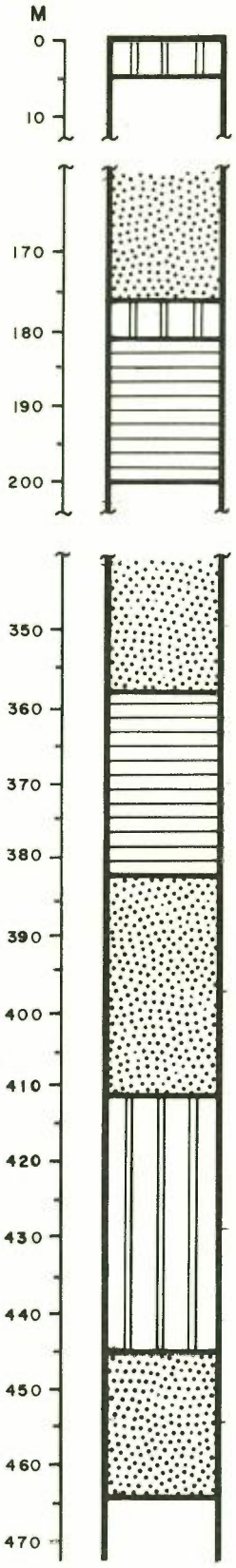
Two other dykes cross the alignment. The first is 1.2 metres wide and the second is 0.9 metres wide. Three faults cross the alignment near the Dombarton portal, and one fault crosses under the creek immediately east of the portal site. None of these faults involve large displacements and the likely effect will be to give closely-spaced joint sets requiring careful excavation and support.

The tunnel will be excavated through ground loosened due to the effects of mining under the tunnel and with some jointing due to faulting. Tunnel excavations will be undertaken by a tunnelling machine. This will result in reduced ground disturbance and minimised overbreak, noise and excess spoil generation.

6.2 SOILS

Soil resources of the study area were documented using a combination of aerial photograph interpretation and field survey. A total of eight soil types were identified. These are described in Appendix B.

There is a strong relationship between geology, terrain and soil type. Consequently, the soil types identified are discussed in terms of their occurrence in the landscape and



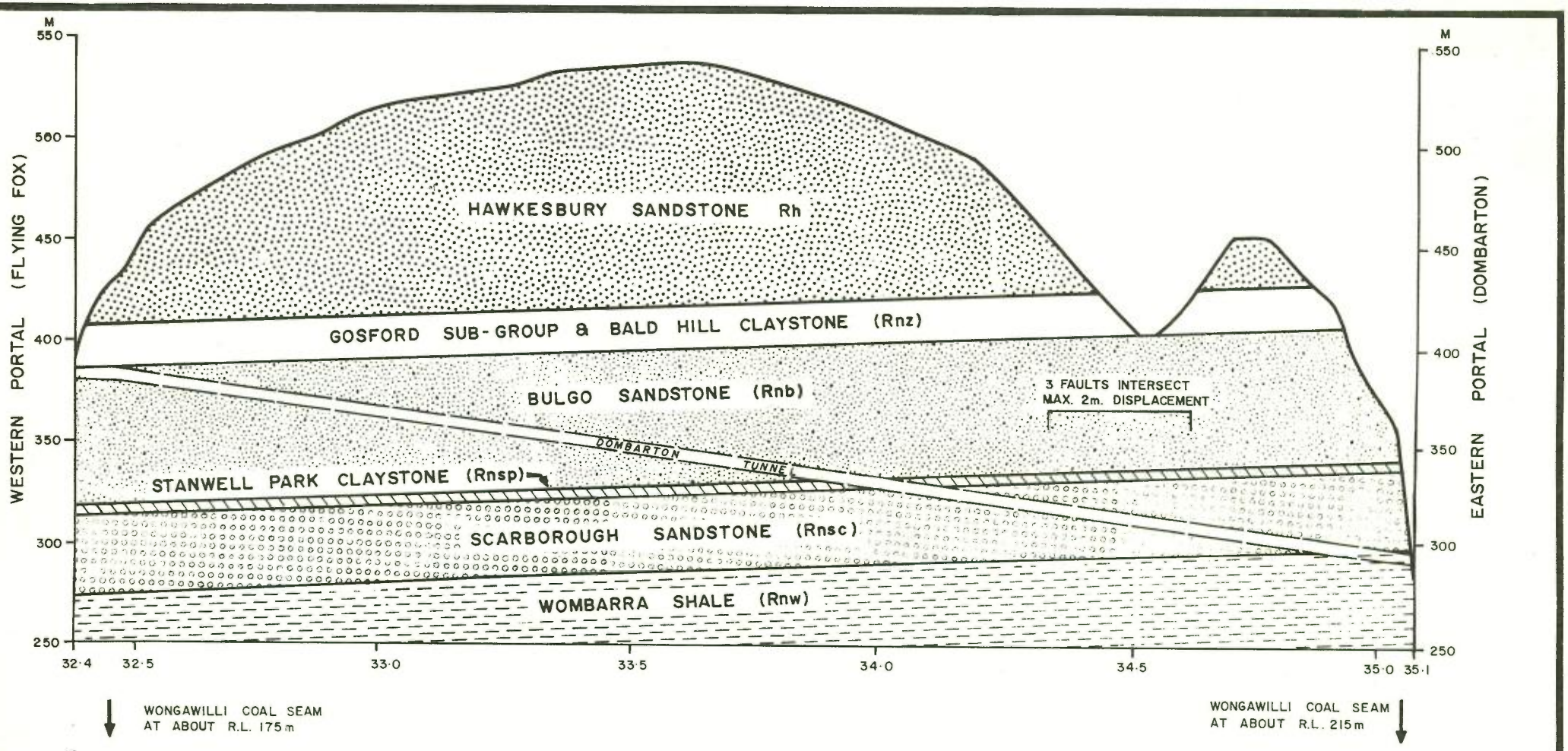
WIANAMATTA GROUP	5 m	Occurs as capping on crests of hills. Predominantly shale but with some siltstone.
HAWKESBURY SANDSTONE	170 m	Occurs over most of the area. Consists of massive bedded quartzose sandstones with minor shale lenses and bands.
GOSFORD FORMATION	6 m	Shales with a few beds of quartz lithic sandstone.
BALD HILL CLAYSTONE	19 m	Claystones with a few bands of lithic sandstones.
BULGO SANDSTONE	158 m	Lithic and quartz lithic sandstone with minor shales.
STANWELL PARK CLAYSTONE	24 m	Claystone, siltstone and minor lithic sandstones.
SCARBOROUGH SANDSTONE	29 m	Quartz lithic and lithic sandstones and lithic conglomerate.
WOMBARRA SHALE	34 m	Shales and siltstones
COAL CLIFF SANDSTONE	19 m	Quartz lithic sandstone with minor shale lenses.

Bulli Coal

NOTE – EXCEPT FOR THE WIANAMATTA GROUP, DEPTH MEASUREMENTS ARE FROM DIAMOND DRILL HOLE 1-32, WHICH IS 350 m WEST OF THE WEST CLIFF - 4 SHAFT.

STATE RAIL AUTHORITY

TITLE: STRATIGRAPHIC SEQUENCE - LOCAL GEOLOGY LOCATION: MALDON - DOMBARTON ROUTE		FIGURE 6-1
SCALE		JOB No. 09886-004-70 DATE: MAY 1983
REF.: GHD		Dames & Moore



STATE RAIL AUTHORITY

TITLE : INFERRED STRATIGRAPHY : DOMBARTON TUNNEL - LONGITUDINAL SECTION LOCATION : DOMBARTON	FIGURE 6-2
SCALE NOT TO SCALE	JOB No. : 09886-004-70 DATE : MAY 1983
REF. : GHD	**Dames & Moore**

the terrain map (Figure 6-3), which can be used in conjunction with the following descriptions.

6.2.1 EXISTING SOIL EROSION

On the grazing lands, particularly in the northern regions of the study area, moderate levels of sheet erosion occur on red and yellow podzolic soils. In localised patches overgrazing of the steeper slopes (to 5°) has resulted in severe sheet erosion.

Within the protected Catchment Areas controlled by the MWS&DB, the general status of erosion is very low due to the uncleared and undisturbed state of the surface. The geological erosion rates of the insitu material on sandstone plateau is high.

6.3 LAND EVALUATION

The primary characteristics of the physical environment which combine to define a land unit include landform, slope, geology, soils and vegetation. A mapping study of this nature was implemented to present concisely the characteristics of the area to be affected by the development.

Eight distinct land units have been identified. They are:

- gorges;
- benched slopes;
- sandstone slopes;
- sandstone plateau;
- drainage plains;
- shale slopes;
- shale plateau;
- coastal escarpment.

The characteristics of each unit are summarized in Appendix B.

6.4 LAND USE

The existing land uses along the proposed railway can be grouped into two categories:

- largely undisturbed land over the MWS&DB catchment area and Illawarra Escarpment;

- agricultural and pastoral from Maldon to Wilton.

Because much of the proposed line traverses MWS&DB land, close liaison between these, the SRA and MWS&DB will take place.

6.4.1 ILLAWARRA ESCARPMENT AND MWS&DB CATCHMENT AREA

Two major land uses occur within this area, the most obvious of which is the collection and storage of water to supply Sydney and south coast communities. This land use largely restricts other activities. Below the surface of this area are the Illawarra Coal Measures

New underground coal mines have recently commenced operations or are planned for the future in this area.

Ony restricted public access is allowed to the Catchment Area. Recreation use is confined to picnic areas at the various dam sites.

6.4.2 PLATEAU BETWEEN MALDON AND WILTON

Land use in this area is primarily rural activity. Other activities include two landing grounds, a parachuting club, and a cement works.

Most of the agricultural pursuits are restricted to gently sloping terrain with a parent material of Wianamatta Shale. On steeper slopes, much of the land remains uncleared.

The proposed railway crosses many utilities and transport routes in this area, including:

- MWS&DB underground channel from Pheasants Nest to Broughton Pass;

- an underground natural gas pipeline;

- several electric power transmission easements;

- the South Western (F5) Freeway;


MOUNT KEIRA ROAD
ABANDONED LANDING GROUND
FIRE ROAD
LAKE CORDEAUX
FIRE ROAD
WONGAWILLA
CREEK
CORDEAUX
DONALDS CASTLE CREEK
CORDEAUX PASSING LOOP
FIRE ROAD 6A
FIRE ROAD 6A
AVON PASSING LOOP
DOG CREEK
FIRE ROAD 6A
FIRE ROAD 6A
LAKE

- Trunk Road 95 (Wilton Road).

6.4.3 COAL MINING

Two aspects of coal mining are important in relation to the proposed railway. If the mining of coal is to be restricted in areas underneath the rail route, consideration will need to be given to the extent of consequent coal sterilization. Where coal mining has or does take place, the affects of subsidence on the line have to be determined.

Figure 6-4 illustrates existing coal resource holdings in the areas adjacent to the railway line. A large proportion of the route is underlain by coal reserves. While the boundaries of these holdings and leases can be defined, the actual areas which will be worked in the future and the degree of coal extraction cannot be determined at this time. Restrictions will apply to mining under the rail route. The SRA will consult with mine owners and the Department of Mineral Resources to minimise the consequent coal sterilization.

