Mainline Upgrading - Evaluation of a Range of Options for the Adelaide - Serviceton Rail Link

Report

In this Report a number of options for the railway line between Adelaide and Serviceton have been evaluated. This work complements that previously undertaken on the Melbourne to Serviceton link. There appears to be little likelihood of congestion on this link sufficient to justify major upgrading within the next twenty years although some minor loop extensions and the introduction of Centralised Traffic Control are justified now. There is no economic justification for any of the Project Peregrine schemes considered for the Adelaide Hills sections.

BUREAU OF TRANSPORT ECONOMICS

MAINLINE UPGRADING - EVALUATION OF A RANGE OF OPTIONS FOR THE ADELAIDE-SERVICETON RAIL LINK

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FORWARD

The Bureau of Transport Economics has been undertaking a series of studies of main line rail links as part of a general assessment of railway freight operations. In this report a number of options to upgrade the railway line between Adelaide and Serviceton have been evaluated. This work complements that previously undertaken on the Melbourne to Serviceton link.

There appears to be little likelihood of congestion on this link sufficient to justify major upgrading within the next twenty years although some minor loop extensions and the introduction of Centralised Traffic Control are justified now. There is no economic justification for any of the Project Peregrine schemes considered for the Adelaide Hills sections.

The study was carried out by a team from the Operations Research Branch under the general direction of R.W.L. Wyers. The team leader was A.J. Storrey and his principal assistants were L. Riggs and K. Porra.

The successful conduct of a study of this nature depends heavily on the co-operation of many parties and I would like to acknowledge in particular the assistance provided by officers of the South Australian Railways.

(G.K.R. Reid)
Acting Director

Bureau of Transport Economics
Canberra
August 1977

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SUMMARY

This report forms one of a series by the Bureau of Transport Economics on mainline upgrading which forms part of a general assessment of railways freight operations. This assessment is being made at the request of the Australian Transport Advisory Council (ATAC).

The study procedure adopted was similar to that used in previous Bureau studies of this type. Forecasts of traffic growth were made and the capacity of the line to carry the forecast traffic was assessed. Sections where congestion would occur were identified and various upgrading options were evaluated.

The evaluations were undertaken from two points of view: firstly from the commercial viewpoint of the railway system, and secondly from the point of view of optimum allocation of resources in the transport sector. Options evaluated included Centralised Traffic Control (CTC), grade and alignment changes and extension of crossing loops.

The conclusions reached were that the best option is to introduce CTC between Nairne and Tailem Bend and extend crossing loops at Petwood, Callington, Monteith and Tailem Bend as soon as possible. None of the Project Peregrine schemes for improvements in the Adelaide Hills sections was found to be financially or economically viable within the twenty year study period. Similarly it was concluded that no upgrading was justified between Tailem Bend and Serviceton.

CHAPTER 1 - INTRODUCTION

The study reported here complements that previously published on the Melbourne-Serviceton line and completes a review of the Melbourne-Adelaide link[(1)]. It forms part of a general assessment of railway freight operations being carried out by the Bureau of Transport Economics which was initiated at the request of the Australian Transport Advisory Council (ATAC) in July 1973. Similar studies have now been completed for all the inter-capital rail links.

The procedure adopted for the study was the same as that used in similar studies of this nature. Traffic forecasts were made for a 20 year study period and train movements were simulated to identify sections where congestion is likely to occur. Possible upgrading options were then examined and their impact in reducing congestion was assessed. For those which were judged to be most effective in reducing congestion the time of optimal upgrading was determined.

The evaluation was undertaken from two distinct viewpoints. Firstly the options were assessed on a basis of the commercial viability of the railway. That is the capital costs of the upgrading were compared with the financial return to the railway by way of reduced operating costs and increased revenue. Secondly the upgrading options were assessed on the basis of the resource costs to the community as a whole, including the costs to users and to the community of diverting the goods to other modes when rail capacity was reached.

The analysis included allowance for traffic generated by the planned Monarto development, but on examination this was found to have little effect on the results of the evaluation.

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(1) Bureau of Transport Economics, Mainline Upgrading - Evaluation of a range of options for the Melbourne-Serviceton rail link, (AGPS, Canberra, 1975).

The report is written in six chapters. The second chapter contains a description of the existing facilities and operations. Chapter 3 presents the quantity of traffic expected to move by rail on the line over the next 20 years. The fourth chapter describes the upgrading options considered in the study and Chapter 5 gives details of the methodology used in the evaluation. Chapter 6 gives details of the evaluation results and the conclusions reached.

CHAPTER 2 - DESCRIPTION OF EXISTING FACILITIES

PHYSICAL LAYOUT

The single track portion of the broad gauge line between Adelaide and Serviceton has been considered in two sections: Adelaide-Tailem Bend and Tailem Bend-Serviceton. The multiple track section of line between Adelaide's Mile End yard and Belair was not considered in detail in this study.

Figure 2.1 shows a schematic diagram of the section of line from Belair to Tailem Bend giving the position and length of crossing loops. Similar details for the Tailem Bend to Serviceton section are shown in Figure 2.2. Over the last few years, South Australian Railways (S.A.R.) has extended many of the crossing loops on this line to a length which is adequate to handle trains worked by multiple locomotives.

The maximum loadings, in trailing tonnes, for the various class locomotives used on the sections are:

Section	Locomotive Class	Up (tonnes)	Down (tonnes)
Belair-Tailem Bend	700	800	750
	930	570	570
Tailem Bend-Serviceton	700	2100	1400 (1)
	930	1700	1400 (1)

(1) Loads limited by conditions beyond Serviceton.

The maximum loadings for multiple working are simply calculated by addition of the loadings for each individual locomotive used on the train.

South Australia's early railways were built individually, and in isolation, from port to inland centre to provide reliable transport for grain and other farm produce to reach navigable waters.

DISTANCE TO ADELAIDE (KM)		LOOP LENGTH (METRES)
120	TAILEM BEND	
110	MONTEIGH	437
101	RABILA	435
97	MURRAY BRIDGE	630
82	MONARTO SOUTH	1150
72	CALLINGTON	411
66	BALYARTA	366
62	PETWOOD	311
56	NAIRNE	435
50	MT BARKER JUNCTION	0
46	BALHANNAH	738
37	BRIDGEWATER	431
34	ALDGATE	765
31	MT LOFTY	619
27	LONG GULLY	413
22	BELAIR	
0	ADELAIDE	

FIGURE 2.1

POSITION AND LENGTH OF CROSSING LOOPS

BELAIR TO TAILEM BEND

DISTANCE TO ADELAIDE (KM)		LOOP LENGTH (METRES)
315	SERVICETON	
307	WOLSELEY	585
294	BORDER TOWN	820
282	CANNAWIGARA	427
273	WIRREGA	1006
261	BRIMBAGO	172
249	KEITH	1027
242	BANEALLA	110
228	COOMBE	733
221	KUMORNA	125
211	TINTINARA	1013
200	CULBURRA	769
183	COONALPYN	1066
168	KIKI	1000
160	YUMALI	120
153	COOMANDOOK	775
137	COOKE'S PLAINS	1012
120	TAILEM BEND	

FIGURE 2.2

POSITION AND LENGTH OF CROSSING LOOPS

TAILEM BEND TO SERVICETON

The main south line to Murray Bridge was opened in sections by 1886. The line was doubled to Belair by 1928, and quadrupled to Goodwood by 1929.

