Rowville Railway …

Pre-Feasibility Study 2004

Report to Knox City Council of an Independent Study Team composed of Professor E.W. Russell, Professor Peter Newman, Dr Rolf Bergmaier, Mr Matt Hurst and Mr Roger Wyatt.

MELBOURNE, 2004

Table of Contents

Executive Summary

The Study's findings are developed in full in this Report. In overview, the Study concludes that:

- A railway can be constructed from Huntingdale to Rowville on an acceptable alignment within a ruling grade and minimum curve radius similar or better to that on other Melbourne suburban lines, such as the Glen Waverley line.

- Since most of the alignment would be on the median strip of North and Wellington Roads, very little provision is needed for property acquisition, which is normally a major cost in retrofitting a Heavy Rail line to an established suburban area.

- A Heavy Rail line from Huntingdale to Rowville could offer many benefits to the Knox area and to Monash University at Clayton including a travel time of 30 minutes from Rowville to the CBD; economic benefits including direct employment generation and the development of Rowville's potential as an activity centre linked to Monash and to the jobs, educational and leisure opportunities of inner Melbourne.

- A Heavy Rail line to Rowville could carry 2350 passengers per hour from Rowville and take a similar number of cars (equivalent to a lane of freeway traffic) from the roads. It can also carry in a contra direction up to that number of students and staff to the Monash campus from inner Melbourne, releasing car parking investment costs at Monash and linking Monash's two largest campuses. It can also via a Park and Ride facility located near the Monash freeway, offer relief to traffic congestion affecting users of that freeway.

- Supported by a redesigned bus network, a Rowville Railway can serve not only the direct residents of Rowville but up to 100,000 as the catchment between the Dandenong line to the South and the Belgrave line to the north, develops.

- A Heavy Rail line offers significant social benefits in providing Rowville catchment residents with the capacity to avoid purchasing their second, third, or fourth car per household, and, as oil prices rise, this will be an access capability that pays an increasing dividend in the future. The rail facility will also provide effective access for those who cannot or do not wish to drive.

- Public transport access times to inner Melbourne can be improved from the current 80 minutes to around 30 minutes (or, if a Smart Bus was to be introduced, from around 55 minutes to 30 minutes). A Heavy Rail system

would also be likely to provide Sunday and evening services not currently available to Rowville catchment residents.

- The route from Huntingdale to Rowville is constrained by the need for a grade-separated road and railway junction at Huntingdale, and to accommodate crossings of seven other main roads and three freeways, existing or planned, on a grade separated basis, since government policy now precludes new level crossings. The need to cross 10 main roads within a 12km route means the Huntingdale to Rowville route is quite costly by reason of the need for elevated elements and/or many overpasses. These elements also raise urban design issues.

- To meet these challenges in engineering terms, this Study presents two possible ways a Heavy Rail line could be constructed along this route. The more expensive option involves 9km of elevated track and a terminus at Stud Park Shopping Centre. The order of cost for this project, subject to various inclusions and exclusions, is $413m. The team also developed a lower cost alternative along the alignment, using 2km less of elevated track, steeper gradients, and a terminus at the Stud Rd/Wellington Rd intersection instead of Stud Park Shopping Centre. This option is estimated to cost $353m. In both cases, an additional $66m would also be needed to cover the cost of lease payments on the six train sets needed to operate the line as well as the cost of other related matters including train stabling, road works and land acquisition.

- A route from Huntingdale to Glen Waverley, as considered in the context of the Scoresby Freeway EES, involves many fewer crossings, but has three overwhelming disadvantages, namely, it requires substantial tunnelling or property acquisition east of Glen Waverley station; it would not serve Monash University Clayton campus, which is a major trip generator supporting the case for the line; and it connects to a suburban line which offers slow travel times due to its inexpensive initial design and the lack of significant upgrades in recent years (eg very slow level crossings at Burke and Toorak Roads). The team considers this route likely to be similar in cost to the less expensive of the Huntingdale options but emphasises that re-examination of the Glen Waverley alternative in detail was not part of this Study.

- There are several Light Rail options that could connect Rowville to Huntingdale, Glen Waverley or Knox City, and SEITA has provided for a possible Light Rail facility as part of the Mitcham to Frankston tollway project. Light Rail options have certain merits, including the capacity to operate at grade and avoid many costly structures. However, despite being substantially cheaper to construct, they do not provide the major travel time improvements only available by Heavy Rail and needed in an outer municipality such as Knox, and hence, like buses or Smart Buses, provide a compromise solution only.

- If Council resolves to pursue the construction of this railway, an important next stage will be discussions with affected communities and with neighbouring Councils, to determine whether agreement can be reached as to a heavy or Light Rail facility that would be acceptable to most stakeholders

and capable of the kind of broad support which councils adopted in advocating the Scoresby freeway in recent years.

1. Introduction

Inception

Knox City Council resolved at its April 2004 meeting to proceed with a pre-feasibility study of a Heavy Rail Link from Huntingdale to Rowville. The Study commenced in late May 2004 and was completed in September 2004. Councillors were provided with an Issues Briefing by the Study Team on 3 August 2004, and the final report was submitted in October 2004.

Steering Committee and Study Team

The Steering Committee for the Project Consisted of Cr Mick van Vreede, Mr Kelvin Ward and Mr Ron Crawford from Knox City Council.

The Study Team consisted of Professor Bill Russell, Professor Peter Newman, Mr Roger Wyatt, Dr Rolf Bergmaier and Mr Matt Hurst.

The Steering Committee met monthly during the progress of the Study.

Scope of the Study

The Study is focussed on examining pre-feasibility issues associated with the provision of a Heavy Rail line from Huntingdale to Rowville, as sought by Council. Some other heavy and Light Rail options were identified and discussed at Council's Issues Briefing by the Team. However the task of the Study was not to compare possible modes and options but to examine the Huntingdale to Rowville option and provide additional bases for Council's consideration of whether studies of this option should proceed further.