Figure 6-5 shows the extent and type of colliery workings along the railway route. There are only two areas where mining has taken place beneath the line and where subsidence could occur as a result of past or current operations.

6.5 HYDROLOGY AND WATER QUALITY

6.5.1 HYDROLOGY

The proposed railway line will pass through the Nepean systems. The plateau is dissected by the Nepean River and its tributaries which have their headwaters in the Illawarra escarpment and flow north to the Hawkesbury River. The Cataract, Cordeaux and Avon Rivers, all tributaries of the Nepean, have been dammed by the MWS&DB in order of supply potable water to the Sydney and South Coast regions of NSW. The proposed railway line roughly follows the drainage divide between the Avon and Cordeaux Rivers and crosses the Nepean and Cordeaux ~~Reservoirs~~ Rivers on high level bridges. The line skirts the south eastern part of the Avon Reservoir near Dombarton, crossing the headwaters of a number of small streams which flow into the Avon Dam. Hydrological data for these streams and for the Avon and Cordeaux Rivers are not available.

In the area underlain by the Wianamatta Group sediments, surface absorption and internal drainage is very slow, resulting in widespread ponding in broad depressions.

In the area underlain by Hawkesbury Sandstone the soils are sandier and surface absorption of water is much more rapid. However, the underlying sandstone strata are only slightly permeable and, after prolonged rain, the surface soil becomes saturated and runoff occurs. Ponding is not extensive and is relatively short-lived.

The groundwater hydrology of the area is in general poorly known. From geological observations, it appears that the near surface groundwater situation is complex. Groundwater probably occurs in numerous small, unconnected or "perched" zones separated by layers of low permeability.

It is unlikely that there is any potential for significant groundwater development, unless more substantial aquifers are present at depths below the coal seams.

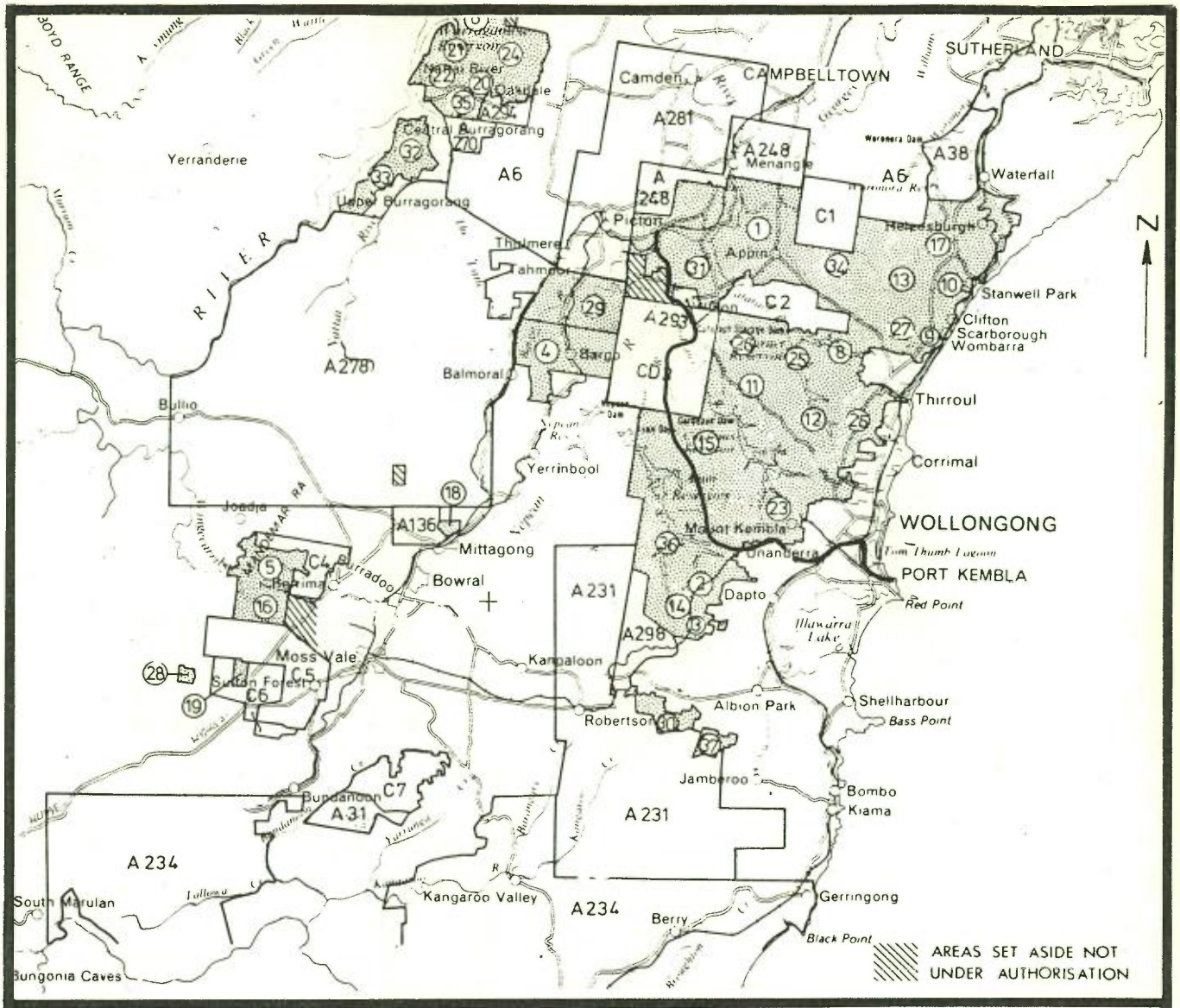
Further details can be found in Appendix C.

6.5.2 WATER QUALITY

Water quality information for the Cordeaux and Avon Rivers is generally lacking. Water in the Avon and Cordeaux Reservoirs is of good quality, being suitable for drinking water and other purposes. The Catchment Areas are relatively unaffected by development. The MWS&DB monitors water quality in the Avon and Cordeaux Reservoirs, but is principally concerned with suspended solids levels, as monitored by colour and turbidity measurements.

There is no monitoring being undertaken of water quality of streams flowing into these reservoirs from the area of the railway route.

As an indication of water quality, data collected in 1974 for the Bellambi Coal Company Ltd (Dames & Moore, 1975) has been summarised in Appendix C.



COLLIERY HOLDINGS

1. APPIN
2. AVON
3. AVONDALE
4. BARGO
5. BERRIMA
6. BRIMSTONE
7. BRIMSTONE No. 2
8. BULLI
9. BULLI MAIN
10. COAL CLIFF
11. CORDEAUX
12. CORRIMAL
13. DARKES FOREST
14. HUNTLEY
15. KEMIRA
16. LOCH CATHERINE
17. METROPOLITAN
18. MOUNT ALEXANDER
19. MURRIMBA
20. NATTAI BULLI
21. NATTAI NORTH
22. NATTAI NORTH No. 2
23. NEBO
24. OAKDALE
25. SOUTH BULLI "A"
26. SOUTH BULLI "B"
27. SOUTH CLIFTON
28. SOUTHERN
29. TAHMOOR
30. TONGARRA
31. TOWER
32. VALLEY No. 1
33. VALLEY No. 3
34. WEST CLIFF
35. WOLLONDILLY
36. WONGAWILLI
37. YELLOW ROCK

West Bellambi?

COAL LEASE APPLICATION AREAS

REF	APPLICANT
C1	CLUTHA DEVELOPMENT P L
C2	AUSTRALIAN IRON & STEEL P L
C4	SOUTHERN PORTLAND CEMENT P L
C5	BELLAMBI COAL CO P L
C6	SOUTHERN COAL (EXT'D) P L
C7	DOMBARTON COLLIERY P L

AUTHORISATIONS

REF	HOLDER
A6	DEPT OF MINERAL RESOURCES
A31	DOMBARTON COLLIERY P L
A38	BULLI MAIN COLLIERY P L
A136	MACDONALD BROTHERS P L
A231	ELECTRICITY COMMISSION OF N S W
A234	ELECTRICITY COMMISSION OF N S W
A248	AUSTRALIAN IRON & STEEL P L
A270	DEPT OF MINERAL RESOURCES
A278	DEPT OF MINERAL RESOURCES (P)
A281	DEPT OF MINERAL RESOURCES
A293	AUST IRON & STEEL P/L (P)
A294	CLINTONS NATTAI COLLIERIES P/L (P)
A298	THE ELECTRICITY COMMISSION OF NSW
CD3	COAL DEVELOPMENT AREA

(P) Denotes pending applications

STATE RAIL AUTHORITY

TITLE: COAL RESOURCES HOLDINGS: MALDON TO PORT KEMBLA

LOCATION: MALDON - DOMBARTON ROUTE

FIGURE 6-4

SCALE 0 50 KM

JOB No. 09886-004-70

DATE: MAY 1983

REF.: BMR

Dames & Moore



LEGEND:

UNDERGROUND WORKINGS

STATE RAIL AU

6.6 CLIMATE

The proposed railway is located near the southern New South Wales Coast, which has a temperate climate with warm to hot summers and cool to mild winters.

A climatic survey has been undertaken based mainly on Bureau of Meteorology records for Port Kembla and Picton. The results of this study and a description of the climatic characteristics of the area are contained in Appendix D.

6.7 AIR QUALITY

There is no historical air quality data for the area close to the proposed route. However, an assessment can be made from a knowledge of existing land use and the location of the closest industrial centres. Details are contained in Appendix D.

Between Maldon and the MWS&DB Catchment Area, the route passes through land devoted mostly to grazing and low density residential use. The land for the remainder of the route is managed by the MWS&DB as a Catchment Area, and is covered mostly with natural vegetation, although it does include several underground coal mines. There is no significant industrial activity. The coal mines may have elevated particulate deposition rates around their surface facilities but these will be local effects.

It is likely that the more distant industrial centres of Wollongong and Sydney will influence air quality when the diluted urban plumes from these centres are carried over the area. However none of these factors are likely to give rise to a significant degradation in air quality. Present air quality is best described as excellent.

6.8 VEGETATION

6.8.1 MAIN VEGETATION TYPES

Six main vegetation mapping units are shown on Figure 6-6. Further details of vegetation types can be found in Appendix E.

Agricultural Vegetation

Cleared and largely cleared land contains only remnant native trees. Most of the area is pasture comprising a mixture of introduced and native grasses.

Grassy woodland identifies areas with moderate tree cover remaining, but still subject to modification, usually by grazing. Thickets of small trees tend to be found on sites with relatively shallow shale soils, sometimes with sandstone close to the surface, and accordingly may contain a mixture of species associated with both Hawkesbury Sandstone and Wianamatta Shale.

Native Vegetation

Subtropical rainforest forms closed-forest on slopes and gullies about Dombarton. The rainforest has been cleared in places for dairy farming, and is also intersected by the existing railway line. Nevertheless the condition of the stands inspected remains good with little invasion by exotic species.

Dry sclerophyll forest and woodland is the main vegetation cover of the MWS&DB Catchment Area.