In order to achieve the lowest possible capital cost of construction, this line was built to a lower standard of construction than had been used prior to that time. Thus the line, which now carries more traffic than any other line in the State, also has some of the steepest grades and the sharpest curves. The ruling grade over the Mount Lofty ranges is 1:45.

SIGNALLING

The major portion of the Adelaide to Tailem Bend section has automatic signalling under train control. The Belair-Nairne section has recently been converted to Centralised Traffic Control (CTC). Between Nairne and Tailem Bend, signalmen are used only at Murray Bridge and Monarto South. At unmanned stations, crossing trains incur a delay of at least 8 to 10 minutes.

The Tailem Bend to Wolseley section operates under CTC, and an Electric Staff Block system under train control is used from Wolseley to Serviceton. None of the stations on crossing loops is manned by signalmen.

TERMINALS

This report does not consider the implications of traffic growth on the capacity of terminals as the whole question of terminal performance and freight wagon utilization is under separate study by the Bureau. It is obvious, however, that the upgrading of terminals and mainlines must be co-ordinated and balanced if the full benefits of upgrading are to be realised.

PRESENT TRAFFIC

The most heavily trafficked section of main line track in South Australia is between Belair and Bridgewater. In 1974-75 this single track line carried over 9 million gross tonnes. Between Adelaide and Belair, each track of the double line carried approximately half of this tonneage while beyond Bridgewater, as far as Tailem Bend, the tonneage dropped to about 8 million gross tonnes. The section Tailem Bend to Serviceton, carried about 6 million gross tonnes in 1974-75.

For the purposes of this study the trains on the line were divided into five different classes depending on the relative importance of the traffic they carry. The priority allocated to each class for the purposes of computer simulation is shown below. These priorities coincide approximately with those used when timetables are prepared. The actual priority given to any train on any particular day by a train controller is, of course, based on many additional factors.

Priority	Train Type
1	'The Overlander' passenger express
2	Passenger motors and express goods
3	Fast goods
4	Goods
5	Wayside goods.

The distribution of traffic within these train classes for a typical busy day in 1976 is given in Table 2.1.

A small number of local goods trains were not considered in the simulation and were assumed to run at times which cause no delay to the more important simulated trains.

TABLE 2.1 - NUMBER OF TRAINS IN EACH PRIORITY CLASS

Section	Priority Class					
	1	2	3	4	5	Total
Belair-Tailem Bend	2	18	2	8	2	32
Tailem Bend-Serviceton	2	13	2	3	1	21

The trains between Belair and Tailem Bend average about 850 gross tonnes and between Tailem Bend and Serviceton average about 1000 tonnes. The average weight of the important interstate express freight trains is about 1000 tonnes.

CHAPTER 3 - RAIL TRAFFIC PROJECTIONS 1975-1995

The broad gauge link between Adelaide and Serviceton provides four services:

- interstate freight;
- SA intrastate freight;
- interstate passenger; and
- SA intrastate passenger.

In this chapter forecasts of demand are developed for each of these services over the period 1975-76 to 1994-95.

Prediction for any economic activity over a 20 year time span is a difficult task and this comment certainly applies to long distance rail transportation. Examination of historical data for use in long term prediction is complicated by the dominance of cyclical and transient movements which tend to obscure long run trends.

Generally the approach has been to use expected growth in production as a basis for growth in transportation. The important interstate component involves the examination of both total traffic growth and the rail/road/sea traffic split. In particular, the substantial competition and subsequent scope for substitution between road and rail must be considered in order to ensure consistent forecasts for individual modes and total flows.

PASSENGER MOVEMENTS

The patronage of both interstate and intrastate passenger trains has not increased over the past few years. In making a forecast of the number of passenger services to be offered in the study period the impact of the development of the Monarto growth centre was considered. If Monarto goes ahead as planned, the Bureau estimates that by the year 2000 there will be about 2500 return commuter trips between Adelaide and Monarto each day.(1) It is not expected any of these trips will be made by train, since the trip time by train will be at best 1.75 hours compared with about one hour by bus or car after the South Eastern Freeway is completed between Glen Osmond and Crafers. This road will be upgraded regardless of what happens to the railway line. With the potential passengers available and the time difference between road and rail it is expected that public transport will be by bus.

INTRASTATE FREIGHT

Discussions with S.A.R. indicate that the intrastate freight trains currently operating will not be increased during the next 20 years as intrastate freight traffic is stagnant. The development of Monarto will not affect this forecast. The Monarto Development Commission estimates that the 500 tonnes of freight per week required at Monarto will be supplied by truck mainly from Adelaide and the Mount Gambier area.

INTERSTATE FREIGHT

An analysis of interstate freight traffic on this line for 1974-75 and 1975-76 shows that the traffic composition has not changed significantly since the Bureau study of the Melbourne-Serviceton line. In that study the major commodity groups were projected to grow at either the projected population growth rate or the projected growth in real personal consumption expenditure. Overall this gave a compound growth rate of just over 4 per cent. This growth rate has been revised down to 3.5 per cent after 1985 to reflect the more cautious current projections for population growth and economic indices.

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(1) Annex B presents a brief economic analysis of a possible high speed rail link between Adelaide and Monarto.

The demise of the A.S.P. shipping service in 1975, with the consequent lift in rail traffic, has been allowed for in the base tonneages from which the forecasts have been made.

CHAPTER 4 - UPGRADING ALTERNATIVES

In this study, the broad gauge link between Adelaide and Serviceton has been considered in two sections: Adelaide to Tailem Bend and Tailem Bend to Serviceton. A description of these sections is given in Chapter 2 of this report. The main limitations of each section are seen to be:

Adelaide-Tailem Bend: steep grades over the Mount Lofty Ranges, congestion due to crossing procedures at unmanned sidings and insufficient long crossing loops between Nairne and Tailem Bend;

Tailem Bend-Serviceton: there would appear to be no obvious problem areas on this section of line.

ADELAIDE-TAILEM BEND

CTC schemes

In addition to remote control of the power signals from a central point, CTC schemes may also incorporate the construction of new crossing loops or extension and rationalisation of existing crossing loops. Selective extension of crossing loops produces marked decreases in delays if long trains are timetabled to cross at the longer loops. Further reductions in delays are expected from the introduction of CTC, especially on densely trafficked lines, because it reduces each crossing delay at unmanned crossing loops from 8 to 10 minutes for the manual setting of switches and points, to about one minute. The reduction in this crossing delay can lead to significant increases in line capacity.