The Study has involved two main streams of activity:

(a) Identifying whether a feasible alignment, having regard to grades, curves, and relationships to existing roads, structures and other urban form, can be identified and a grade-line established, and

(b) Examining whether a railway constructed on this alignment could deliver significant benefits to the Rowville community and whether a feasible rail service model by which such services could be accommodated within the Melbourne suburban rail network in view of the levels of existing traffic on the Dandenong line, City Loop etc.

The Study is modest in scale compared with a formal feasibility study. A number of the issues raised will need further consideration during the Environmental Effects process and as design studies proceed. Similarly, a range of matters will require engagement and consultation with affected communities, adjoining municipalities and

public authorities. These discussions will doubtless result in negotiation and variation to the proposals contained herein as the project develops. However we believe this report provides a clear proposition on the basis of which such discussions could commence.

2. Benefits of a Huntingdale to Rowville Railway

Construction of a Heavy Rail link from Rowville will confer a wide range of benefits. Some of these are specific to those who live or work in the catchment, while others accrue to motorists passing through the area and others still are benefits to the livability and development of Melbourne and its south eastern suburbs in particular.

In this section some of these benefits are discussed.

- **Rowville would become much closer in travel time to other key centres of Melbourne life, such as the CBD, higher educational institutions, jobs, leisure and entertainment venues.** This will have significant advantages for present and future Rowville residents in terms of their employment, educational and leisure options;

- **The role of Rowville as an important activity centre within the City of Knox and within metropolitan Melbourne will be strongly underlined and supported.** Such developments are in accord with the State Government's land-use planning vision, *Melbourne 2030*. If the railway is not constructed, Stud Park, Rowville and the southern parts of the municipality will develop at a slower pace and may not compete effectively as retail and employment centres;

- **Traffic congestion in Knox will be reduced.** On the basis of four trains per hour, approximately 2500 cars per hour will be removed from the streets of Rowville. This will make a significant contribution to the reduction of traffic congestion, road trauma, and pollution associated with excessive road traffic;

- **Knox households will experience transport choice, and be able to avoid in some cases the costs of second, third or fourth cars.** At present, households in the southern part of Knox municipality do not have viable public transport as an alternative to purchasing additional cars. The operating costs of additional cars are a heavy burden on the household budgets of many residents. Knox residents are entitled to the transport choices and savings available to other Melbourne residents;

- **Direct and indirect employment and economic activity will be generated.** This project will provide considerable employment both in the short and medium terms. International experience has demonstrated that communities served by Heavy Rail enjoy greater economic success, attract investment and employment is multiplied as a result. The mechanisms are complex but can be understood in terms of the choices made by investors wishing to choose between alternative locations for investment in new businesses, apartment projects and commercial development generally. The superior economic performance of areas served by Heavy Rail also relates to the wider range of

potential residents that are attracted to such areas because of the preferred access to wider employment, study and leisure choices;

- **As world oil price rises in the coming two decades, Rowville residents will have some protection against escalating travel costs if they can make some journeys by public transport instead of car.**

  A significant risk factor for all Australia's outer suburbs, Rowville included, is the problem of future travel costs as oil prices rise. Such costs are currently at an all time high and are predicted to increase further as oil production peaks this decade and thereafter commences to decline. Those suburbs that have a travel alternative for residents and potential residents such as a Heavy Rail line will benefit and over the next 20 years it can be expected that property prices between and within suburbs will reflect consumers' expectations of travel costs. Travel costs to households in outer suburbs can already be substantial, however this may become an extreme problem as limited world oil supplies are pressed in future years to meet burgeoning demand from massive new markets in developing countries. Construction of a rail link to Rowville provides infrastructure that offers some protection to catchment residents against this category of risk. The protection extends to investment and economic activity in the area since it may be expected that future decades will see a net internal migration by choice within cities towards those areas with rail links. Rowville and the southern area of Knox municipality would be one of these areas if a rail link were constructed now.

- **In coming years, intense competition for rail enhancement will develop among outer suburbs and it is in the interest of Knox residents and businesses to secure this investment or risk many years of unresolved waiting.**

  Already issues of capital availability have resulted in a number of important outer suburban rail projects being subject to substantial delays until they can be funded. These include areas such as Epping North, Doncaster East and a number of areas to the west of the CBD, such as the need to provide electrification to Sunbury and Melton. A Rowville Railway project, supported by the communities and municipalities it serves, needs to be considered and advocated in an appropriate form if it is to compete for capital with projects being advocated by other outer suburban communities. A Rowville Railway project has some significant comparative strengths, such as its capacity to serve the Monash Clayton campus and its capacity to relieve congestion on freeways in the southeast; however considerable work will be needed to refine options, achieve consensus and obtain community, bureaucratic and political support and recognition for the project.

3. Route Options and General Issues

The Community and its Needs

A Rowville Railway would specifically serve three main communities in the Cities of Knox and Monash. These are the suburb of Rowville, centred on its shopping centre at Stud Park, the growing residential area developing at Waverley Park on the site of the old AFL stadium, and Monash University's Clayton campus.

The Need for Better Access to Education, Jobs and Leisure

The Rowville community today consists of approximately 40,000 residents, most of whom live in detached low-density housing. Most journeys undertaken by this community today are undertaken by car. The community has many young couples and an unusually high number of children in the 0-5 age group. In coming years these young people will need effective public transport to schools and tertiary education, jobs and leisure venues. A Rowville-Huntingdale link would connect with Monash Clayton and Caulfield campuses, the CBD and many employment and leisure venues including MCG, Telstra Dome, Vodafone Arena and many others.

The Need to Lessen the Impact of Car Ownership Costs on Households

If enhanced public transport is not provided, it is likely that many households in the Rowville area will need to operate three or even four cars in future years. Where families are required to operate several cars, a high proportion of family disposable income must be devoted to car operation costs. In Melbourne, those suburbs where public transport is poorest experience the highest levels of car ownership and the impact on household budgets in those suburbs is greatest. Rowville currently has an extremely low modal share for public transport due to the lack of fixed rail facilities. The share of trips undertaken by public transport is about 3%, whereas the government's objective for Melbourne is about 20% of trips by public transport.