The height of the tree stratum varies: ridge areas and upper slopes tend to carry low open forest (tree heights 8-10 m). In more protected areas, and on lower slopes with deeper soils, height increases to 15-20 metres.

Plateau dissection is much more pronounced in the Brown's Road area, and both ridges and slopes tend to carry a shallow to skeletal soil with frequent sandstone outcropping. The main tree species, form a low open forest or low woodland (tree heights 5-8 metres, cover 30 percent).

The understorey in both sub-units largely reflects fire history. The pattern of prescribed burning practised by the MWS&DB together with occasional wildfires has given rise to a mosaic of understorey types. The most common is an understorey shrub cover of 1-2 metres, comprising sclerophyllous shrubs . The areas with denser tall shrub layers appear to have escaped burning by wildfire for some years, although they are included in areas of prescribed-burning by the MWS&DB.


MOUNT KEIRA ROAD
ABANDONED LANDING GROUND
FIRE ROAD
LAKE CORDEAUX
FIRE ROAD
WONGAWILLA
CREEK
DONALDS CASTLE CREEK
Heath
CORDEAUX PASSING LOOP
FIRE ROAD 8A
AVON PASSING LOOP
Partially cleared
Area of clay capping
LAKE

Clay soil caps within the sandstone plateau have a grassy understorey with relatively few sclerophyllous shrubs present.

Gorges and incised streams carry a variety of vegetation. The rim and upper half of the steep broken slopes of both the Nepean and Cordeaux gorges carry low open forest or low woodland of sandstone species already noted for plateau surfaces. Lower slopes and the actual stream fringes are generally an open scrub with Water Gums, Hopbush, Coast Myall and smaller shrubs.

Incised streams, within the MWS&DB Catchment have a sparse cover of small trees and tall shrubs along their courses. The King Fern is frequent, and other ferns are common.

Swamps are present on the plateau surface and also in deep and broad gullies above the Avon Reservoir. Swamps on the plateau surface are dominated by sedges, with areas of heath. The soils are peaty. The swamps above the Avon Reservoir are, more strictly, wet heaths, containing a mixture of swamp species proper and sclerophyllous shrubs.

Heaths are found in small areas on the plateau surface.

6.8.2 SIGNIFICANT HABITATS AND VEGETATION

The dry sclerophyll forest of the MWS&DB Catchment Area has considerable conservation significance. The railway easement will remove only a very small proportion of the dry sclerophyll forest. The Nepean River gorge provides a strip of more or less intact native vegetation through a largely cleared landscape, but again, the proposed development will remove only a small portion of this.

In terms of extent and physical characteristics, the swamp areas are regarded as the most significant habitat encountered.

6.9 TERRESTRIAL WILDLIFE

The Maldon to Dombarton route passes through wildlife habitats that are representative of the region and have remained largely undisturbed.

As a result of previous patterns of land use, and the management regime imposed on the area by the MWS&DB, an ideal situation has been created for the herbivorous marsupials. Food, water and cover are juxtaposed in a particularly favourable way, and the above areas have to be understood as a system rather than a set of independent parts. Further details can be found in Appendix F.

6.9.1 HABITAT

The following habitat types were identified according to the structure and species composition of vegetation:

- scribbly gum, bloodwood low open forest/woodland;
- swamp heath: paperbark and swamp gum complex;
- dry heath: Banksia and Leptospermum;
- ironbark, bloodwood tall woodland;
- mixed low open woodland;
- riparian: watergum.

It is the MWS&DB's policy to burn grassland annually creating a very favourable management programme for herbivores. This same management programme has rendered the burnt areas less favourable for the ground-dwellers that depend on close ground cover.

6.9.2 BIRDS

Bird counts at various points were totalled and compared. The total species number in the dry forests indicated a low to moderate density. The abundance of honeyeaters would also probably increase during flowering of plants.

All birds recorded in the study are widely distributed in similar habitats of NSW. However, some species which require attention are those preferring wet habitats and heath or heath-like conditions, as these habitats are limited in number and extent and are coming under increasing pressure elsewhere in eastern Australia. These species are the:

- Eastern Whipbird;
- Variegated Wren;
- Pilot Bird;
- Chestnut-rumped Hylacola;
- New Holland Honeyeater (although this species is more able to adapt to other habitats).

6.9.3 MAMMALS

The populations of each mammal species recorded was con-sidered to be stable, though subject to long term natural fluctuations, so long as their habitats remain unaltered by human interference. Interchange between parts of the mammal population north and south of Trunk Road 95 occurred to a varying extent. The macropods were subject to a more local reduction of their population than other mammal groups as they are attracted to the roadside where their mortality rate is increased by collision with vehicles.

Road kills of macropods in recent years had appeared to stabilise at a low level, which suggested that the macropod populations were low within the immediate vicinity of the road and were in equilibrium with those of the hinterland.

6.9.4 KOALA OBSERVATION SURVEY

An informal observation survey has been undertaken within the catchment area over the past three years by staff of the MWS&DB. Koala spottings are noted and locations recorded.

The main concentration of animals observed lies in the area west of the Avon Dam. However some spottings have occurred in scattered locations in the area east of the Dam. The most relevant to the proposed railway are two sitings near the junction of the line with the proposed West Bellambi coal development loop.

6.10 ARCHAEOLOGY

A total of three archaeological surveys have been undertaken in the preparation of this Environment Impact Statement. These surveys and their results are described in Appendix G.

6.10.1 HISTORICAL BACKGROUND

According to Tindales map of tribal areas, the proposed route of the railway line lies within the territory of the Wodi Wodi "tribe" or dialect group (Tindale 1974, Mathews, 1898). Along the coast these people were also known as the Illawarra tribe.

Being close to Sydney, the fertile land around Picton and Wollongong was settled by Europeans at a comparatively early time. By 1889, it was recorded that there were only six "full-blooded" Aborigines remaining in the general Picton region, and all Aborigines were settled on non-Aboriginal owned farms (NSW Aboriginal Protection Board; Picton census, 1889).

6.10.2 EXISTING ARCHAEOLOGICAL ENVIRONMENT

Within the Wilton - Cordeaux district, the sandstone rock shelters containing Aboriginal drawings and stencils have been the subject of interest to art specialists for many years.

Examinations of the National Parks and Wildlife Service's Site Register indicated that no sites had previously been recorded within the proposed route, although one site, a rock shelter with art, was immediately adjacent (Site 5 on Figure 6-7).

6.10.3 SURVEY RESULTS

During the surveys undertaken, four archaeological sites were recorded while the previously located site (Site 5) was re-inspected.

The five archaeological sites are described briefly below. Additional information on the sites has been provided on site cards for the National Parks and Wildlife Site Register.

Site 1 : Nepean River Shelter: Shelter with Art and Potential Archaeological deposit

Location: The shelter is located is a small outcrop of sandstone on the western side of a small gully which flows into the Nepean gorge from the north. It is about 10 metres above the gully floor.

Description of Shelter: A small to medium sized shelter formed by cavernous weathering.

Archaeological Evidence: No sign of Aboriginal occupation was seen on the floor of the shelter. However, several drawings were on the shelter wall above the shelf. A total of nine motifs was recorded.


MOUNT KEIRA ROAD
FIRE ROAD 6
ABANDONED LANDING GROUND
LAKE CORDEAUX
FIRE ROAD
WONGAWILLA CREEK
CORDEAUX RIVER
DONALDS CASTLE CREEK
AVON RIVER
CORDEAUX PASSING LOOP
FIRE ROAD 6B
FIRE ROAD 6A
PASSING LOOP
NATIVE DOG CREEK
FIRE ROAD 6H
FIRE ROAD 6A
300
400

Site 2 : Cordeaux River Shelter: Shelter with Art and Potential Archaeological Deposit

Location: The shelter is located in a sandstone outcrop on the southern side of a small gully which runs into the Cordeaux gorge on its eastern side.

Description of the Shelter: The maximum dimensions of the shelter are approximately 11 x 1.5 metres.

Archaeological Evidence: No sign of Aboriginal occupation was seen on the floor of the shelter. However, two faded white hand stencils were on the shelter wall.

Site 3 : Native Dog Creek Shelter: Shelter with Art

Location: In a low cliffline sandstone outcrop on saddle between the headwaters of Native Dog Creek and an unnamed tributary of Gallahers Creek to the west of Bellbird Creek.

Description of Shelter: The shelter has formed by cavernous weathering. Its approximate maximum dimensions are 12 x 2 x 2 metres.

Archaeological Evidence: No signs of Aboriginal occupation were noted on the shelter floor. There was art on the walls.

Site 4 : Flying Fox No.1 Shelter with Occupation Deposit

Location: Within a small sandstone outcrop on south west facing slopes over looking Flying Fox No.1 Creek, just below plateau top.

Description of Shelter: Approximate maximum dimensions of the shelter are 5 x 3 x 2.5 metres.

Archaeological Evidence: One fine-grained silicrete flake, 2 cm long was found on the shelter floor.

Site 5 : East Avon Shelter: Shelter with Art (National Parks and Wildlife Site No. 52-2-459)

Location: The shelter is in a rocky outcrop on the plateau top and is visible from Fire Road No.6A.

Description of Shelter: The site is one of two immediately adjacent shelters.

Archaeologial Evidence: No sign of Aboriginal occupation was noted. The art on the walls consists of hand stencils, two lizards and some charcoal lines.

As well as archaeological sites, there were 16 Potential Occupation Sites, which are sites with possible archaeological content. Of these sites, all but one occur within the Nepean and Cordeaux gorges or in subsidiary gullies. Their locations are indicated in Figures 6-8 and 6-9. Only Potential Occupation Sites 3, 10, 11 and 12 are considered to have a reasonable potential for having archaeological material of any significance.