Remote control of the power signals has no direct effect on line capacity, but allows considerable manpower savings since fewer men are required for signalling purposes. Centralised control may also lead to more effective scheduling by considerably facilitating the train controller's task, and thus increase line capacity indirectly. This possible improvement was not quantified in this study.

S.A.R. scheme for CTC between Nairne and Tailem Bend

The S.A.R. has plans to install CTC equipment on all crossing loops between Nairne and Tailem Bend with the exception of Balyarta and Rabila. The crossing loop at Nairne is already attached to CTC, which means that a further six loops will be connected to the current Belair to Nairne CTC system. In addition to changed signalling the S.A.R. scheme includes yard extensions at Petwood, Callington, Monteith and Tailem Bend.

The capital cost of this scheme is estimated to be:

	$(1976)
. resignal 2 existing loops @ $150 000 per loop 4 extended loops @ $160 000 per loop	940 000
. CTC equipment @ $25 000 per loop	150 000
. linewires to carry CTC supervisory circuits and signalling interlocking circuits @ $2 800 per km	180 000
. extend Petwood yard(1)	414 000
. extend Callington yard(2)	365 000
. extend Monteith yard	144 000
. extend Tailem Bend yard	309 000
	2 502 000
add 10 per cent contingencies	250 200
	2 752 200

TOTAL: $2.75 million

Savings will accrue from the introduction of CTC because all stations may then operate without signalling staff. The saving in manpower is estimated by the S.A.R. to be $259 000 per annum.

(1) High cost due to heavy rock excavation involved in realignment of track.
(2) High cost due to duplication of rail bridge.

This figure includes the base salary and allowances for 20 per cent overtime and 25 per cent railway standard on-costs for the twenty-five signalling staff saved.

Project Peregrine

In a report entitled 'Project Peregrine' the S.A.R. advanced three possible schemes which would upgrade the Adelaide to Tailem Bend rail link. Every scheme would reduce train running times and enable the provision of a high standard passenger service to Monarto. The ultimate design specifications for the upgradings are set out in Table 4.2, but not all specifications are met by any one of the proposed upgradings.

TABLE 4.1 - PROJECT PEREGRINE,ULTIMATE DESIGN SPECIFICATIONS

- Maximum ruling grade: 1:100
- Minimum curve radius: 1600 metres
- Minimum structure gauge: 7 metres high
- Double track: as far as Monarto
- Signalling: both directions on double track due to large disparity between passenger and goods train speeds
- Level crossings: eliminated where line speed exceeds 125 km/h
- Track standard: 160 km/h to Monarto, thence 110 km/h
- Maximum axle loads: 10 tonnes for 160 km/h trains.

Project Peregrine Scheme 1

This proposed upgrading involves small scale improvements to the line which would reduce curvature, increase speeds, decrease the overall distance and thus reduce running times. Each deviation would be short in length, self-contained and able to be constructed and operated independently of all other deviations. No attempt would be made to achieve the desired ruling grade of 1:100 between Adelaide and Monarto. All existing stations would continue to be serviced by the new alignment. The scheme would remove all infringements of the minimum structure gauge, and would include duplication of the line, signalling in both directions, and elimination of level crossings. S.A.R. estimated the cost of this upgrading as $51 million (September 1974 dollars).

Project Peregrine Scheme 2

This scheme proposes a surface line following the existing line, except for two long deviations which would involve heavy construction costs. In addition to improving curvature, grade improvement to the maximum 1:100 standard would be achieved except for Down trains in the first 25 km from Adelaide. Some existing communities would cease to be served, but other communities, not already served by a trunk route would benefit. Provided track standards were adequate, intercity trains to Monarto could cover the distance in just under one hour. S.A.R. estimated the cost of the upgrading as $70 million (September 1974 dollars).

Project Peregrine Scheme 3

In this scheme a long tunnel would be bored between Mitcham and Mount Barker and then an improved line constructed to Monarto. The grade in the long tunnel would be either 1:80 or 1:67, so that with a ruling grade of 1:100 beyond Mount Barker Down goods trains would need to be 'topped up' at this station. This inconvenience is inherent in both Scheme 2 and Scheme 3. Also this scheme would not serve existing communities between Mitcham and Bridgewater and it is probable that the existing line would have to be retained over this length in addition to the new line. S.A.R. estimated the cost of this scheme as $198 million (September 1974 dollars).

TAILEM BEND-SERVICETON

An investigation of the current line indicated that no upgrading of this section would be required during the study period with the expected growth in freight traffic. The results of this investigation are given in Chapter 5 of this report.

CHAPTER 5 - METHOD AND ASSUMPTIONS

The question of how and when to upgrade a railway line is not a simple one to answer. Given a traffic forecast, the problem is essentially one of trading off the reductions in transport cost resulting from the upgrading against the cost of introduction. Like any other production facility, railway lines exhibit an increasing cost characteristic as output is increased beyond a certain point. The main source of additional cost is congestion, reflected as increased train crew costs and motive power and rolling stock investment. Ultimately the point is reached beyond which the railway cannot carry any further increase in traffic, and any additional freight movement is diverted to alternative transport modes. This suggests two points of view for economic evaluation of railway line upgrading; firstly, the commercial viewpoint which in essence is a profit maximising exercise, and secondly, the resource viewpoint which takes into account the additional costs of diversion of traffic to alternative modes.

The analysis of the upgradings from the commercial viewpoint requires not only an estimate of the direct and indirect costs of carrying the growth in interstate freight traffic, but also an estimate of the revenue generated by that traffic. Rail revenue may be considered as a variable during the study period because it would be rational for the railways to increase their rates as congestion costs rise, leading to a new supply/demand equilibrium as the demand curve shifts in response to growth. In practice, however, competition for railway services is far from perfect, with interstate freight dominated by contract arrangements between the railways and a relatively small number of customers. The range of pricing strategies available to the railways tends to be attenuated by the averaging process inherent in lumpy contracts. For similar reasons, freight rates are not expected to fall in the latter part of the study period. Thus, in this study, commercial evaluation of upgrading is based on a constant revenue per unit from the growing traffic over the study period. The average revenue rate for traffic on the Adelaide-Serviceton link is of the order of 1.57 cents per tonne km.

In estimating the resource costs of diverting general freight to another mode when rail cannot accept further traffic, only the road alternative has been considered. General freight traffic favours the higher frequency and shorter transit time of the land modes when compared to sea transport. The two land modes are also readily interchangeable.

The step by step evaluation procedure used in this study is outlined below.

Starting from the freight forecast for each year, the average number of trains in each direction is calculated for an 'average busy day'; each year's traffic is then exercised on a single track simulation of the sections of line subject to congestion delays for both the present line and the proposed upgraded configurations. The estimated delay characteristics are then translated into delay costs and incorporated into an annual net revenue variation as traffic grows. This leads to the idea of line capacity from both commercial and resource viewpoints, which then becomes the basis for the selection and timing of upgradings.