The Need to Reduce Traffic Congestion

Traffic congestion is a current and growing problem in the Rowville area. Car journey times are affected by traffic congestion in the area – CBD trips in peak times can take 50 minutes from Rowville. It is by no means certain that the construction of the Mitcham-Frankston freeway will reduce overall congestion in the area. In relation to the Monash freeway, significant congestion is common.

The Need to Better current slow Journey Times by Public Transport

Existing road based public transport (buses) does not provide a form of public transport that can compete with the car for journeys to places such as the CBD, central sporting and entertainment venues, or educational institutions. The fastest peak service from Rowville to the city by bus and train takes 69 minutes; most services take 84 minutes. An appropriate rail service via Huntingdale could reduce this journey time to 30 minutes.

A transfer of journeys from the road system to rail will have the capacity to reduce traffic congestion. People will use public transport if it is reliable, fast, frequent and safe, and offers significant benefits in reduced journey times to their destinations. The rail service will readily have the capacity to remove 2350 cars per hour from roads in the area, equivalent to an entire lane of freeway traffic.

Between Rowville and Scoresby village, the site of the Caribbean gardens has been identified as a future employment precinct. It is hoped that a high technology precinct may develop in this area, and that links with the Monash Clayton campus, the new Synchrotron and associated research facilities will grow stronger. A Rowville Railway would provide a tangible link between the Scoresby employment precinct and the Monash University precinct.

The Need for evening and weekend services

Public transport services for Rowville are provided by bus services operating under contract to the Department of Infrastructure. These bus services run north south in Stud Road to provide links to Knox City and Ringwood to the north and Dandenong to the south. An east west bus service links Lysterfield and Glen Waverley Station. These bus services do not operate after 7.00pm or provide a comprehensive service on weekends. A future Rowville Railway is likely to provide the evening and weekend services now lacking, which mean Rowville residents have no choice currently but to own multiple cars per household.

Light and Heavy Rail Options

The 7 Options Considered

For the purpose of this study, which was undertaken to examine the feasibility of rail connection to Rowville, a total of seven light and Heavy Rail options were considered, although, in accordance with the Study Terms of Reference, and as confirmed with Council at its Issues Briefing on 3 August 2004, only the Huntingdale to Rowville Heavy Rail option received detailed consideration. However it is important to briefly place this option in the context of other possibilities.

Light Rail or Heavy Rail?

Rowville could be served by either Light Rail or Heavy Rail. Light Rail is significantly cheaper but slower, and this is an important issue since ridership will be maximised only if a significant advantage in journey time over the car can be maintained. Light Rail represents an intermediate step in this respect between buses and Heavy Rail, in that outer suburban Light Rail installations today typically have speed advantages over buses when in reserved track, but must slow or stop for at-grade intersections as do buses. Buses can be made to replicate some features of a Light Rail installation by the construction of bus ways; however these are usually a compromise in which the buses ultimately have to rejoin congested traffic at each end of the dedicated route.

Heavy Rail on the other hand is constructed with no grade crossings, indeed government policy strongly militates against the provision of new at-grade rail/road crossings. This is wise from a safety and operational standpoint, although it does add materially to the cost of new railways, especially in areas such as the Huntingdale to Rowville line where there are many main roads to be crossed. However the absence of grade crossings is a key reason why Heavy Rail can deliver far faster journey times than Light Rail or Smart Bus.

Heavy Rail allows journey time can be minimised, offering the maximum sustainable travel time advantage over the motor car, which can also achieve an uninterrupted journey if freeway access is available and traffic is not congested. Rowville has excellent freeway access to the CBD at present via the Monash Freeway, but that freeway, despite major enhancements during the past decade, remains subject to serious congestion problems. A Heavy Rail rather than a Light Rail option will offer the best incentive to people to use a Rowville Railway.

While Rowville's small population and limited growth potential (due to its nearness to the urban growth boundary) suggest the cheaper option, Light Rail's slower journey times are not effective for linking the community with educational, employment and leisure venues in central Melbourne.

For these links, Heavy Rail is ideal and it can compete well with freeway travel; if routed via Monash Clayton campus there are enough riders to make a Heavy Rail extension to Rowville viable.

Journey Times

Existing Journey Times

Rowville to the City – Morning Peak

The principal public transport route currently available from Rowville to the CBD is the 754 bus, which operates from Stud Park Shopping Centre to Glen Waverley station. Persons leaving Rowville between 7am and 8am in the morning are offered only four buses, two of which are expresses. The express buses take 25 minutes for the journey to Glen Waverley, whereas the normal service takes 30-35 minutes. None however connects with the two express trains on the Glen Waverley line during this hour, (the 8.19 and the 8.51) and journey times from Rowville to the City range from a minimum of 66 minutes to a maximum of 84 minutes for the journey.

Rowville (754 bus)	**dep**	**7.13**	**7.17**	**7.40**	**7.55**
Glen Waverley	arr	7.38	7.57	8.06	8.40
Glen Waverley (Train)	dep	7.45	8.02	8.10	8.43
Melbourne Central	arr	8.22	8.38	8.46	9.19
Journey Time (minutes)		**69**	**81**	**66**	**84**

As an alternative, a passenger at Rowville could choose one of three buses offered in this hour on route 654 to Ringwood. Despite connections there with express trains, all these journeys take 84 minutes or more. There are also two services during this hour using bus 691 to Ferntree Gully station; a passenger utilizing these services would take 83 or 77 minutes for the journey from Rowville to Melbourne Central.

For purposes of comparison, it may be noted that the minimum journey time of 66 minutes is slower than the service to be introduced for Ballarat passengers in 2005 under the Regional Fast Rail project, while the worst journey time is the same as that to be offered to Bendigo passengers. However, whereas Bendigo is 160km from Melbourne, Rowville is only 30km. The Rowville service is by this comparison 5 times slower than the service to Bendigo.