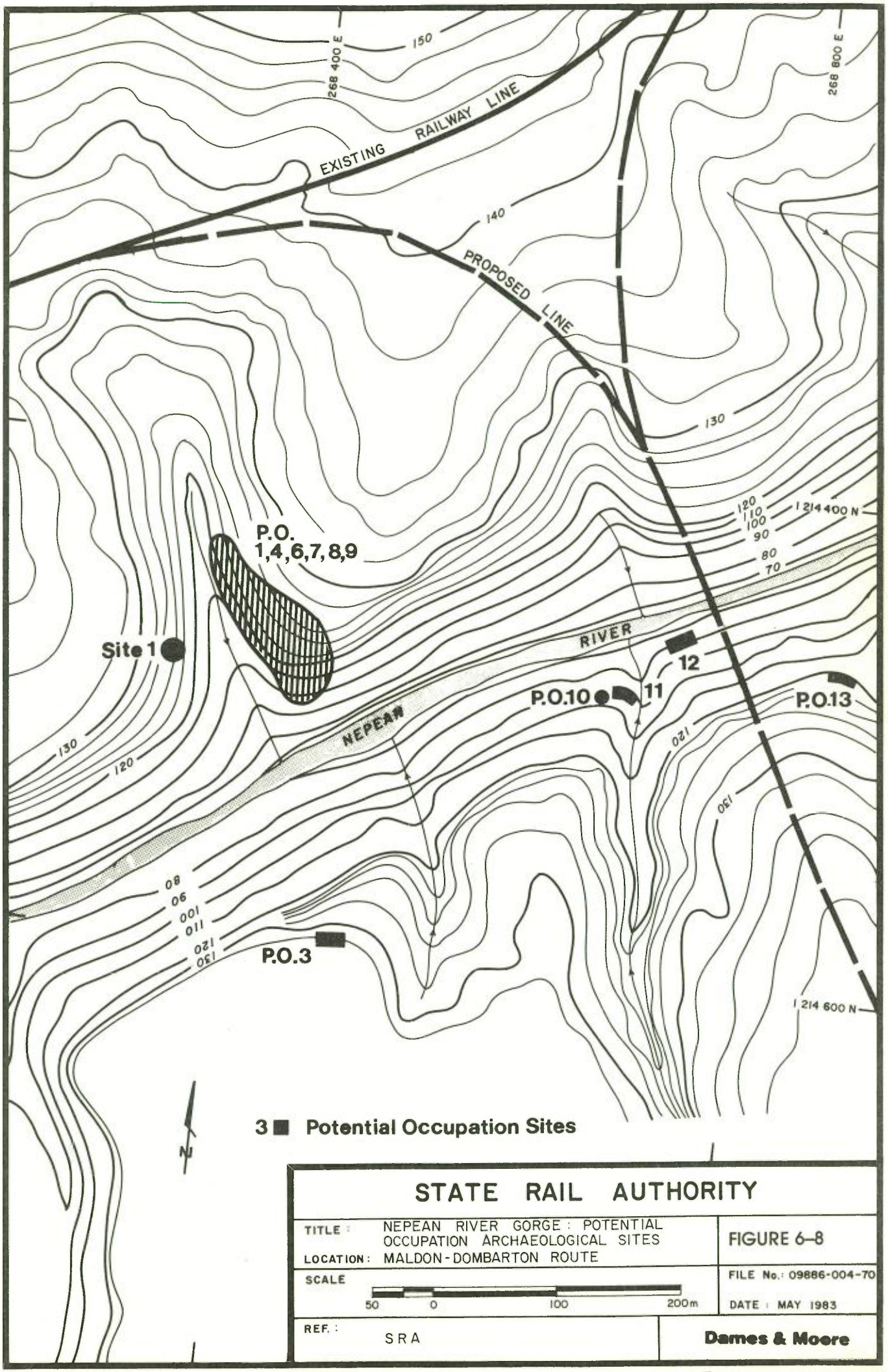
6.11 VISUAL CONSIDERATIONS

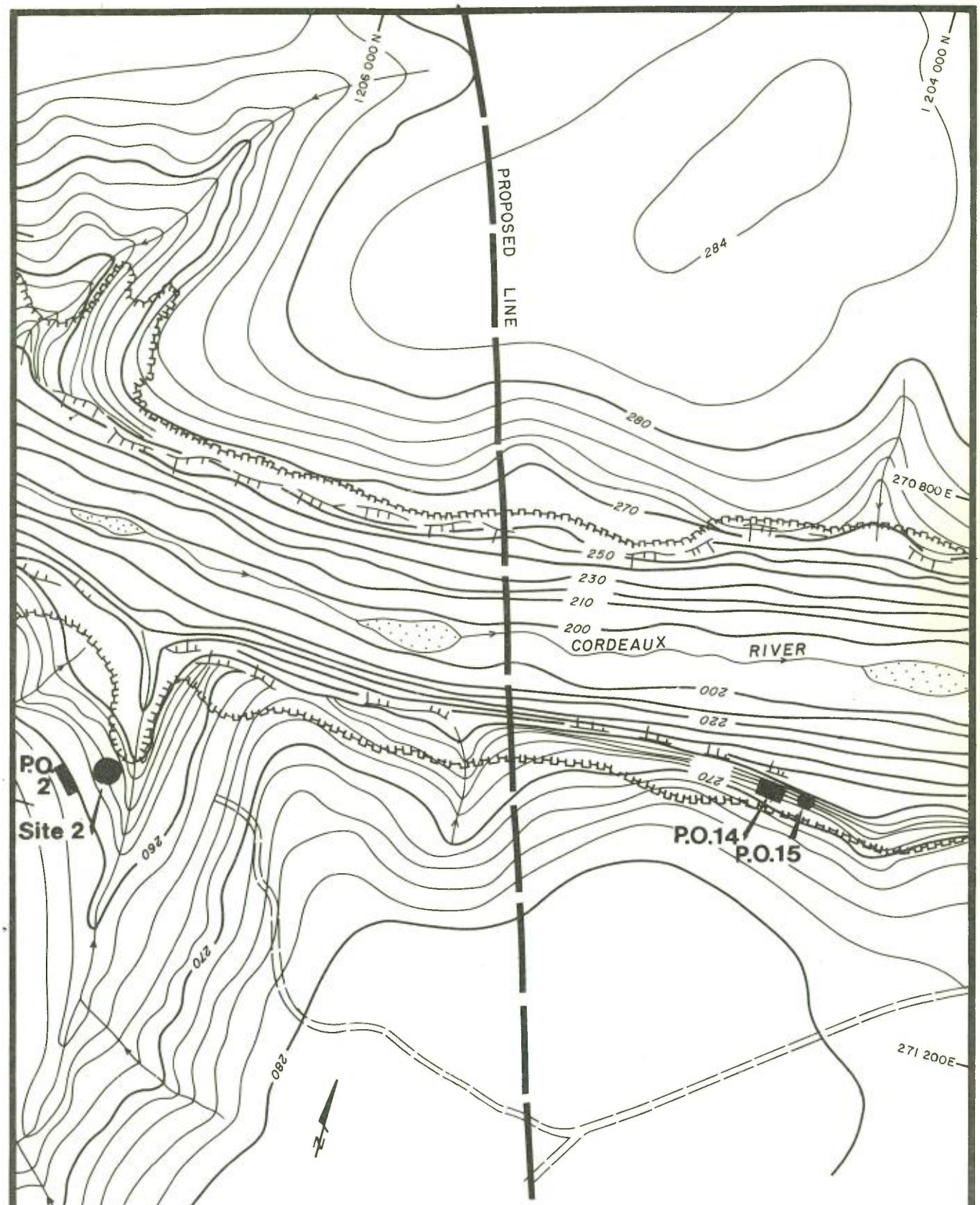
An aesthetic evaluation was undertaken of the proposed railway route. The study was aimed at defining those local and regional characteristics of visual significance which were relevant to impact assessment and project design.

Between the Main Southern Line and the MWS&DB Catchment Area, the line will pass through a landscape of large and small holdings on gently undulating terrain. To local residents, the most important visual quality of this area is its rural character. The landscape can be defined as "country-side" but while picturesque, it possesses no outstanding visual characteristics. Figures 6-10 and 6-11 illustrate the character of this area.

In the vicinity of the proposed rail route, the character of the landscape has been altered by the construction and operation of the Main Southern Railway Line, the F5 Freeway, Trunk Road 95, the Maldon Cement Works, the Parachute Club airstrip, power transmission lines and an increasing density of development on small rural residential blocks.

The township of Wilton is visually appealing as a small urban centre but unimpressive. The dividing effect of Trunk Road 95 and the general nature of the urban sprawl in the newer


268 400 E
268 800 E
150
EXISTING RAILWAY LINE
140
PROPOSED LINE
130
120
110
100
90
80
70
1 214 400 N
P.O.
1,4,6,7,8,9
Site 1
RIVER
12
11
P.O.10
P.O.13
NEPEAN
P.O.3
1 214 600 N
3 ■ Potential Occupation Sites
N
STATE RAIL AUTHORITY
TITLE : NEPEAN RIVER GORGE : POTENTIAL OCCUPATION ARCHAEOLOGICAL SITES
LOCATION : MALDON - DOMBARTON ROUTE
FIGURE 6-8
SCALE
50 0 100 200m
FILE No.: 09886-004-70
DATE : MAY 1983
REF. : SRA
Dames & Moore



STATE RAIL AUTHORITY

TITLE :	CORDEAUX RIVER GORGE: POTENTIAL OCCUPATION ARCHAEOLOGICAL SITES	FIGURE 6-9
LOCATION :	MALDON - DOMBARTON ROUTE	
SCALE	50 0 100 200m	FILE No. : 09886-004-70
		DATE : MAY 1983
REF. :	SRA	Dames & Moore



FIGURE 6–10



FIGURE 6–11

areas to the north of the road have destroyed the once "country village" appearance of the town. Thorntons Hill provides a backdrop to the township.

The section of the proposed line through the Catchment Area passes through relatively undisturbed country after the crossing of the Cordeaux River. This area is virtually inaccessible at present and the route is not visible from any vantage points. However the area, particularly the gorge of the Cordeaux River is very appealing visually. Part of its attractiveness is its undisturbed nature. There is a strong feeling of exposure at the gorge edge and a sense of remote wilderness.

From the Cordeaux River crossing, the route passes along the ridgeline between the Avon and Cordeaux Catchments. Much of the native tree and shrub vegetation along this ridge has been removed and fire trails constructed. In its natural state, the area would have appeal visually based on its wilderness value. However the activities of the MWS&DB have minimised this value.

As the route passes from the ridgeline down into the proposed tunnel, it briefly traverses the slopes of the Avon Reservoir. The area's character is one of relatively undisturbed wilderness adjacent to the water body. The artificial nature of the dam and the mine ventilation shaft with associated access tracks, mitigate against this characteristic. The area is not visible from any point within the Catchment Area to which the public can gain ready access.

6.12 NOISE

6.12.1 NOISE MONITORING PROGRAMME

The existing acoustic environment has been investigated during a 24-hour monitoring programme. The programme is described in Appendix H.

Table 6.1 describes the locations of the monitoring sites.

6.12.2 RESULTS OF MONITORING PROGRAMME

The data in Table 6.2 shows the typical background noise levels (L_{90} values) and also shows other statistical

TABLE 6.1

DESCRIPTION OF NOISE MONITORING SITES

SITE	DESCRIPTION
1	On the north side of road leading from the Freeway to Maldon approximately 15 metres from the centre of the lane carrying Wilton-bound traffic. Ground surface was compacted earth.
2A	Approximately five metres from the road edge on the eastern side of Peel Street and about 100 metres from the Wilton-Appin Road. Ground surface was grass.
2B	Approximately 15 metres from the centre of the Appin-bound carriage way of the Wilton-Appin road and five metres from the eastern side of Camden Street. Ground surface was grass.
2C	As for (2B) but 34 metres from the Wilton-Appin Road.
3A	On the eastern side of the Lake Cordeaux picnic area. Ground surface was grassed.
3B	On the western side of the Cordeaux Lake access road approximately 30 metres from the entrance gate to the picnic area. Ground surface was grass.
4	On the grass verge on the eastern side of Bardess Road (a short cul-du-sac) and about 10 metres from the Dombarton - Port Kembla railway which passes through a deep (approximately 5 metre) cutting at this point.
5	On grassed area 34 metres from the railway line by Fairlock Road, Farmborough Heights.