TRAINS REQUIRED TO MEET PROJECTED DEMAND

Since interstate freight is estimated to be the only growth traffic on the line, all other traffic is assumed to operate indefinitely on the present timetable. In practice, the timetabling would be adjusted periodically to take account of operational and demand changes, but it is assumed that in relation to the growing congestion delays, the effect of these adjustments may be ignored.

The present interstate freight trains have an average gross weight of about 1000 tonnes. From data supplied by the S.A.R. the average gross tonneage to load carried was calculated to be 2.24 in the Up direction and 2.87 in the Down direction. These ratios were assumed to remain constant during the study period.

The use of heavier interstate freight trains can be benefical provided that the increase in train length can be accomodated in the existing goods yards and crossing loops, and providing the corresponding reduction in train frequency does not adversely affect market clearance. Heavier, but fewer trains can increase the tonneage capacity of the line, reduce train crew costs and may lead to a reduction in the size of the locomotive fleet.

In the particular case of Adelaide-Tailem Bend, heavier trains would not be practical until the introduction of an upgrading measure which involves crossing loop extensions. In this study, it has been assumed that the extension of crossing loops will not cause any reduction in the current frequency of freight trains and that additional trains will only be timetabled when average train weight exceeds 1400 gross tonnes.

In calculating the numbers of train per day, given a freight forecast and train weight, it is unrealistic to assume that the traffic would be uniformly distributed across 365 days per year. From an examination of the timetable we have estimated that the 'average busy day' traffic may be calculated on the basis of 312 days per year.

It is necessary to postulate a timetable for these new trains before the likely congestion delays can be quantified. Timetables for the projected interstate trains were prepared according to the following guidelines:

(a) A limited number of trains travelling overnight should depart as late as possible in the afternoon and arrive as early as possible the next morning in an attempt to achieve a 24 hour door-to-door service. The remaining interstate freight trains will provide say, a 48 hour door-to-door service.

(b) During the early part of the study period, interstate freight trains are timetabled to depart during normal working hours in order to defer the introduction of multiple shifts for as long as possible. However some overtime may be worked. Because of delays imposed by existing goods yards (especially Dynon), a minimum of 90 minutes is required between the departure of consecutive trains. Thus, at first, the working day is filled in at 1.5 to 2.0 hour intervals.

(c) By about 1980, it is likely (according to some freight forwarders) city congestion or legislation will force most freight to be delivered at night. It is therefore likely that train departure times between 10 pm and 6 am would then be introduced. Thus it has be assumed that existing loading and unloading facilities would be more fully utilised and the traffic on the line would become more evenly spread by making use of what now amounts to an 'off-peak' period.

The timetables developed using these guidelines are summarised in Table 5.1. The order in which additional trains should be introduced as traffic increases is given in this table also.

CONGESTION DELAYS AND CAPACITY

Congestion delays

The congestion delays were estimated by simulating the various line configurations using the Single Track Railway Simulation (STS) model jointly developed by the Bureau and IBM Systems Development Institute. The model allows for the input of departure times, sectional transit running times for the various train classes, track configuration data and train priority weighting factors for resolving crossing conflicts. The model generates synthesised timetables and delay statistics by train class.

TABLE 5.1 - INTERSTATE EXPRESS FREIGHT TRAINS TO 1995-96

Departure Time	Order of Introduction
SERVICETON TO ADELAIDE	
From Serviceton	
1.00 am	9
1.30 am	Existing
4.30 am	7
8.15 am	Existing
9.30 am	8
3.30 pm	Existing
6.00 pm	11
7.00 pm	Existing
9.45 pm	Existing
10.30 pm	10
11.15 pm	Existing
ADELAIDE TO SERVICETON	
From Adelaide	
12.00 midnight	7
10.00 am	10
11.30 am	Existing
1.30 am	8
3.30 pm	9
5.00 pm	Existing
7.00 pm	Existing
7.30 pm	Existing
9.00 pm	6
10.45 pm	Existing

Delays produced by STS were similar to those computed from actual train diagrams. This, together with experience using STS on other mainline studies, increases confidence in the ability of STS to give realistic estimates of the delays caused by high traffic levels in the region of track capacity.

Physical capacity of any line configuration is defined as that traffic level at which the next additional train cannot complete its journey within 24 hours. In practice, it would be impossible to sustain the highest traffic levels synthesised by STS because of non-traffic delays caused by operational factors such as late departures, temporary speed restrictions etc.

In this study, the upgradings are all scheduled before physical capacity is reached, and the capacity definition only affects the magnitude of the benefit-cost ratios in the case of resource cost calculations. Because the simulation permits train running at congestion levels above what could be achieved in practice, the calculated benefit-cost ratios represent a lower limit.

Commercial and resource capacity

As additional trains are scheduled, net revenue will be increasingly eroded by the increase in congestion delay costs until the point is reached where the net revenue increase from an additional train is zero. This is defined as the commercial capacity of the line and defines that point at which the railway, as a commercial operator, would decline further traffic. Subsequent growth in the total freight would be diverted to the next preferred mode.

From a resource point of view, the railways should continue to accept this additional traffic until the marginal resource cost by rail equals the marginal resource cost by the alternative mode. This point is defined as the resource capacity of the line. It would be expected to be somewhere between commercial and physical capacity.

SELECTION AND TIMING OF UPGRADING

The upgradings were compared on the basis of net present value over a range of discount rates, 7, 10 and 12 per cent, using an investment analysis computer program especially developed for this task.

The program selects the optimal year (or years) in the study period in which to introduce an upgrading (or sequence of upgradings) in such a way as to maximise the net present value of the upgrading programme over the study period.

In this study, the upgradings were found to be either economically justified before commercial capacity is reached, or not economically justified at all in the study period. In this case, it can be shown[1] that the optimal timing of economically justified upgradings is independent of the selection criterion (commercial or resource) and the revenue rate.

RESOURCE COST OF TRANSPORTING THE INTERSTATE FREIGHT TRAFFIC

The total resource cost of transporting the railway share of the Adelaide-Serviceton freight traffic can be calculated as the sum of the following:

- total rail line haul cost, including that due to congestion, and road-rail transfer at the railheads;
- cost of rail upgrading, expressed as an annuity during the appropriate part of the study period less savings directly attributable to the upgrading;
- average truck operating cost for diverted traffic, when applicable;

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(1) See the Melbourne-Sydney and Melbourne-Serviceton Mainline Upgrading reports.

- additional cost to diverted traffic and other road users, when applicable; and

- cost of transporting diverted steel traffic by sea, when applicable.

The year by year total resource cost may then be discounted to a single present value at a specified discount rate. The difference between present values for the situations with and without rail upgradings is the net present value of the resource benefit attributable to the upgrading.