Rowville to Monash University, Clayton Campus

In the morning period studied, between 7 and 8 am, two buses are provided from Rowville to Monash Clayton campus. The buses operate on an extension of Route 691, which normally terminates at Waverley Gardens shopping centre. These services take 28 minutes from Rowville to Monash Clayton campus. We would expect a Heavy Rail service from Stud Park Shopping

Centre to arrive at Monash University within 4 minutes – again providing a significant improvement on the current road based public transport service.

Table 1: Portion of Existing Bus Timetable on Route 754 from Rowville to Glen Waverley

Route No: 754

Route Name: Stud Park Shopping Centre - Glen Waverley (including the Rowville Express)

Effective from: 24 March 2003

1 MONDAY TO FRIDAY

Direction of travel: Stud Park Shopping Centre to Glen Waverley (including the Rowville Express)									
Stud Park Shopping Centre (outside KMart Store)	6:17 AM	6:30 AM LR	6:42 AM		6:50 AM	7:13 AM		7:17 AM LF	7:40 AM
Wheelers Hill (Garnett Road / Whalley Drive)		6:38 AM LR			6:58 AM			7:25 AM LF	
Wheelers Hill Shopping Centre (Jell's Road)		6:45 AM LR		6:55 AM S	7:05 AM		7:25 AM S	7:35 AM LF	
Glen Waverley (Gallaghers Road / Remington Drive)		6:52 AM LR		7:03 AM S	7:13 AM		7:35 AM S	7:45 AM LF	
Glen Waverley Railway Station (Bus Terminus - Bay No.5 / Railway Parade North)	6:37 AM	7:00 AM LR	7:02 AM LF	7:15 AM S	7:25 AM	7:38 AM LF	7:45 AM S	7:57 AM LF	8:06 AM

LR Bus used is a low floor bus with ramps for wheelchair access depending upon availability

LF Bus used is a low floor bus depending upon availability

S Bus operates on School Days only

W Bus detours via Wheelers Hill Secondary College on School Days only

Direction of travel:

Light Rail Options

Four Light Rail Options in brief:

Four Light Rail options have been considered:

- **Light Rail Option 1: Stud Park Shopping Centre to Oakleigh Station via Stud Rd, Wellington Rd and Huntingdale Station**

  Length 14km, Cost $185m

  This option provides insufficient improvement over bus options. Passengers would still have to change modes at Oakleigh or Huntingdale; the public transport vehicles would be relatively slow as they would cross arterial roads at grade, and the Light Rail system would be isolated from other parts of the tram system, requiring stabling and incurring other costs

- **Light Rail Option 2: Stud Park Shopping Centre to Vermont South Tram Terminus via Knox City**

  Length 11km, Cost $120m

  An effective Light Rail option which would connect Rowville with Knox City and the Burwood Highway tram. Moderate cost and provides a basis for developing improved public transport within Knox. Does not require stand alone tram stabling, maintenance and support as the other two Light Rail options do.

- **Light Rail Option 3: Stud Park Shopping Centre to Glen Waverley Station via Scoresby, Jell's Rd, Waverley Rd and Springvale Rd**.

  Length 9 km, Cost $ 105m

  This option would be quite slow, and would also be an isolated system. Limited advantage over existing bus system. Significant conflict with road traffic.

- **Light Rail Option 4: Stud Park Shopping Centre to Monash University, connecting with a new Light Rail service to be provided from Monash Clayton to Monash Caulfield via Dandenong Rd.**

  If a Light Rail service were provided from Monash Clayton to Monash Caulfield via Dandenong Rd, an extension via Wellington Rd to

Rowville would become an option worthy of consideration. This option is speculative, but could be considered by Council as the possible basis of a joint proposal with Monash City Council at some future time.

This project has not been estimated as to cost.

Pros and Cons of the four Light Rail Options

Light Rail Option 1 - Stud Park Shopping Centre to Oakleigh Station

Advantages-

Lower capital cost than Heavy Rail
Serves both Rowville and Monash University

Disadvantages-

Excessive travel time compared with Heavy Rail
Riders would still have to change vehicles to join the Dandenong line to travel towards the city
Insufficient improvement over existing bus service
Disconnected from tram system and would require stand alone stabling and maintenance facilities at extra cost

Light Rail Option 2 - Stud Park Shopping Centre to Vermont South Tram Terminus via Knox City

Advantages-

Lower capital cost than Heavy Rail
Unifies Knox and provides Rowville residents with improved public transport access to Knox City
Through link to Burwood Highway tram, links Rowville with Deakin University and schools in East Burwood area such as PLC and Mount Scopus.
Connected to existing tram system avoiding costs of an isolated tram system

Disadvantages-

Excessive travel time compared with Heavy Rail
Doesn‘t provide a viable option for travel to inner city or Monash campuses

Light Rail Option 3 - Stud Park Shopping Centre to Glen Waverley Station via Scoresby, Jell's Rd, Waverley Rd and Springvale Rd.

Advantages-

Lower capital cost than Heavy Rail
Could serve Rowville, Scoresby and the Scoresby/Rowville Employment precinct.
Would provide a link to the CBD via the Glen Waverley railway which serves a variety of schools including Holmesglen TAFE, Scotch College and St Kevin's
A relatively cheap option

Disadvantages-

Excessive travel time compared with Heavy Rail
Doesn't provide a viable option for travel to inner city or Monash campuses
Conflict with road traffic in Waverley Rd and Springvale Rd
Disconnected from tram system and would require stand alone stabling and maintenance facilities at extra cost

Light Rail Option 4 - Stud Park Shopping Centre to Monash University connecting with proposed Light Rail to Monash Caulfield.

Advantages-

Lower capital cost than Heavy Rail
Could serve Rowville, Scoresby and the Scoresby/Rowville Employment precinct.
Would provide a link to the both Monash campuses and Chadstone shopping centre
Possibly provides a basis for a joint approach with Monash City Council
Could connect at Caulfield with existing tram system.

Disadvantages-

Excessive travel time compared with Heavy Rail
Doesn't provide a viable option for travel to inner city.
Conflict with road traffic in Dandenong Rd
Being a larger and more speculative project, may take considerable time to develop and implement.