TABLE 6.2

RESULT OF NOISE MONITORING PROGRAMMES

SITE	DATE	START TIME	WIND SPEED (m/s)	WIND DIRECTION	TEMP (°C)	RELATIVE HUMIDITY (%)	PRESSURE (mb)	CLOUD COVER (eights)	L_{99} dB(A)	L_{90} dB(A)	L_{50} dB(A)	L_{10} dB(A)	L_{1} dB(A)	L_{eq} dB(A)	PRINCIPAL NOISE SOURCES (see footnotes)
1	3 Mar 83	11.58 am	0-5	N	33	42	1006	1	30.3	31.5	38.3	57.5	72.3	58	C, T, I, A, Tr
2A	3 Mar 83	12.45 pm	calm	-	32	39	999	1	33.0	35.0	42.5	56.3	66.3	53	C, T, Br, I
3A	3 Mar 83	2.00 pm	5	SE	28	72	986	4	34.3	37.8	40.8	44.0	48.8	42	F, Br, DT
4	3 Mar 83	3.30 pm	0-5	NE	29	69	1011	1	38.3	39.5	41.8	47.3	56.3	45	I, F, DT (man washing car 20 metres away for last 5 minutes)
1	3 Mar 83	4.50 pm	3-5	SE	30	47	1004	3	39.8	41.0	50.0	68.3	79.3	66	Tr, T, C
2A	3 Mar 83	5.30 pm	0-5	NE	26	71	998	3	32.5	35.0	44.5	59.3	70.3	58	C, T, Br, V, DLM
3B	3 Mar 83	7.20 pm	calm at surface, some wind in trees	NE	24	73	983	3	30.0	31.5	35.0	40.3	45.3	37	DT, Br, F, Co
4	3 Mar 83	10.10 pm	calm	-	25	70	1012	1	34.3	35.0	36.5	44.3	54.8	42	Dg, I, DT, A
1	3 Mar 83	11.28 pm	calm	-	23	83	1007	6	31.8	32.8	34.5	50.5	72.3	57	C, I, T
2B	4 Mar 83	12.05 am	calm	-	20	91	1000	3	29.3	30.0	33.8	48.3	58.3	45	Fr, I, A, Dg, DT, C, T
3	4 Mar 83	12.50 am	calm	-	21	91	984	2	24.3	25.3	27.5	34.5	38.8	30	DT, I
4	4 Mar 83	5.45 am	calm	-	22	88	1010	2	34.5	35.3	37.5	39.8	42.8	38	I, F, DT, R, Dg
1	4 Mar 83	7.02 am	0-1	N	18.5	95	1006	4	43.5	46.8	46.8	72.5	80.0	78	T, I, Tr
2C	4 Mar 83	7.35 am	calm	-	21	91	998	8	38.3	39.5	46.0	64.3	74.3	61	T, C, R, Dg, DT
3	4 Mar 83	8.15 am	0-4	N	21	91	988	7	37.8	38.8	40.5	43.3	47.5	41	F, DT, Br
4	4 Mar 83	9.20 am	0-4	N	27	71	1012	3	36.3	37.8	43.3	49.5	54.3	46	Br, C, DT, DLM
5	12 May 83	3.00 pm	0-1	N	18	73	1020	0	37.8	39.0	32.0	53.0	60.8	49	C, MC, Br, V, I

V = VOICES
R = ROOSTER
DT = DISTANT TRAFFIC
Tr = TRAIN
C = CARS
T = TRUCKS
I = INSECTS
Br = BIRDS
DLM = DISTANT LAWN MOWER
F = WIND IN FOLIAGE
Dg = DOG BARKING
A = AIRCRAFT
Fr = FROGS
Co = COLLIERY
MC = MOTOR CYCLES

parameters such as L_1 (a measure of the "maximum" noise levels during the monitoring period), L_{99} (measure of noise levels during the quietest periods) and lists the principal noise sources.

Most of the route passes through either farm land or natural bushland where the recorded L_{90} levels ranged from a very quiet 25 dB(A) at Site 3B to 47 dB(A) at Site 1. At Wilton (Sites 2A, 2B and 2C) L_{90} values ranged from 30 dB(A) during quiet periods at night to 40 dB(A) during the day. L_1 levels at the monitoring sites in Wilton were in the range 58 to 74 dB(A), with the louder noises being associated with truck traffic along the Wilton-Appin Road.

The sound levels reported above are more or less those that would be expected for the respective environments.

6.13 SOCIAL AND ECONOMIC ASPECTS

For the purposes of the socio-economic studies, the local area was assumed to be the Shire of Wollondilly and the City of Wollongong. A comprehensive review of the existing situation in these two areas is set out in Appendix J.

6.13.1 EMPLOYMENT STRUCTURE

The employment structure of the two areas reflects the size and growth rate of their respective economies. Wollondilly Shire's workforce grew by 31% in the 1976 - 1981 period and is in the process of transition from a primarily rural based economy to serving as a residential commuter area for both Sydney and Wollongong. In contrast, Wollongong's workforce grew by 7.2% in the same period.

6.13.2. EMPLOYMENT MULTIPLIERS

Total employment multipliers which express the changes in total employment as a result of changes in basic industries are estimated as 2.6 for Wollondilly Shire and 7.0 for the City of Wollongong for the period 1976-81. The total area multiplier is 4.7. This figure means that for each job created in the basic sectors of the economy, 3.7 jobs are created in the service industries.

Unemployment levels are high in both the Shire and the City, due largely to retrenchments in the coal mining industry, the steel industry and local manufacturing - plants.

6.13.3 POPULATION DISTRIBUTION

The majority of the population of the study area isConcentrated in the City of Wollongong. Some of the recent growth in Wollondilly Shire has occured in towns. The remainder has been scattered into rural areas of the Shire as small hobby farms and/or farmlets.

6.14 LOCAL COMMUNITIES

As an integral part of the environmental studies for the proposed Maldon-Dombarton railway line, a survey of the Wilton community was undertaken to establish the concerns of both the townspeople and landholders towards the project. Figure 5-12 shows property boundaries and residence location in the areas adjacent to the proposed line.

During a meeting of the Wilton Progress Association, representatives from the SRA & D&M described the project. The most controversial issue discussed was the three alternative proposed routes of the railway line from Maldon to Wilton. It was indicated at the meeting that the zone of land between the three routes would be studied.

Townspeople were concerned about the proximity of the railway to the township. Many agreed that if the railway passed around the southern side of the town around Thorntons Hill, they would be more in favour of the project.

Landholders were concerned about the effect of the railway on their properties, minimising the effects and compensation.

6.14.1 COMMUNITY SURVEY

D&M representatives conducted a survey of the Wilton community in the local hall on 17th and 24th March, 1983. A letter and map were distributed to both townspeople and landholders (where possible). A list of landholders was obtained from the council and people were contacted by telephone (where telephone numbers were available). If

survey times were inconvenient, people were welcomed to phone to discuss the project or make alternative appointments.

6.14.2 WILTON TOWNSPEOPLE'S CONCERNS

The township of Wilton is located relatively close to Picton, Campbelltown, and Wollongong. This allows people to live in Wilton and commute to work.

Many of the people who live in Wilton were attracted to the area by its location, the rural atmosphere of the area, the cost and availability of land, and the quality of life offered by living in a rural environment.

The major concern of the townspeople was the proximity of the railway to the township of Wilton. One of the alternative routes from Maldon to Wilton passed within less than a kilometre of the township. People interviewed were concerned about the loss of amenity to the area the railway would cause, and increased noise levels. Other impacts of a railway located close to Wilton were seen to include loss of visual amenity, dust, vibration, loss of land values, danger to children, and the potential fire hazard.

6.14.3 WILTON LANDHOLDER'S CONCERNS

Landholders in the Wilton area own properties that range in size from six hectares to over 200 hectares. They have lived in the area from less than one year to over twenty years.

The majority of landholders surveyed were those directly effected by one of the alternative routes. As part of the survey questionnaire, landholders were asked how the proposed railway line would effect them if, hypothetically it passed through the middle, or, alternatively, along one side of their property.

Generally, if the railway halved any of the smaller properties, the effects were considered to deliterous. In most cases, remaining land on either side of the line was seen to be useless. Some landholders were concerned about personal disturbance from increased noise levels, and loss of access to their property. Adjacent landholders were also concerned about loss of access, noise and disturbed catchment areas for dams. Dams on properties adjacent to the railway

could potentially become useless if drainage patterns are changed by the construction of the railway.

Landholders with larger properties in the Wilton area generally manage the land as a farm not a hobby farm. In general, the concerns of these landholders fall into three categories; economic, farm management and personal.

Major economic concerns were loss of investment. The productivity of the farm is highly dependent on the type of farm and farm management practices. Management practices would have to be changed and replanned if the railway dissected any of the larger properties.

Other concerns, of a more personal nature, were expressed by all landholders. These concerns included: loss of access to property if the railway line crossed any access road, loss of soil due to erosion, loss of visual amenity, increased dust, increased noise levels, and being left with unfarmable and unsaleable pieces of land due to their size and proximity to the railway. Also the effects of railway maintenance procedures, night lights, shooters, theft and increased frontage thus increased access, and disturbance to farm animals were items of concern.

The major concerns of the railway line being parallel to any properties was loss of amenity.

6.15 BUSHFIRES

6.15.1 WILDFIRES

Risks of severe bushfires along the proposed route are greatest in the Cordeaux Catchment Area, in forested lands under the control of the MWS&DB. Accurate fire records have been maintained since 1972, with information on the ignition source, location and area of wildfires.

Most of the route was burnt in wildfire in summer 1977-1978, with the ignition source being multiple lightning strikes.

The area to the west of Fire Road 6B, which approximates part of the proposed rail route, had been burnt by wildfire in the mid-1960's. One area near the route was also burnt by a

wildfire in the 1980-1981 season, the ignition source in this case being a prescribed-burn that got out of hand.

Bushfire control is discussed in Appendix A and E and in Section 5.5.5 of this Volume.

6.15.2 PRESCRIBED BURNING

Since 1973, the MWS&DB has conducted prescribed burning within the Catchment to reduce the fuel available to a wildfire (Max Wooton, MWS&DB, Pers. comm.). Prescribed burning is conducted on a "5-year return" basis, that is, with a minimum span of 5 years between subsequent burns, and the actual time span beyond 5 years being determined on the basis of level of fuel accumulation. In practice, the actual span between repeat burning is 6-7 years.

6.15.3 FIRE ON AGRICULTURAL LANDS IN THE NEPEAN GORGE

The natural vegetation in agricultural areas has been modified by clearing and grazing to such an extent that any loss of remaining natural vegetation will not mean the destruction or major modification of significant habitats or plant communities. The risk of fire is much greater in the agricultural lands than in the catchment area because of the much higher level of human activity.

7.0 ENVIRONMENTAL MANAGEMENT PROGRAMME AND IMPACTS

This section summarises the anticipated environmental impact of the proposed railway development. It sets out those components of the environmental management programme designed to minimise and ameliorate the impacts. Descriptions of aspects of the programme are provided in the various Appendices and in Section 5.0 of this report.