CHAPTER 6 - EVALUATION OF OPTIONS

The freight projections used in this study where calculated from the base year of 1975-76. Table 6.1 sets out the interstate freight train projections. The study period is 1975-76 to 1994-95 with all costs expressed in 1976 Australian dollars discounted to 1975-76. For convenience, the years of the study period are designated 1 to 20.

Figure 6.1 shows the delay curves for the existing and upgraded line configurations when the freight traffic grows at the expected rate. The delays are plotted in the form of a congestion factor which is defined as the average delay per train divided by the base average transit time per train. This normalised delay permits comparison of all the main lines under study by the Bureau on a consistent basis. It has been found from experience that unless the congestion factor for a particular line configuration exceeds 0.25 during the 20 year study period, it is highly unlikely that any upgrading can be economically justified. Thus it is possible to identify those sections of line which should be given priority for upgrading. The graphs do not give any indication of the optimal timing of those upgradings.

EVALUATION OF UPGRADINGS - COMMERCIAL CRITERIA

Adelaide-Tailem Bend

In this section the four proposed upgradings for the Adelaide-Tailem Bend line are evaluated from the railway's point of view as a commercial operation.

The existing situation

Figure 6.1 shows that if no upgrading is undertaken the level of congestion will increase sharply after 1989-90. This level of congestion would prove to be commercially unacceptable and freight traffic which would otherwise go by rail will transfer to other modes.

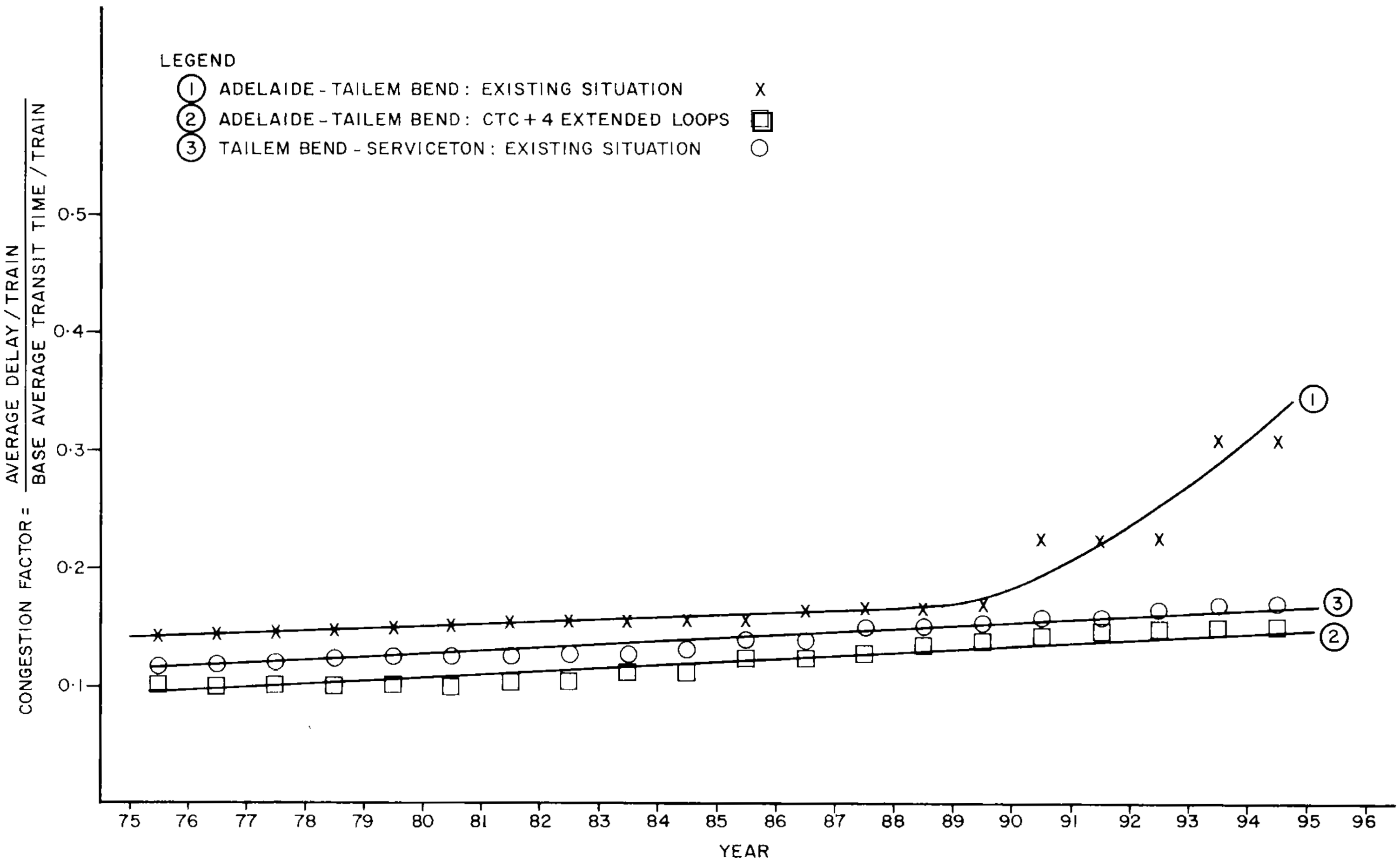

FIGURE 6·2
ADELAIDE-SERVICETON DELAY CURVES-EXPECTED GROWTH RATE

Introduction of CTC and four extended loops between Nairne and Tailem Bend

Figure 6.1 shows that this upgrading has a significant effect on line congestion. The capital cost of the upgrading is estimated as $2.75 million and has direct cost savings of $0.259 million per annum. Indirect benefits accrue from the introduction of CTC due to the reduced trip times for all trains on the upgraded line. The benefits associated with lower crew, fuel, locomotive and wagon maintenance costs and the improved locomotive and wagon utilisation have been calculated. The extension of the crossing loops also allows the average train weight to rise to 1400 tonnes. Although these trains would then require more locomotives on average than 1000 tonne trains and the interstate train frequency would not be allowed to fall below current levels, the future growth in train numbers would be reduced by this operational change and lead to substantial crew savings. The results for this evaluation are shown in Table 6.2.