Heavy Rail Options

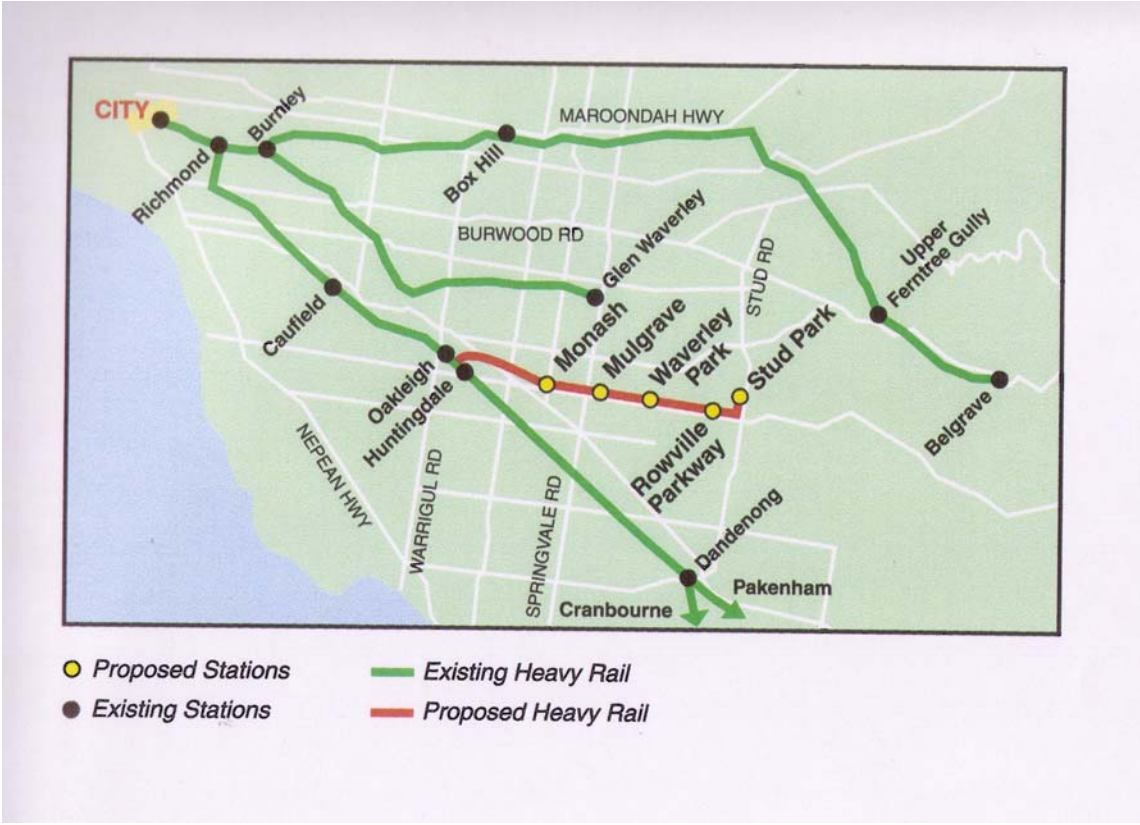
Three Heavy Rail Options:

Three Heavy Rail options have been considered – two via Huntingdale and one via Glen Waverley. Only the Huntingdale options have been investigated in detail and only for those options have grade lines and alignments been specifically defined.

The Recommended Option

Heavy Rail Option 1A: Stud Park Shopping Centre to Melbourne CBD via Monash University, Wellington and North Roads, joining Dandenong line at Huntingdale. Option with 9 km of elevated construction. Typical gradient 1 in 50. Length Stud Park Shopping Centre to Huntingdale: 12.3km. Journey times, Rowville to Parliament: 30 minutes with express connection.

Approximate construction cost: $413m



A Slightly Cheaper Alternative

Heavy Rail Option 1B: Corner Stud and Wellington Rds Rowville to Melbourne CBD via Monash University, Wellington and North Roads, joining Dandenong line at Huntingdale. Option with 7 km of elevated construction and lower cost terminus at Rowville.

Approximate construction cost: $353m

The Huntingdale options are considered the most effective in terms of the rapid journey time and have been the focus of the team's work.

The Huntingdale route crosses 7 arterial roads and 3 existing or planned freeways. It is somewhat expensive to construct. The requirement for feasible grade-lines and the need to avoid level crossings dictate considerable lengths of elevated construction in both options.

The Non-Preferred Option:

Heavy Rail Option 2: Stud Park Shopping Centre to Glen Waverley Station via Scoresby, with tunnels underneath the suburb of Glen Waverley east of Springvale Rd.

Length, Stud Park Shopping Centre to Glen Waverley: 9 km.

Estimated cost: $350m

This option was previously investigated as part of the Scoresby EES. The heavy tunnelling costs and the reduced ridership since it does not serve Monash Clayton are considered key reasons not to pursue this option.

It was not within the scope of this Study to develop a grade-line and alignments for this Option.

Pros and Cons of the three Heavy Rail Options

Heavy Rail Option 1A. - Stud Park Shopping Centre to Melbourne CBD via Monash University, Wellington and North Roads, joining Dandenong line at Huntingdale. Option with 9 km of elevated construction.

<u>Advantages</u>-
Most direct connection with minimum journey time (30 minutes)
Almost all alignment on public lands
Could serve Rowville, and Monash University Clayton, which significantly expands potential ridership and thus viability
Park and ride and bus interchange can draw on wider catchments.
Will enhance role of Stud Park Shopping Centre as an Activity Centre
Can serve most of the catchment within the urban growth boundary in accordance with the objectives of *Melbourne 2030*.

<u>Disadvantages</u>-

Significant structures needed to cross 3 freeways, 7 main roads, an escarpment and the Dandenong Creek Valley, and to join Dandenong line

Heavy Rail Option 1B. – Corner Stud and Wellington Roads, Rowville to Melbourne CBD via Monash University, Wellington and North Roads, joining Dandenong line at Huntingdale. Option with 7 km of elevated construction.