Impacts relate to both the construction and operational phases. The former are likely to be more acute and evident. The SRA will retain an environmental officer on the project management team to ensure that environmental management is effective throughout the duration of the railway design and construction.

During the construction of the railway, the SRA will maintain constant supervision of the works undertaken by the construction contractors. A superintendent will be appointed to maintain continuous inspection and ensure that all work is done to the satisfaction of the SRA. Survey checks to ensure the work is laid to the design geometry will also be carried out prior to commissioning of the line.

7.1 GEOLOGY

The two aspects of geology relevant to the environmental assessment of this project are subsidence and coal sterilization. These are discussed in Appendix E.

The engineering impacts of subsidence upon the construction of the railway are not expected to be significant except if subsidence occurred in the vicinity of major structures, like bridges, the tunnel or major steep sided cuttings. The current policy of the Department of Mineral Resources is that subsidence at cliff faces or under major structures must be limited to 150 mm. Engineering design of these structures must take this into account.

Limitations on future mining due to the possibility of subsidence, will be necessary only in specific areas. The SRA has no objection to mining taking place in a controlled manner along the general route provided that companies consult with the SRA before extraction is planned.

Major bridgeworks are planned for the two river crossings and it will be necessary to limit the extraction of coal beneath

over →

these locations. Some restrictions may also be necessary beneath the crossing of the F5 Freeway and Trunk Road 95.

Because of the possible effect of subsidence on the railway tunnel, restrictions on coal extraction will also be necessary along its route. This will result in limitations being placed on coal recovery in the Wongawilli Colliery of Australian Iron & Steel Pty Ltd.

AIS INVOLVEMENT

Offices of the Department of Mineral Resources and Wongawilli Colliery have indicated that no further coal extraction is proposed from either Wongawilli or Bulli seams underlying the immediate area of the tunnel where extraction could have an effect on the structural significance of the tunnel. The presence of main access roadways in the area of the pit and prior pillar extraction inhibits further extraction. Beyond the western portal where future workings may extend, provision will be made for subsidence effects.

In the view of the Department of Mineral Resources and the Company, both the existing two tunnel route and the alternative single long tunnel route will have no effect on coal sterilization.

Minor amounts of coal may be sterilized in areas beneath specific major or steep sided cuttings along the route. These will not be identified until detailed design is undertaken.

WHAT IS DEFINITION OF MINOR

7.2 SOILS

An unavoidable impact of surface clearing is increased runoff and soil erosion. The aims of the programme which will be implemented by the SRA to minimise soil erosion are to:

- conserve topsoil for rehabilitation;
- construct stable batters;
- construct proper surface water drainage systems and to control erosion by diverting runoff to well vegetated areas and existing drainage lines;
- promote the return of native species possibly after an initial phase of stabilization by temporary exotic species;

- use specialized techniques for stabilization such as jute meshing, hydro and hay mulching and bitumen emulsions.

Much of the proposed railway line traverses protected catchments under the juristiction of the MWS&DB. Consequently, water quality and, therefore, the amount of runoff and erosion generated by the proposed railway line is of particular importance. This is discussed in Appendix C.

The SRA recognizes the high erodibility of soils on the development sites and will implement an effective soil conservation programme to minimise erosion. The details of the programme have been developed and will be implemented in conjunction with the SCS and MWS&DB and are outlined in the Appendices.

Broadly, the three main areas in which safeguards against soil erosion will be implemented are earthworks, surface drainage, and vegetative stabilization during construction and operational phases of the railway line. Details of these safeguards are set out in Appendices A and B. Site disturbance will be kept to a minimum during the construction period to minimise erosion.

Batter slopes will be controlled to minimise instability.

Throughout the entire works, a drainage system will be established which at all times will drain water directly off or keep water away from all structures, formation, access roads, cut and fills, and work areas. The drainage system will ensure that no damage is caused to structures associated with the railway, the pattern of flow on neighbouring land is not adversely altered, soil erosion is minimised, and that water rights of neighbouring landowners are not affected.

Catch drains will be constructed along the tops of all major cuttings to impede surface flow. Steeper batters will be constructed with a bench at the base.

Table drains will be constructed along all new upgraded roads in order to direct road runoff onto stable areas. Where possible, new roads will be constructed along ridgelines in an attempt to minimise their impact upon the present surface drainage.

Clearing will involve the removal of all large vegetation, stumps, logs, and property improvements within the railway easement. Substantial trees which do not effect driver visibility or could not fall onto the lines can be left.

Topsoil along the route will normally be stripped to a line about three metres outside the toes of the embankments or tops of cuttings. Care will be taken to minimise the disturbance of areas beyond this width. Stripped topsoil will be stored in appropriate areas for later use for rehabilitation of embankments and cuttings.

The stockpiled material, which contains valuable organic matter and vegetative seed store, will be respread on those disturbed areas which do not have a permanent cover. Because a certain amount of erosion and surface movement will be unavoidable, filter dams will be constructed in drainage lines downslope of major cut and fill sites.

Because of the extent of cutting, excavation in this area and excavation from the tunnel, it will be necessary to dispose of excess material on suitable areas adjacent to the ridge-line. The recommended location of these disposal areas is shown in Figure 5-14. The quantity of excess material will be minimised, where economical, by its use elsewhere along the line where fill is required. The SRA will restrict the extent of borrow areas located within the MWS&DB Catchment Area.

Soil erosion measures will include grassing of all earth-faced embankments and cuttings, and all major earth drains and levee banks.

A grass seed mixture approved by the SCS will be applied to provide a rapid vegetation cover in agricultural areas. Upon completion of grassing, maintenance will be continued to ensure that the grass seeds have germinated and commenced to form a vegetative cover which will minimise soil erosion.

Within the MWS&DB boundary, the SRA will examine the feasibility of using native grasses and plants to vegetate the exposed earth in order to eliminate the introduction of exotic species into the large area of predominantly natural habitat. No mulch material will be introduced into the area which could contain weeds or exotic plant species. Small native vegetation cleared from the area before construction will be used as mulch.

Additional stabilisation techniques such as hydro mulching, bitumen emulsion and hay mulching on areas requiring special erosion treatment will be undertaken with the advice of the SCS.

Any necessary borrow areas will be restored by grading to permit normal surface drainage, covered with topsoil, and vegetation. Upon removal of temporary facilities, buildings and other material from construction areas, these sites will also be covered with topsoil and vegetated.

In the Catchment Area, the extent of clearing will be determined in consultation with the MWS&DB.

7.3 LANDFORMS AND LAND USE

The establishment of the proposed railway line will create a permanent change to the landsurface configuration by way of cut and fill along the railway alignment. However, this impact will be relatively minor because the changes in landform will be designed to ensure that only minimal disruption results to land use and surface drainage. These changes is outlined in Appendix B.

It will be necessary to acquire land in the Maldon - Wilton area to provide an easement for and access to the proposed new railway line.

The proposed rail route passes within 100 metres of the western end of the airstrip presently used by the Wilton Parachute Club. Consultations are being held with officials of the Club and the Department of Civil Aviation in respect to the restrictions this may place on the Clubs operations.

Figure 7-1 illustrates the topographical relationship between the existing airstrip surface and the proposed railway. The airstrip is currently 900 metres in length. 600 metre length is adequate for light aircraft. Options are available to minimise the effect of the line on aircraft operations. One, illustrated in Figure 7-1 involves the filling of the northern section of the airstrip to increase its height relative to the railway. Alternatively the strip could be reorientated. A combination of these two options is also feasible. Earthwork, if required, would take place concurrent with rail construction.

Through the MWS&DB Catchment Area the land on the route will probably be a reservation or easement subject to Board conditions. There will be no adverse effect on recreational use of these areas as the MWS&DB limits public access to them.

All-weather access roads to all parts of the route from public roads will be established for both railway line construction and maintenance purposes. Their routes have not yet been determined but will be accordance with the requirements of relevant Authorities.

During construction of the proposed railway line every effort will be made to avoid causing inconvenience to land users over which the line will pass.

The SRA or its construction contractors will assume responsiblity for the safety of stock on and near the site.

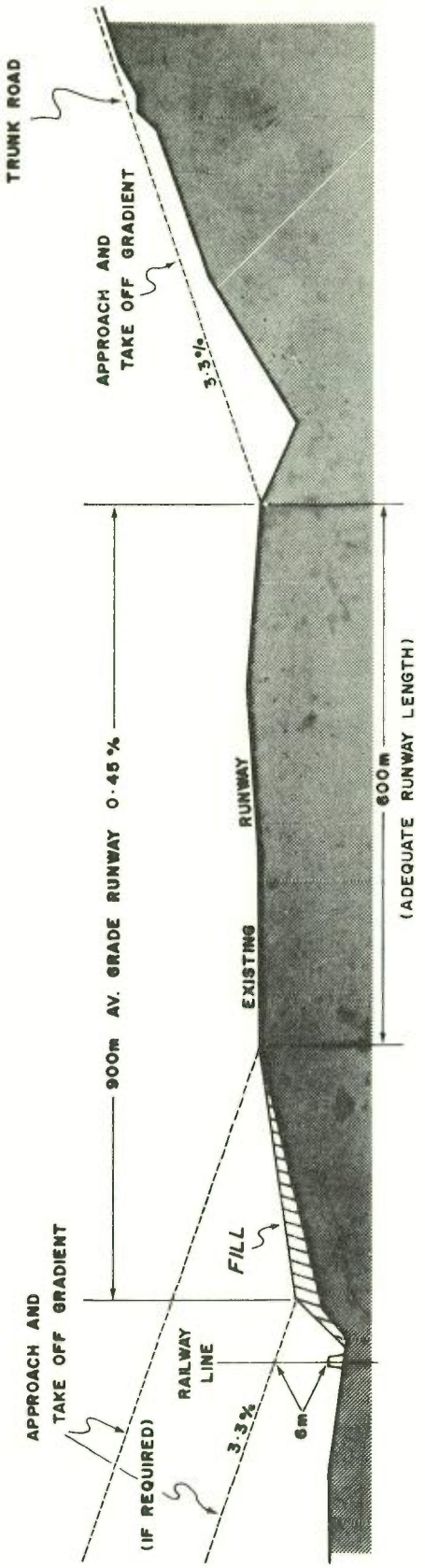
Every effort will be taken to prevent pollution of waterways, dams and grass area which may in turn affect the value or health of stock.

Once contractors have become active in the Catchment Area and adjacent to the State Recreation Area near Dombarton, controlled access point will be established to each site.

7.4 HYDROLOGY AND WATER QUALITY

Since the proposed line follows the ridge crest between the Avon and Cordeaux Reservoirs, and will cross the Nepean and Cordeaux Rivers on high level bridges, the hydrology and water quality impacts of the operation are expected to be negligible. Further information can be found in Appendix C. The line will cross a number of minor streams which flow into the south eastern portion of the Avon Dam near the entrance to the Dombarton tunnel, and associated works will cause slight modification to the existing flow regime. This will have no long term impact on flow into the Reservoir.

Construction of the line will result in slight modification to drainage regimes elsewhere along the route. In particular on that section of the line where it traverses agricultural land, care will be taken to locate culverts such that surface flow is not impeded or catchments affected.