Project Peregrine Scheme 1

The capital cost for this project was estimated by S.A.R. to be $51 million in September 1974. This cost has been inflated by 20% to $61.2 million to bring the costs into line with all other costs used in the study (June 1976). A conservative estimate indicates the upgrading could be completed within 8 years. The following assumptions have been made in order to calculate the economic viability of this project:

- the capital is spent in five equal amounts between 1980-81 and 1984-85;
- since there are no grade reductions the number of locomotives per train remains the same as at present;
- the total transit time of interstate freight and all passenger trains between Adelaide and Tailem Bend is reduced to 90 minutes and for intrastate freight trains to 120 minutes;

TABLE 6.1 - EXPECTED NUMBER OF INTERSTATE FREIGHT TRAINS/BUSY DAY

Year	Adelaide to Serviceton		Serviceton to Adelaide	
	1000 gross tonne trains	1400 gross tonne trains (1)	1000 gross tonne trains	1400 gross tonne trains
1975-76	5.0	5.0	6.0	6.0
77	5.5	5.0	6.1	6.0
78	5.9	5.0	6.3	6.0
79	6.1	5.0	6.5	6.0
80	6.3	5.0	6.8	6.0
1980-81	6.5	5.0	7.0	6.0
82	6.8	5.0	7.2	6.0
83	7.0	5.0	7.5	6.0
84	7.2	5.2	7.8	6.0
85	7.5	5.4	8.0	6.0
1985-86	7.8	5.6	8.3	6.0
87	8.0	5.8	8.6	6.2
88	8.3	6.0	8.9	6.4
89	8.6	6.2	9.2	6.6
90	8.9	6.4	9.5	6.8
1990-91	9.2	6.6	9.9	7.1
92	9.5	6.8	10.2	7.3
93	9.9	7.1	10.5	7.6
94	10.2	7.3	10.9	7.8
95	10.5	7.6	11.3	8.1

(1) The weight/train increases from 1000 to 1400 gross tonnes before any more trains are timetabled.

TABLE 6.2 - COMMERCIAL RESULTS, CTC & EXTENDED LOOPS

	Discount Rate		
	7%	10%	12%
. Best year to introduce upgrading	1	1	1
. Present value of net revenue associated with upgrading ($ million)	15.17	11.37	9.49
. Present value of net revenue associated with no upgrading	12.83	9.73	8.21
. NPV of upgrading ($ million)	2.34	1.64	1.28

- all crossing delays are zero; and
- the average interstate freight train weight is 1400 gross tonnes.

These assumptions are optimistic and thus show the upgrading in the best possible light. The results for this upgrading are given in Table 6.3.

TABLE 6.3 - COMMERCIAL RESULTS, PROJECT PEREGRINE SCHEME 1

	Discount Rate		
	7%	10%	12%
. Year in which upgrading completed	10	10	10
. Present value of net revenue associated with upgrading ($ million)	-8.80	-9.38	-9.14
. Present value of net revenue associated with no upgrading ($ million)	12.83	9.73	8.21
. NPV of upgrading ($ million)	-21.63	-19.11	-17.35

Thus the implementation of such a scheme would lend to a significant loss to the railway.

Project Peregrine Scheme 2

As for Scheme 1 the capital cost of this project has been inflated to June 1976 costs with a revised capital cost of $84.0 million. The following assumptions have been made in order to calculate the economic viability of the project:

- the capital is spent in five equal amounts between 1980-81 and 1984-85;
- grade reductions in the Up direction, but not the Down direction would mean that a 1400 tonne train would be hauled by one locomotive on the Up and the same number as at present on the Down;

- the total transit time for interstate freight and all passenger trains between Adelaide and Tailem Bend is 75 minutes and for intrastate freight trains is 105 minutes;
- all crossing delays are zero; and
- the average interstate freight train weight is 1400 tonnes.

These assumptions are optimistic and show the upgrading in the best possible light. The results for this upgrading are given in Table 6.4.

TABLE 6.4 - COMMERCIAL RESULTS, PROJECT PEREGRINE SCHEME 2

	Discount Rate		
	7%	10%	12%
. Year in which upgrading completed	10	10	10
. Present value of net revenue associated with upgrading ($ million)	-14.39	-14.78	-14.20
. Present value of net revenue associated with no upgrading ($ million)	12.83	9.73	8.21
. NPV of upgrading ($ million)	-27.22	-24.51	-22.41

Again implementation of this scheme would lend to a significant loss to the railway.

Project Peregrine Scheme 3

The capital cost of this scheme is estimated as $237.6 million at June 1976 costs. The following assumptions were made in order to maximise the attractiveness of this scheme:

- the grade reductions mean that one locomotive can haul a 1400 tonne train in each direction;
- the total transit time for interstate freight and all passenger trains is 60 minutes and for intrastate freight trains 75 minutes;

- all delays are zero;
- the average interstate freight train weight is 1400 tonnes; and
- the capital is spent in five equal amounts between 1980-81 and 1984-85.

The results for this upgrading are given in Table 6.5.

TABLE 6.5 - COMMERCIAL RESULTS, PROJECT PEREGRINE SCHEME 3

	Discount Rate		
	7%	10%	12%
. Year in which upgrading completed	10	10	10
. Present value of net revenue associated with upgrading ($ million)	-79.62	-71.40	-65.18
. Present value of net revenue associated with no upgrading ($ million)	12.83	9.73	8.21
. NPV of upgrading ($ million)	-92.45	-81.13	-73.39

Once more implementation of this scheme would involve the railway in a major loss.

Tailem Bend-Serviceton

Figure 6.1 shows that if no upgrading of this line is undertaken during the study period the level of congestion rises only marginally. In these circumstances, no proposals for upgrading this line were examined in this study.

EVALUATION OF UPGRADINGS - RESOURCE CRITERIA

From a resource point of view, the concern is with the development of a Melbourne-Adelaide transport corridor which meets the total transport task in the most economic way.

In the previous section it was demonstrated that one way of upgrading the Adelaide-Serviceton line, which produced satisfactory results using commercial criteria, is to increase gross freight train weight to 1400 tonnes, introduce CTC between Nairne and Tailem Bend and extend the crossing loops at Petwood, Callington, Montieth and Tailem Bend. This upgrading would be justified before commercial capacity of the line is reached. Thus, it would be expected that upgradings justified on commercial criteria would be consistent with those justified on resource criteria. It will therefore be sufficient to present resource benefit-cost ratios of the short list of options considered for the commercial evaluation.

Rail revenue is not considered in resource calculations and the 'base case' is defined as consisting of the existing rail link carrying all traffic in 1000 tonne trains.

Table 6.6 expresses the total resource cost of transporting the railway share of interstate freight traffic. The results are shown for a range of discount rates.

In calculating the resource cost associated with the construction of the high speed rail link projects (Project Peregrine schemes), the deferral of work to complete the South Eastern Freeway between Glen Osmond and the start of the freeway has been included as a benefit. The South Australian Highways Department estimate the cost as $20 million and the maximum deferral of expenditure as 2 years from 1985 to 1987.

The resource benefit-cost ratios are given in Table 6.7. The cost is simply the present value of the capital cost of each upgrading implemented over 1 year for the CTC scheme and over 5 years for the Project Peregrine schemes; the benefits are calculated as the difference between all other costs and savings.