<u>Advantages</u>-
Journey time still far better than Light Rail, bus or Smart Bus or Heavy Rail Option 2.
Could serve Rowville, and Monash University Clayton, which significantly expands potential ridership and thus viability
Park and ride and bus interchange can draw on wider catchments.
Journey time of 33 minutes can be implemented
Cost savings compared with Option 1A by having steeper grades and less elevated construction.

<u>Disadvantages</u>-
Significant structures needed to cross 3 freeways, 7 main roads, an escarpment and the Dandenong Creek Valley, and to join Dandenong line
Does not enter Stud Park Shopping Centre and therefore doesn't support development of it as an activity centre and transport interchange
Marginally longer journey time than Option 1A , due to steeper gradients.
.

Heavy Rail Option 2 Rowville (Stud Park Shopping Centre) to Glen Waverley Station via Scoresby, with tunnels underneath the suburb of Glen Waverley east of Springvale Rd.

Advantages-

Direct connection and reasonable journey time.

Could serve Rowville, Scoresby and the Scoresby/Rowville employment precinct.

Would provide a link to the CBD via the Glen Waverley railway which serves a variety of schools including Holmesglen TAFE, Scotch College and St Kevin's

Journey time is much better than all bus or Light Rail options but 40% slower than best Heavy Rail journey time via Huntingdale. (i.e. Option 1A)

Underground component makes minimal intrusion on existing built environment.

Disadvantages-

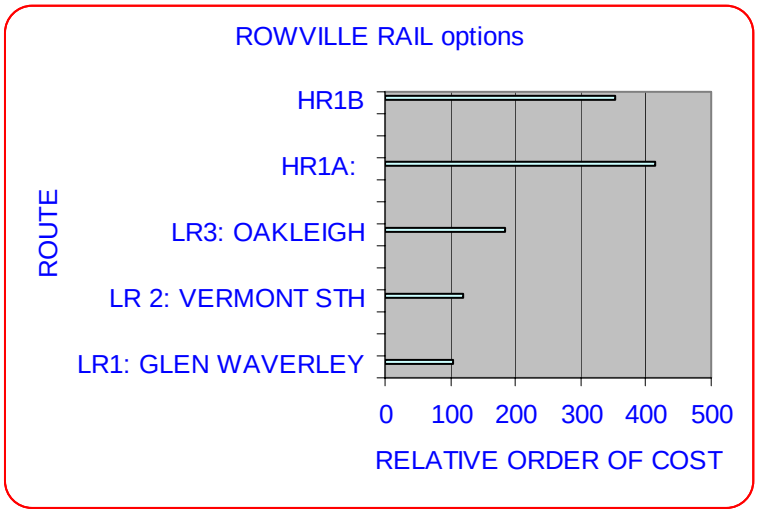
Heavy tunnelling costs due to urban development east of Springvale Rd

Doesn't provide access to, or patronage from, Monash campuses

Glen Waverley line does not provide particularly rapid access to City (36 minutes best, while the worst is 48 minutes). This would translate to a 42 minute journey from Rowville to the CBD.

Comparative Cost Estimates

The following chart presents a comparison of our order of cost estimates of Light and Heavy Rail options considered in this Study.



All Heavy Rail options are considerably more expensive than all Light Rail options. However only Heavy Rail options have the capacity to deliver the level of service

necessary in order to deliver journey times that can compete with the motor car and induce modal shift.

The Huntingdale options involve the necessity for much of the line to be elevated to overcome at-grade crossings of the many north-south main roads that are encountered, as well as many minor suburban crossings and entrances serving residential and light industrial estates.

The Huntingdale options also require a minimum of property acquisition, as space exists in the median strip of North and Wellington Roads over nearly all the route. Some very few property acquisitions of low grade warehouses may be needed to accommodate the junction at Huntingdale. The opportunity could be taken at this time to enhance urban design aspects of the Huntingdale shopping centre and station, which are currently threatening and unattractive, with a central position taken by a public toilet block, narrow subways for the station approach, and a bus stop overshadowed by a road overpass and adjacent to an abandoned car yard.

However the additional construction costs of the Huntingdale options are more than outweighed by the fact that it can service the major trip generator in the region, the Monash University Clayton campus, and provide a link between that campus and the CBD and suburban dormitory areas of Melbourne, as well as with Rowville.

Is a Smart Bus an Option?

Smart Bus Concepts

The issue has been raised as to whether a Smart Bus service on North and Wellington Roads would be likely to provide an appropriate transport link for Rowville residents.

The Smart Bus concept is not precisely defined however characteristics are normally seen to be:

- Direct rather than circuitous routes
- Limited stops
- High Service Frequency
- Services extended to evenings and weekends
- Higher average speed resulting in reduced travel times.

Smart Bus services were introduced on certain services in the South-Eastern suburbs in December 2003. To benchmark such services, the team examined Route 888, a Smart Bus service operated on Springvale Road southwards from Nunawading station.

The following are service characteristics of the Route 888 Smart Bus service operating between Nunawading Station and Glen Waverley station, based on the published timetable:

Route:

- The route basically follows Springvale Road, but does include a deviation into Forest Hill Chase Shopping Centre.

Service Frequency

- The Monday to Friday peak period service was examined. Between 7 and 9 am, five buses are provided. The service frequency averages a bus every 30 minutes.
- On Saturdays and Sundays, an 80 minute gap between buses occurs.

Extended Services

- The 888 service operates 7 days a week, until 11.35pm weekdays and until 8 pm on Saturdays and Sundays

Average Speed

- The average speed of the 888 Smart Bus in the southbound morning peak is 12.2kmh.

Application of Smart Bus service standards to the Huntingdale to Rowville route

Service Frequency

The level of service frequency of five buses in two hours on Route 888 Smart Bus during the morning weekday peak is similar to that already provided on the 754 service from Rowville to Glen Waverley.

A Smart Bus based on the current Smart Bus model would offer no service frequency advantage.