STATE RAIL AUTHORITY

TITLE: WILTON PARACHUTE CLUB AIRSTRIP	FIGURE 7-1
LOCATION: WILTON	
SCALE: AS SHOWN	JOB No: 09886-004-70
	DATE: September, 1983
REF: S.R.A.	Dames & Moore

There is potential for significant short term water quality impacts during and immediately after the construction phase particularly in the area adjacent to the western tunnel portal. Because of the steep slopes and proximity to the dam, it will be difficult to control runoff of turbid waters from construction areas, and the sediment yield to the dam may increase.

Water quality impacts will be minimised by retaining the maximum amount of existing vegetation, by implementation of bunds and sediment control dams, and where necessary by stabilisation through mulching or other means, of the exposed banks and steep areas, to reduce runoff. Water flows will be diverted away from these areas during construction and until vegetation is established. This work will be undertaken in conjunction with the SCS.

The SRA will establish a monitoring programme on streams draining areas which will be affected by construction operations prior to work commencing. The programme will continue until the effects of operations have been ascertained. In the event that a significant deterioration in water quality is observed action will be taken to remedy this.

7.5 AIR QUALITY

Air quality information is provided in Appendix D. Diesel locomotives will emit diesel exhaust consisting mainly of oxides of nitrogen and minor traces of hydrocarbons and particulates. These emissions will be of no practical environmental significance.

At loading and unloading points, there will be emissions of coal dust, however the impact of these will be minor and local in effect. Truck design includes sloping rear and front ends so that any splinter coal in the loading process will fall to the ground at the loading point and not be caught on the sides of the truck. In addition, coal moisture content is kept high to minimise dust generation at any stage in the handling and transport. There are no loading points on the line.

Monitoring programmes have been undertaken which demonstrate that coal trains do not result in degradation of local air

quality. Consequently no adverse air quality effects are expected due to operation of the line.

During the construction phase there will be some dust generation however this will be local in effect and of a temporary nature. The SRA and the construction contractors will adopt standard procedures to ameliorate dust generation at the construction sites and along dirt roads. Where appropriate this will involve watering of dirt roads and exposed spoil faces prone to dust generation.

Under Section 16 of the Clean Air Act an approval to commence construction is required from the SPCC. This approval relates to dust generation, burning-off etc., during construction activities.

7.6 VEGETATION

The main impacts of the proposed rail construction will be within the MWS&DB Catchment Area. Outside the Catchment Area, the railway will disturb a small segment of native vegetation in the Nepean River gorge at the bridge site. The tunnel portal and junction at Dombarton will necessitate the dissection of a stand of sub-tropical forest, but this will occur wherever a portal might otherwise be sited along the Illawarra escarpment. No known rare or threatened species have been noted outside the Catchment Area. However, the presence of equivalent rainforest for some considerable distance north and south of the proposed portal and junction at Dombarton should mean that such species would not be immediately threatened by the proposal.

Within the Catchment Area, the rail construction would require clearing additional to the areas already cleared for the MWS&DB fire roads. Over most of the route, this is not seen as ecologically significant because the dry sclerophyll forest and woodland through which the route passes extends over most of the Catchment Area and the clearing would remove only a very small proportion of the total occurrence.

However, the proposed route intersects two swamp areas. Easement clearing, provision of access and line construction could result in a change of the swamp habitat and a loss of the swamp vegetation and flora in this case.

Because on constraints imposed on the route by the grade, the location of tunnel portal, and the need to avoid the foreshore of the Avon Dam, it is not possible to locate the line to avoid these areas.

The line will be constructed over culverts at these locations to ensure continued drainage flow to and through the wetland areas. Some fill will be necessary but this will be minimised. A detailed examination of evaluation of swamps in the area will be undertaken, with objectives first to confirm the presence or absence of rare species within the affected swamps and second to determine the degree to which individual swamps in the area are replicates of each other.

Vegetation control, including weeds, is an important aspect of on-going operations.

As part of safety requirements and action taken to minimise bushfire risk, vegetation is controlled adjacent to railway lines. Vegetation is controlled chiefly by chemical treatment. An annual control programme will be implemented once construction of the line has been completed. Only chemicals approved by the MWS&DB will be used in or adjacent to the Catchment Area.

Noxious weed control will be undertaken as appropriate. Within the Catchment Area, provided care is exercised in relation to soil mulch material introduced during the construction phase, little difficulty with weeds is anticipated. In agricultural areas, similar practices to those employed by local landholders will be followed. Further information on vegetation can be found in Appendix F.

7.7 TERRESTRIAL WILDLIFE

It is not envisaged that construction of the proposed railway will cause any major adverse impact on regional fauna populations since the line will only destroy a thin line of their habitat. This is discussed in Appendix F. The line will mostly be located in habitats previously disturbed by Trunk Road 95, other roadways and a natural gas pipeline.

To minimise the obstruction to macropod fauna movement, the SRA will install underneath the line several large box culverts some 2 m high to permit movement where appropriate.

Furthermore, the railway line will not be fenced through the MWS&DB Catchment Area, which will also permit faunal movement across the proposed line.

The wet heath or swamp community is a small and comparatively rare habitat important because it has a local profusion of bird life and serves as a drought refuge for non-resident reptiles. This habitat is threatened by siltation and water diversion during construction of the railway if erosion-control measures are not undertaken.

The firebreak and maintenance track alongside the proposed railway line will provide better access for bushfire control, which may in turn reduce the numbers of wildlife lost in a large fire.

7.8 ARCHAEOLOGY

The archaeological surveys which traversed the proposed route of the railway and adjacent areas located five archaeological sites. In addition, 16 Potential Occupations Sites were located. Details are provided in Appendix G. The railway route has been relocated to avoid impact on the five archaeological sites. Care will be taken during construction to ensure that these sites are preserved.

In the event that any of the Potential Occupation Sites are to be disturbed or that relics are discovered during the construction operations, the SRA will immediately notify the National Parks and Wildlife Service in accordance with the relevant legislation.

A detailed survey will be undertaken of those areas on which spoil disposal and borrow areas are planned to be located to ensure that no sites will be affected. If construction work is undertaken outside the area surveyed, further archaeological studies will be made to examine whether other Aboriginal sites or relics may be disturbed.

The SRA is undertaking consultations with members of the Aboriginal community in the region to ensure that the communities are advised of the proposed development and that the importance of any sites or areas affected can be evaluated and protective measures formulated.

7.9 VISUAL EFFECTS

The visual impact of the proposed new rail line must be considered in the content of the existing characteristics of the area through which it passes.

The variables that form the components of visual impact are summarised below, together with actions proposed to ameliorate any adverse effects.

SCALE: A significant visual impact of the proposed development relates to the physical magnitude of structures including bridges, cuttings and rail facilities. The major bridges at the Nepean and Cordeaux Rivers will impose on the local landscape as well as the underpass of the three roads in the Maldon to Wilton section. The Nepean bridge will be of a similar scale to the existing Trunk Road 95 bridge and the road underpass will be of a scale similar to or smaller than existing roadworks for the F5 Freeway. The Cordeaux bridge will be in contrast to other local features but will not be highly visible due to its isolated location. The line and associated facilities are of sufficient scale to be significant in total, but apart from structures like cuttings, sub-stations and passing loops, will not impose significantly on the local landscape.

FORM: In the area between Maldon and the MWS&DB Catchment Area, the form of the railway, the Nepean bridge and roadway underpass will be similar to existing transportation corridors in the area. They will be in contrast to the local rural countryside character of the area, but this already has been disrupted by the other developments. Within the MWS&DB Catchment Area the line will be in contrast to other visual characteristics but will only be visible at close quarters.

COLOUR: The major impact on existing colour will be the presence of cuttings or embankments of disturbed soil and other material. Over time and with revegetation, the colour of these exposed surfaces will match the existing rural and natural colour scheme. The colour of passing trains will be in contrast to other local colours but will be intermittent.

MOVEMENT AND ACTIVITY: The principal source of impact incorporated in this variable will be the movement of construction equipment and personnel and train operations. The former will be significant but temporary. The latter

will be intermittent. Both are unavoidable. They will be most significant within the Catchment Area in which they will not be visible to the public because of the restricted access to the area.

LIGHT: The major effect of lighting will be the night lights on passing trains and lights at the Wilton Siding. The former will be intermittent and not likely to cause annoyance. The latter is situated away from the Wilton urban area and no houses are located near it. However, depending on the extent of lighting at the siding, the overall effect could be a distant glow which would be in contrast to the present character of the area.

CHARACTER: The alteration of land along the route from either rural or natural to a transportation corridor will be a significant local effect. This will be particularly noticeable during the construction phase and will diminish as the railway corridor assumes the character of the adjacent established rail and road routes in the Maldon to Wilton area and as revegetation of disturbed areas occurs within the Catchment Area.

Action will be taken by the SRA to minimise visual obtrusion. Electrification masts and sub-station designs (Figures 5-5 and 5-6) have to be selected to result in the least visual impact. The underpass of roadways between Maldon and Wilton and the location of the route to the south of Thorntons Hill will minimise visual impact in this area. The retention of all possible native vegegation within the Catchment Area will shield the line from general view. Revegetation of disturbed surfaces will harmonise with local conditions. The design of bridges over the two rivers will be functional and their appearance will be "clean-cut" and not unattractive.

7.10 NOISE

7.10.1 CONSTRUCTION PHASE

Section 27 of the Noise Control Act requires approval to be given by the SPCC prior to the commencement of constructon. The noise producing items of equipment, that will be used in the construction phase, and their maximum associated noise levels (at 15 metres) are listed below:

- one D10 dozer (equipped with blade and ripper - 90 dB(A);
- one front end loader - 87 dB(A);
- two 25-tonne trucks - 88 dB(A);
- one sheeps foot roller; and,
- one vibrating roller.

Assuming a 6 dB(A) attenuation per doubling of distance, the maximum noise levels at the closest residences in Wilton which is 1,300 metres away, can be expected to be 55 dB(A). Topographical shielding could be expected to reduce the L_{max} level of 55 dB(A) by at least 11 dB(A) to 44 dB(A). The estimated L_1 and L_{10} noise levels are 40 and 34 dB(A) respectively. The L_{max} and L_1 noise levels are therefore estimated to be 9 and 5 dB(A) above the existing L_{90} and the L_{10} is estimated to be 1 dB(A) below the existing L_{90}.

Construction will be confined to day-time hours only, 7 a.m. to 6 p.m. Considering these relatively low predicted noise levels, the short duration of the construction period (the line will on average be built at a rate of 1 km per month) and the restricted hours of work, it is not expected that construction will give rise to significant inconvenience.

It is not envisaged that blasting will be used, however if some small charges are required, the residents within two kilometres of the blast area will be informed prior to the blast, and noise and vibration levels will be monitored.

In addition to the general residences in Wilton, there are four residences within 190 to 380 metres of the proposed track (see Figure 5-12 Volume 1) and the maximum noise levels experienced at these locations will range from 71 to 65 dB(A) with predicted L_1 and L_{10} noise levels ranging from 66-60 and 62-56 dB(A) respectively. The temporary nature of the construction work, which will be confined to day-time, should result in only minor inconvenience to these residents.