TABLE 6.6 - RESOURCE RESULTS: NPVs, EXPECTED FREIGHT PROJECTION

Line Configuration	Discount Rate 7%	10%	12%
Existing line			
. Present value of total resource cost ($ million)	-17.65	-14.07	-12.30
CTC & 4 extended loops			
. Present value of total resource cost ($ million)	-15.39	-12.50	-11.09
. Best year of introduction	1	1	1
. NPV of upgrading ($ million)	2.26	1.57	1.21
Project Peregrine Scheme 1			
. Present value of total resource cost ($ million)	-37.99	-31.84	-28.34
. Year of introduction	10	10	10
. NPV of upgrading ($ million)	-20.34	-17.77	-16.04
Project Peregrine Scheme 2			
. Present value of total resource cost ($ million)	-43.80	-37.23	-33.40
. Year of introduction	10	10	10
. NPV of upgrading ($ million)	-26.15	-23.16	-21.10
Project Peregrine Scheme 3			
. Present value of total resource cost ($ million)	-108.81	-93.85	-84.37
. Year of introduction	10	10	10
. NPV of upgrading ($ million)	-91.16	-79.78	-72.07

TABLE 6.7 - RESOURCE RESULTS: MINIMUM BENEFIT - COST RATIOS, EXPECTED FREIGHT PROJECTION

Upgrading	Discount Rate 7%	10%	12%
CTC & 4 extended loops	2.06	1.58	1.45
Project Peregrine Scheme 1			
Project Peregrine Scheme 2	Resource benefits are negative		
Project Peregrine Scheme 3	(B/C ratio meaningless)		

CONCLUSIONS

The following conclusions may be drawn from the above evaluation of upgradings:

- the best upgrading on commercial criteria is to introduce CTC between Nairne and Tailem Bend and extend the crossing loops at at Petwood, Callington, Monteith and Tailem Bend at an estimated capital cost of $2.75 million;
- the timing of this upgrading is insensitive to the discount rate;
- this upgrading could be implemented in 1 year with a resource benefit-cost ratio of 1.58 using a 10 per cent discount rate;
- since the best year in which to introduce this upgrading is 1975-76, the growth rate of interstate freight cannot affect the timing, only the magnitude of the net benefits;
- none of the Project Peregrine schemes is viable, commercially or on a resource cost basis, within the study period.

ANNEX A

DATA USED IN THE STUDY

TRACK DISTANCES

Section	Distance (km)
Adelaide-Tailem Bend	120
Tailem Bend-Serviceton	95
	215

VEHICLE CAPITAL COSTS

Vehicle	Cost ($)	Lifetime (years)	Annual Distance Travelled (km)
Locomotive	640 000	25	131 000
Wagons	35 000	25	35 000

NUMBER OF WAGONS ON TRAINS (EXCLUDING THE BRAKEVAN)

Train	Wagons
1000 gross tonnes	22
1400 gross tonnes	31

CREW COSTS

Train	Cost ($/hour)
Overlander	117
Freight	26

These costs include Saturday, Sunday and night penalties, and service expenses.

MAINTENANCE COSTS

Type	Cost (cents/km)	Cost (cents/gross tonne km)
Locomotive	16.17	
Wagons	3.76	
Single track line		0.02
Double track line		0.05

FUEL COSTS: LOCOMOTIVE

Train	Cost (cents/km)
1000 gross tonne	46.89
1400 gross tonne	65.65

CTC STAFF SAVINGS

Staff saved = 25

Salary saved = $259 038 per annum

This cost includes base salary, 20 per cent overtime and 25 per cent standard railway on-costs.

FREIGHT REVENUE

This figure is based on the Sydney-Brisbane revenue which is known to average 1.57 cents per tonne km.

AVERAGE WAGON CHARACTERISTICS

Length	15.8 metres
Tare weight	20 tonnes
Gross weight	62 tonnes (steel)
	45 tonnes (other)

GANTRY COSTS

These costs are based on costs at the Tamworth freight centre and are used to estimate the road-rail interchange costs when calculating resource costs, under the assumption that all increase in interstate freight is containerised.

Capital cost	\$326 000
Power and maintenance	\$700/gantry/year
Average cost per shift	\$24 200 (based on the operation of 4 gantries, 3 shifts per day)

GANTRY CHARACTERISTICS

Load/unload time	3 minutes
Placing train and checking brakes	1 hour
Capacity (1000 gross tonne trains)	7.5 trains/day
Capacity (1400 gross tonne trains)	5.9 trains/day

COST OF OVERFLOW TO ROAD

The truck costs were obtained from firms running a semi-trailer shuttle service between Sydney and Melbourne using the Hume Highway. They are based on a 20 tonne five-axle truck achieving an average speed of 56 km/h and travelling 159 000 km per year.

Truck capital (excluding sales tax)	\$64 000
Truck life	5 years
Operating costs per vehicle km	22.58 cents

ANNEX B

MONARTO HIGH SPEED LINK

INTRODUCTION

Implicit in the development of Project Peregrine has been the desire to provide a high speed rail link to the planned growth centre of Monarto. Although the traffic associated with the projected Monarto development has been included in the analysis of the upgrading options for the Adelaide-Serviceton link, it appears to be desirable to provide some separate discussion of the economics of a high speed Adelaide-Monarto link. This annex contains a brief analysis of the financial and economic viability of such a link.

TRAFFIC PROJECTIONS

The projected growth in commuter traffic to and from Monarto is given in Table B.1.

The projections were based upon population projections supplied by the Monarto Development Commission and the assumption that the workforce will comprise 38 per cent of the population.

It has been assumed that, in the long term, the public sector of the workforce will be split equally between those employed under the Public Service Act and those employed in other capacities. In light of the number of public servants already scheduled for relocation to Monarto in the period 1980-1983, allowance has been made for the number of Public Service Act employees to be greater than 50 per cent of the public sector in the early years of development. It was assumed that the Departments of Environment and Conservation, Lands and Agriculture will be relocated in 1980, 1981 and 1983 respectively and that the number of workers involved will be 250, 600 and 400.