There is no electrified suburban rail service that offers less than a 20-minute (3 services per hour) peak frequency.

Extended Services

The Services offered by Route 888 are better than most bus services in the South-Eastern suburbs.

However there is no electrified suburban rail service that ceases operation at 8pm on weekends as the 888 bus does. Even the Upfield line has a service from the CBD that continues until midnight on Sundays.

Average Speed and Journey Times

Route 888 Smart Bus averages 12.2 kmh.

The distance from Rowville to Huntingdale is 12.3km.

If a journey by Smart Bus from Rowville to Huntingdale was based on experience with Route 888, it would take 60 minutes.

The bus to rail interchange at Huntingdale in both directions is indirect and requires passengers transferring modes to wait while the bus circles through the overpass, cross a main road and navigate an underground subway. At least 4 minutes is needed for this changeover.

The train journey time from Huntingdale to the CBD (8.55 am limited express) is 19 minutes.

It is concluded that, based in existing Smart Bus speeds, a journey from Rowville to the CBD by a new Smart Bus would take 83 minutes. This is the same as the existing journey time.

In reality, however, it should be possible to better this time. A Smart Bus *with carefully designed services, priority lanes, traffic signal priority and a higher average speed* could offer some limited improvements over present journey times, though not of sufficient magnitude in our view to provide a serious alternative to Heavy Rail. A Smart Bus service would be an appropriate interim measure to develop the public transport market in the area until replaced by the railway. This phase may last for some considerable time.

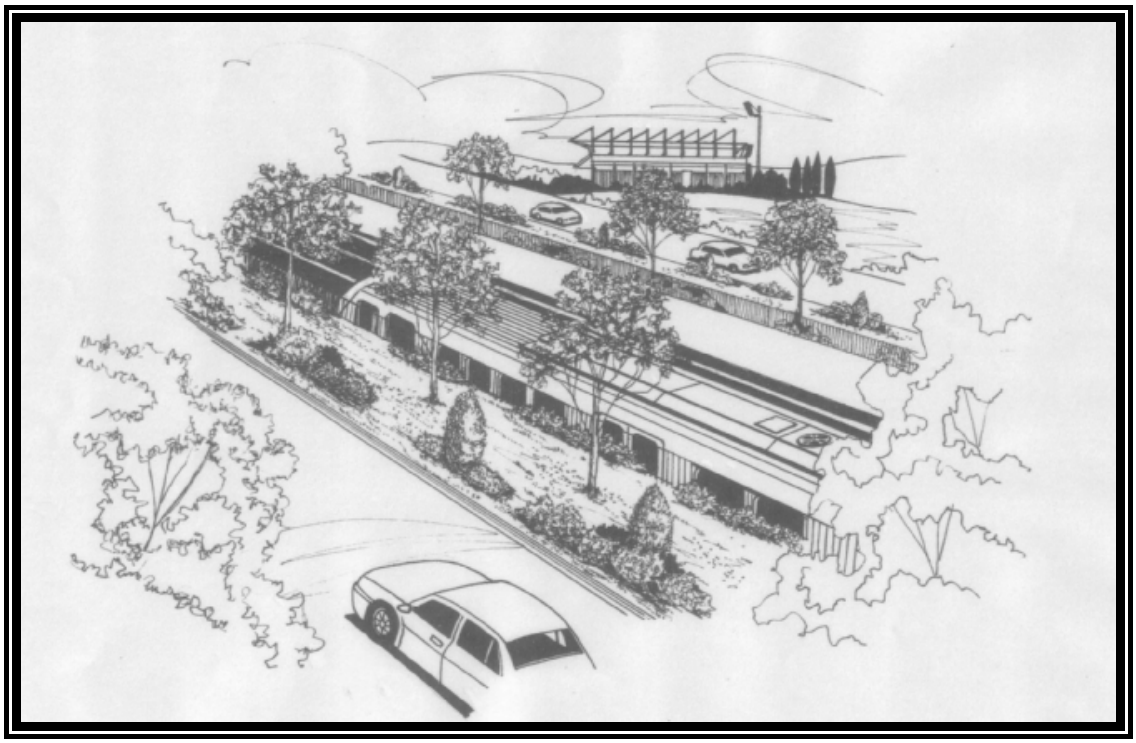
Amenity and Urban Design

Amenity and urban design needs to be an important aspect of this project. Monash City Council officers have raised concerns that the treatment of any Heavy Rail route through that municipality must have high standards of urban design.

The current urban design of the route varies in quality. Although there are attractive tree plantings in parts of the median strip, the area between Huntingdale and Clayton Roads is mainly a light industrial area where much could be done to improve urban design. The Huntingdale station and shopping centre precinct, as noted earlier, is threatening and the construction of the railway could be taken as an opportunity to introduce some urban design values there.

In the western end of the railway, the elevated design will give an attractive high tech feel to the area that is consistent with Monash Clayton's role as a centre of research and development.

East of Jackson's Road, where the railway can be constructed in a slot in the median strip, plantings can minimise the visual impact of the line. The following artist's impression suggests how it could appear.



(Note: drawing omits overhead cables, pedestrian fencing and safety barriers)

Stud Park Shopping Centre is also worthy of some re-consideration from an urban design point of view. Here the bus/train interchange can become an attractive feature of the re-design of the facility.

Urban Design Issues

The following will be important urban design issues that will need to form part of the consultation and planning of the project from the outset. An inadequate approach to these issues is likely to create local concerns and/or opposition to the project, whereas many of the issues may be capable of a designed or negotiated solution if addressed early enough:

Streetscapes

- At **Huntingdale**, the shopping strip abuts the existing road overpass where the present bus stop adjoins an abandoned car yard and a public

toilet block. The elevated railway would pass above this area. The installation of the railway should be used as an opportunity to reconsider the design of the southern end of the Huntingdale shopping strip. There is currently a large car park at the eastern entrance to Huntingdale station, which includes some plantings. It will be important to ensure that plantings are re-instated and an attractive pedestrian entrance to the station is created. The existing subway entrance to the station is narrow and damp and presents security issues. The design team should be asked to identify cost-effective alternatives to the present arrangements.