7.10.2 MALDON TO WILTON AREA

Noise levels associated with trains which will use the line are listed below:

- wheel/rail contact noise;
- engine noise (diesel and electric);
- noise from regenerative braking;

- o noise from dynamic braking;
- o brake squeal (intermittent), and;
- o warning hooter (intermittent).

In normal operations, it is expected that 24 train trips each way per day will be required for hauling coal. Since the diesel-electric trains are a little noiser than electric locomotives, they have been used in the impact assessment calculations.

The closest approach that the railway will make to the higher density residential areas in Wilton is about 1,300 m. There will be no requirement for braking or use of the horn except in unusual circumstances. Maximum noise levels at that distance will be about 64 dB(A) regardless of the type of locomotive used. This predicted noise level does not take into account the shielding which will be provided by topography. This will be highly variable but the minimum shielding effect is estimated to reduce the 64 dB(A) by 11 dB(A) to 53 dB(A). This is 23 dB(A) above the night-time background for the area and 13 dB(A) above the day-time background. This is significantly less than the maximum noise levels that are presently experienced from cars and trucks travelling through the town. The noise level will persist for a few minutes rather than a few seconds as with a cars and trucks, but a maximum of 48 train passes per day is unlikely to cause a significant deterioration in the acoustic environment. In fact if the reduction in coal truck traffic is considered, then the net effect on the acoustic environment, will almost certainly be considered by most residents to be beneficial.

There are four residences which will be within the range 190 to 380 metres of the proposed line and at this distance the maximum noise levels could be as high as 75 dB(A) for the closest of these or 71 dB(A) for the most distant. This is significantly above the existing day and night-time backgrounds (L_{90}) for the area (40 dB(A) and 35 dB(A) respectively) and may cause some sleep disturbance until residents become accustomed to the noise. No time restrictions are planned for routine train operations.

To determine specific measures that would be required in the Wilton area, an acoustical consultant has been appointed to undertake a study. In consultation with the SPCC, acceptable

noise criteria levels from trains will be established recommendations made for the measures required to obtain these levels. The SRA will evaluate, and as appropriate implement these recommendations in the detailed project planning.

7.10.3 METROPOLITAN CATCHMENT AREA

The closest approach that the line will make to the picnic area on Lake Avon is about 4 km. At this distance, maximum train noise levels will be about 59 dB(A). Air absorption over this distance could be expected to reduce this level by about 11 dB(A) to 48 dB(A). This is 9 dB(A) above the day-time background observed at the Cordeaux picnic area which is likely to have a similar noise environment and 18 dB(A) above the 30 dB(A) which is customarily adopted as the night-time background noise level for very quiet areas where measured L_{90}'s are less than 30 dB(A). Thus while trains are travelling past these areas at night they will dominate the noise environment however the low frequency of trains and the short duration nature of the noise makes it unlikely that the recreational amenity of these areas will be diminished.

No vibration effects are anticipated outside the boundaries of the SRA reserve except for the effects of some blasting during the construction phase. This will be temporary and no buildings will be affected.

7.11 SOCIAL AND ECONOMIC ASPECTS

An examination of the impact of the proposed development on the socioeconomic environment is discussed in Appendix J.

It is not possible, in relation to social and economic impact, to differentiate meaningfully between the construction and operational activities of the new line between Maldon and Dombarton and the duplicated section betwen Dombarton and Port Kembla. As a consequence, the following information relates to the full project.

7.11.1 CONSTRUCTION PHASE

Total man-hours by each major labour and task during the construction phase are shown as Table 7.1.

TABLE 7.1

MAN-HOURS

CATEGORY	UNSKILLED	TRADESMAN	OPERATORS	STAFF	TOTAL
Major Bridges	93,530	78,710	18,750	43,050	234,040
Minor Bridges	27,960	23,220	4,360	13,140	68,680
Tunnel	276,880	125,460	129,510	191,180	723,030
E/W and Drainage	76,860	69,660	287,610	108,350	542,480
Trackwork	70,070	31,750	32,770	42,330	176,920
Sigs/Comm/Elec	77,440	210,550	-	31,190	319,180
TOTAL	622,740	539,350	473,000	429,240	2,064,330

Source: SRA

When these figures are applied to the construction schedule for this project, the estimate of total man-hours for the construction programme is 2,084,544.

Presently, the programme is planned over 33-36 months with the earthworks, bridges and culverts team assumed to be working in advance of the ballast, track-laying and signalling groups. The latter task does not commence until about 9 months into the schedule. The on-site peak workforce of 468 should occur at around month 18. After month 6 the number of on-site jobs would remain relatively stable at around 280 workers. In addition, there will be an off-site workforce directly associated with the project.

As the railway line is located in close proximity to both Wollongong and Sydney, all of the workforce is expected to either commute to the job on a daily basis or stay in hotel or motel accommodation for the work-week. The latter would most probably consist of sub-contractors with the shorter tasks to perform.

As the workforce will mainly commute to the site, the stimulus to the local labour market and economy is difficult to estimate. Assuming as a minimum that all operator jobs and unskilled jobs are taken by local workers, a substantial short-term boost to the local economy from the re-spending of their income may be anticipated.

Assuming total payments to labour for the project are $32.65 million, some $21.42 million would flow to the local economy over 33-36 months. As there are a relatively high proportion of tradesmen presently available in both areas, the injection of salaries to the local area could be considerably higher.

The effect on service industries in the City of Wollongong will also be substantial. Up to 970 short-term jobs can be predicted to result from the stimulus to the construction industry. This figure must be tempered by the present high level of excess capacity in the City's manufacturing sector.

7.11.2 OPERATIONAL PHASE

The operational workforce required to operate the line will be train crews plus a six man inspection and maintenance gang on the line. Additional signalling personnel would be necessary at Wollongong. It is not expected that this labour

would be drawn from the smaller centres on the western portion of the line. They are most likely to be from existing staff in Wollongong or Sydney.

On the basis of 24 loaded trains per day, 17.2 million tonnes of coal could be transported per year. In order to move the same volume of coal per day by truck would require in excess of 5,000 (2 way) trips per day.

The diversion of coal onto the new railway line will significantly effect the growth of the road transport sector in Wollondilly Shire. In the City of Wollongong, the relationship does not appear to be as significant.

Some 271-400 workers, representing 3.4 to 5.1% of the Wollondilly Shire workforce are presently engaged in road transportation. The potential longer-term decrease of employment in this local sector in the operational phase could be balanced against the short-term construction opportunities that will be created and the possible diversification of truck operations.

Operation of the railway line will reduce road truck traffic on Trunk Road 95, the Princes Highway, and on roads leading to the coal Loader in Wollongong. The amount of coal truck traffic on these roads has been the subject of concern and complaint over recent years. A reduction in the truck movements will result in improved amenity, better traffic flow, fewer road accidents and lower road maintenance costs.

The line will also provide improved access to the Port Kembla Coal Loader and will facilitate the supply of coal to the proposed Stages IIA and IIB of the Loader.

7.11.3 ENERGY USE

The anticipated fuel requirements for a 3000 tonnes train travelling between Maldon and Port Kembla is 1,700 litres for three 442 class diesels or 5530 kilowatt hours for three 85 class electric locomotives.

At this stage no energy requirements for the construction phase can be accurately estimated.

7.12 LOCAL COMMUNITIES

7.12.1 WILTON TOWNSHIP

The SRA has responded to the concerns of the Wilton townspeople and considered the township of Wilton when making their final decision regarding route location. Through the results of public meetings and a residents survey, it was considered that the most satisfactory alternative for the railway line route was to pass around the southern side of Thornton's Hill, minimising the social and environmental impacts of the proposed railway line on the township of Wilton.

7.12.2 WILTON AREA LANDHOLDERS

The proposed route is located within 500 metres of three house, directly affects only one dam and the catchment area of only three others.

The landholders who will be directly effected by the railway preferred route are J. Nixon, T. Blair, B. Burge, L. & B. Biggs, M. & C. McCarthy, Dalbar Pty Ltd, the Australian Gas Light Company and the Department of Main Roads. These properties and the proposed railway line are shown in Figure 5-12 and are listed in Table 5.2.

The effect on Nixon, Blair and Burge is similar as they all own large parcels of land. The railway cuts through all three properties and alternative farm management practises will be required. The SRA is holding consultations with these property owners at present.

Biggs, McCarthy, Australian Gas Light Company, Dalbar Pty Ltd and the Department of Main Roads are all smaller properties. The railway location will interfere with their long term plans to build a house, and minimise the usefulness of the land for farming.

The effect on Dalbar Pty Ltd and the Department of Main Roads property is minimal as the railway only cuts a portion of the land. The loss of land is unlikely to cause any major impact. At present Dalbar Pty Ltd lease their land to a parachute club. The area contains an airstrip and target landing ground used generally on weekends by the parachute club. The location of the railway may restrict the

activities of the parachute club. This is discussed in Section 7.3.

7.13 BUSHFIRES

Risk of wildfires will be very greatly increased during line construction. Potential ignition sources include lunch-time fires, cigarettes and machinery and vehicles with faulty or unsuitable exhaust systems.

Once the line is in operation, risks will be very slight, resulting primarily from train braking, and should be effectively minimised by maintenance of fire breaks within the railway reserve.

The Clean Air Act, 1961 is binding on the SRA. The effect of this is to restrict the use of fire for the disposal of matter in specified areas by the SRA. Fire hazard reduction in or adjacent to urban areas is generally achieved by moving and cutting vegetation. In rural areas controlled burning-off is the most common practice.

Burning-off practices are carried out in accordance with the Bush Fire Act 1949. Railway regulations require the construction and maintenance of a firebreak on all property boundaries of at least two metres wide with cross breaks at 500 metre intervals.

Fire control and prevention measures will be developed and implemented in association with local landholders, bushfire authorities and the MWS&DB.

Sufficient suitable fire fighting equipment will be kept on the site ready for use at all times during construction.

8.0 STUDY TEAM

SRA Maldon - Port Kembla Project:

Project Manager	:	Mr Doug Neil - SRA

SKP Project Management Team:

Project Director	:	Mr. David Howarth - SKP
Project Environmental Engineer	:	Mr. Tim Macoun - SKP

Environmental Studies and EIS Preparation:

Study Director	:	Mr Warren Atkinson - D&M
Study Manager	:	Ms. Kerry Morrison - D&M
Land Studies	:	Dr Stuart Miller - D&M
	:	Mr Peter Ryan - D&M
	:	Mr Malcolm Hughes - D&M
Hydrology and Water Quality	:	Dr Ian Irvine - D&M
Climate and Air Quality	:	Dr Nigel Holmes - D&M
Vegetation	:	Dr Tim Fatchen
Wildlife	:	Dr Bob Root - D&M
Archaeology	:	Ms. Val Attenbrow
	:	Dr Johan Kamminga
Noise	:	Dr Nigel Holmes - D&M
Local Communities	:	Ms. Kerry Morrison - D&M
Social and Economic	:	Mr Doug Martin - D&M