TABLE B.1 - ADELAIDE-MONARTO UPGRADING, COMMUTER GROWTH PROJECTIONS

Year	Population	Workforce	Breakdown of Workforce: Public %	Public no.	Private %	Private no.	Building and Construction %	Building and Construction no.	Public Service Commuters to Monarto	Other Commuters to Monarto	Total Commuters to Monarto	Total Commuters from Monarto	Total Commuters both directions
1977	200	76	-	-	10	8	90	68	-	8	8	-	8
1978	300	114	-	-	10	11	90	103	-	11	11	-	11
1979	1700	646	-	-	10	65	90	581	-	65	65	-	65
1980	5300	2014	25	504	14	282	61	1228	125	176	301	-	301
1981	7240	2751		850		665		1236	404	190	594	120	714
1982	9180	3488		1146		1058		1284	333	264	597	240	837
1983	11120	4226		1467		1447		1321	462	298	760	361	1121
1984	13060	4963		1788		1835		1340	370	371	741	481	1222
1985	15000	5700	37	2109	39	2223	24	1368	305	445	750	601	1351
1986	18333	6967		2530		2861		1576	241	570	811	822	1683
1967	21667	8223		2949		3500		1784	216	676	892	942	1834
1988	25000	9500		3370		4138		1992	198	782	980	1062	2042
1989	28333	10767		3790		4777		2200	205	887	1092	1183	2275
1990	31667	12033	35	4211	45	5415	20	2407	211	992	1203	1203	2406
1991	35000	1330		4655		5985		2660	233	1097	1330	1330	2660
1992	38333	14567		5098		6555		2914	255	1202	1457	1457	2914
1993	41667	15833		5541		7125		3167	277	1306	1583	1583	3166
1994	45000	17100		5985		7965		3420	299	1411	1710	1710	3420
1995	48333	18367		6428		8265		3674	322	1515	1837	1837	3674
1996	51667	19633		6871		8835		3927	344	1619	1963	1963	3926
1997	55000	20900		7315		9405		4180	366	1724	2090	2090	4180
1998	58333	22167		7759		9975		4433	388	1829	2217	2217	4434
1999	61667	23433		8201		10545		4687	410	1933	2343	2343	4686
2000	65000	24700	35	8645	45	11115	20	4940	432	2038	2470	2470	4940

For relocated public servants the commuter rate was taken as 50 per cent initially, falling to 25 per cent over 3 years and to 10 per cent over a further few years. Other sectors of the workforce were assumed to have a 10 per cent communter rate throughout. It was assumed that the population of Monarto would be too small to support outward commuting before 1981, but that the level of outward commuting would rise to 10 per cent by 1990.

The assumption of 10 per cent commuting in both directions for Monarto once it becomes established is based upon experience of the Geelong-Melbourne relationship.

POTENTIAL BENEFITS

Effect on road construction

The worst case with regard to road construction, i.e. the condition equivalent to the maximum possible benefit from a rapid rail service, is the case where all the Monarto commuter traffic is carried by private car. Assuming a 5 per cent annual growth in the existing traffic on the Mount Barker Road, a peak hour volume of 9 per cent of the Annual Average Daily Traffic (AADT) and a six to four directional split for existing traffic, then the morning peak hour flows can be calculated and are shown in Table B.2. In the table, the Monarto traffic is based on a car occupancy of two people per vehicle with the commuter traffic spread over 2 hours.

The existing traffic capacity of the Mount Barker Road is estimated at 1660 vehicles per hour(1). Thus it may be seen that for Adelaide bound traffic, the capacity is reached in 1987 without Monarto traffic and in 1985 with Monarto traffic. Thus, assuming that all commuter traffic is by private car, the effect is to bring forward the time of upgrading by about 2 years.

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(1) All existing traffic figures, capacities and upgrading cost estimates were provided by the South Australian Highways Department.

TABLE B.2 - PEAK HOUR TRAFFIC ON THE MOUNT BARKER ROAD, ASSUMING ALL MONARTO COMMUTING BY CAR

Year	V/H Towards Adelaide			V/H Towards Monarto		
	Base	Monarto	Total	Base	Monarto	Total
1974	864	-	864	576	-	576
75	907	-	907	605	-	605
76	953	-	953	635	-	635
77	1000	-	1000	667	2	669
78	1050	-	1050	700	3	703
79	1103	-	1103	735	16	751
1980	1150	-	1158	772	75	847
81	1216	30	1246	810	148	958
82	1277	60	1337	851	149	1000
83	1340	90	1420	894	190	1084
84	1407	120	1527	938	185	1123
85	1478	150	1628	985	188	1173
86	1552	205	1757	1034	203	1237
87	1629	235	1864	1086	223	1309
88	1711	265	1976	1140	245	1385
89	1796	296	2092	1107	273	1470
1990	1886	301	2187	1257	301	1558

The upgrading planned for the Mount Barker Road involves an expenditure of the order of $20 million and would provide a capacity sufficient to see out the evaluation period for the present rail upgrading options. Thus the absolute maximum benefit obtainable in this form from provision of a high speed rail link would be the present value of the difference between an expenditure of $20 million in 1985 and 1987, that is, of the order of $1.5 million assuming a 10 per cent discount rate. In practice little of this potential benefit could be achieved, since it would not be feasible to have a high speed link operating before 1985 and commuter patterns to and from Monarto would be well established by then.

Travel time savings

Even given that the rail link to Monarto is upgraded to the standard envisaged in the 'long-tunnel' version of Project Peregrine and the system is electrified, there is no immediate prospect of reducing the Adelaide-Monarto rail trip time to below 1 hour. Thus it would remain very close to that of car or commuter bus using the South Eastern Freeway. Thus unless road congestion builds up to the extent that trip times are significantly increased, there is little prospect of conversion of passengers from road to rail on the basis of trip time. Under existing conditions, and under any lesser level of upgrading, the rail trip will take considerably longer than the road trip and hence rail may be expected to obtain only a small share of the commuter market. (Present trips times are of the order of two hours and are not expected to be reduced below one and three-quarter hours by lesser levels of upgrading.)

If it is assumed under these conditions half of the commuters will travel by train, then travel time benefits may be estimated. Assume that if all commuters remain on the road travel time increases from 1 hour in 1985 to 1 hour 40 minutes in 2005, while if half the commuters go by train then road travel time will increase from 1 hour in 1985 to 1 hour 20 minutes in 2005. Based on 250 working days per year and a time value of $1 per hour the annual savings may be calculated.

As previously indicated the number of commuters between Adelaide and Monarto is estimated to reach 1351 in 1985 and 6305 in 2005. Thus, if the rail upgrading does not go ahead, the travel time costs for commuters will be $1351 per day in 1985 and $10 088 per day in 2005 for a single direction only. If rail is improved so that 50 per cent of trips are by rail after 1985 then travel time costs will grow from $1351 per day in 1985 to $7250 per day in 2005, again for a single direction only. Thus savings to Monarto commuters through the high speed rail link would be $2838 per day by 2005 for each travel direction. In addition, there would be savings to the road users if traffic is reduced by some Monarto commuters travelling by rail. Assuming that there are 5500 travellers affected by Monarto commuter traffic in each daily peak 2 hours in 1985 this will increase to 14 593 in 2005. Assuming also that the travel time savings to those users are the same as for the Monarto commuters (i.e. 20 mins per trip), then the savings produced by the high speed link would be $4378 per day by 2005 for each travel direction.

The total savings of this nature will be approximately $3.6 million per year by 2005. The total value of the saving stream expressed in 1985 present value terms would be $11.5 million.

COSTS

To have any chance of achieving the possible benefits outlined above it would be necessary to electrify the line, since diesel cars could not achieve the speeds needed to obtain the travel times indicated. Thus the benefits would be offset by the cost of electrification and the cost of new electric rolling stock.

The electrification cost alone was estimated at $16 million in 1974 values and so would be considerably higher in 1985 values.

Thus the provision of a high speed passenger link to Monarto is not economically justified.