- **North Road and Wellington Road Median Strips** are currently grassed and planted with trees. During construction of elevated sections of the track, some of these trees will be removed. An inventory of tree species in the median strip will be needed to ensure that they are appropriate to the available envelope.

- **Monash University.** This report identifies two possible approaches for the Railway to pass Monash University bus station and provide interchange facilities. The Monash campus is quite intensively developed and consultation with university authorities will be necessary to ascertain a preferred alignment. If this cannot be achieved it would be necessary for the railway to pass the University in Wellington Rd. Such a solution would be less convenient to patrons and would require careful design of station access to ensure safety of users. Safety issues at this location include the need to avoid conflicts with buses and other vehicular traffic as well as a design which avoids placing users in isolated locations where personal safety may be at risk.

- **Mulgrave Station.** At the intersection of Wellington and Springvale Roads, the need for an interchange with north-south Smart Buses suggests a requirement for careful design of bus-train transfer points that are safe from a user point of view as well as from a road traffic standpoint. Space at this location is restricted and there is heavy traffic to contend with. The design team should consider if the buses can load at a centre island position beneath the station by redesign of the traffic islands and turning bays in Wellington Rd east and west of Springvale Rd. This is preferred to locating conventional bus stops in Springvale Rd north and south of left turn lanes as this would require public transport users to walk a substantial distance and to negotiate two crossings of busy thoroughfares to change modes.

- **Dandenong Creek Escarpment.** The railway requires 11-metre pillars to descend the escarpment at this location. As the railway cannot be concealed at this location, particular attention needs to be paid to an elegant and pleasing design of structures. Recent freeway designs, as on the Eastern Freeway, have demonstrated how utilitarian structures can be made attractive by good design. Over time, elevated railway

structures such as the Taradale, Malmsbury and Moorabool viaducts in this country as well as many similar structures overseas, have become well-loved icons and providing excellent design is employed, this should be the result here. The opportunity to use this location for a sculptural statement about Knox's aspirations as a high tech employment centre could be considered.

- **Stud Park Shopping Centre.** At the moment this is a utilitarian commercial precinct dominated by car parking; urban design values are modest. The installation of the station entrance could be taken as an opportunity to develop a new urban design Master Plan for this area.

Noise attenuation

Generally the conventional track form of concrete sleepers in ballast carried on a concrete superstructure or on formation above or below ground level will provide sufficient attenuation of structure-borne and ground-borne noise.

At a few locations, a combination of air and structure-borne noise may require additional measures. These could include the use of the "Cologne egg" or similar fastening system to isolate the rail from the structure and fitting of extended parapets to contain air-borne noise. Appropriate choice of bearings between the superstructure and substructure can contribute to further attenuation of ground-borne noise.

Overlooking

Elevated sections of the railway may tend to overlook some backyards, but in most cases the width of Wellington Road means that the line will be quite distant. In the course of the Environmental Effects Statement process, conditions may be imposed for the installation of visual barriers at some locations, although it is worth noting that there are many locations in Melbourne where backyards are overlooked by railways, freeways or other public spaces.

It may be that at those locations where the railway is closest to private residences a combined noise and visual barrier will need to be installed; however this issue is best considered during the EES process.

Land Acquisition and Compensation

Land Acquisition issues

Land acquisition costs associated with this project as proposed are expected to be small, as nearly all the route is located on public land, although there are several locations where air space is required, and the issue of the location of the station and alignment within or beside Monash University would need to be negotiated with University authorities.

Compensation issues

It would be necessary for the government to establish in advance an appropriate regime for dealing with claims of property owners who consider that the presence of the railway detracts from their amenity by reason of detriments, actual or perceived, such as noise, vibration, visual detriment or overlooking.

In the case of the new Epping to Chatswood railway in Sydney, a compensation guarantee framework was established by the State Government early in the process to provide assurances to property owners that such claims would be impartially considered. In addition to individual claimants, the question of the overall positive or negative impact of the project on nearby properties may be expected to come into play.

We consider that the Rowville project in this respect would be similar to the NSW case, where it was argued that while the project:

> *"… could have a marginal negative impact on property values over the short term construction period, the proposal is not expected to result in a significant adverse long term impact on property values surrounding the alignment. In the long term its construction is expected to have an overall positive effect.*
>
> *This conclusion was based on the critical assumption that the project would meet stringent environmental controls, particularly in relation to noise and vibration. As a result, requirements to meet these controls were embedded by PlanningNSW in the project's conditions of approval. These included additional noise mitigation measures, including approximately 2.5 kilometres of the most effective and expensive form of track isolation technology. This is the "floating slab" treatment, where the track bed is separated from the tunnel floor by a layer of isolating rubber. .."*

Overall, the team considers that the land acquisition and compensation issues associated with the Huntingdale to Rowville route are manageable, but would require careful planning and effective and early consultation with stakeholders.

4. Rail Service Model

This Chapter outlines our analysis of the service factors that would influence the provisioning of the proposed Rowville Railway. Specifically the following factors have been examined in detail:

- Demand and Patronage;
- Patronage Impact of Route Options;
- Rail Networking Issues and Constraints;
- Service provisioning issues and
- Summary Specifications.

This Rail Service Model analysis first details investigations into the model required to satisfy the task; then outlines the preferred rail solution. It finally provides a brief overview of some ancillary considerations that would need to be addressed such as bus network integration and coordination, and Park and Ride locations and issues.

Demand and Patronage

Catchments

A railway in the Rowville Corridor (from Huntingdale to Stud Park Shopping Centre) would serve a substantial catchment area beyond the normal 1 kilometre walking distance of most rail stations. Less than half of the Rowville suburb is within this 1 km ***walking catchment***. However the entire accessible catchment includes considerable areas beyond the walking catchment which can gain access to the proposed station locations by either car (using Park and Ride) or by buses. Options involving bus access to the new rail stations offer many opportunities to significantly improve both access to the proposed stations and also to provide improved access to local activity centres as well.

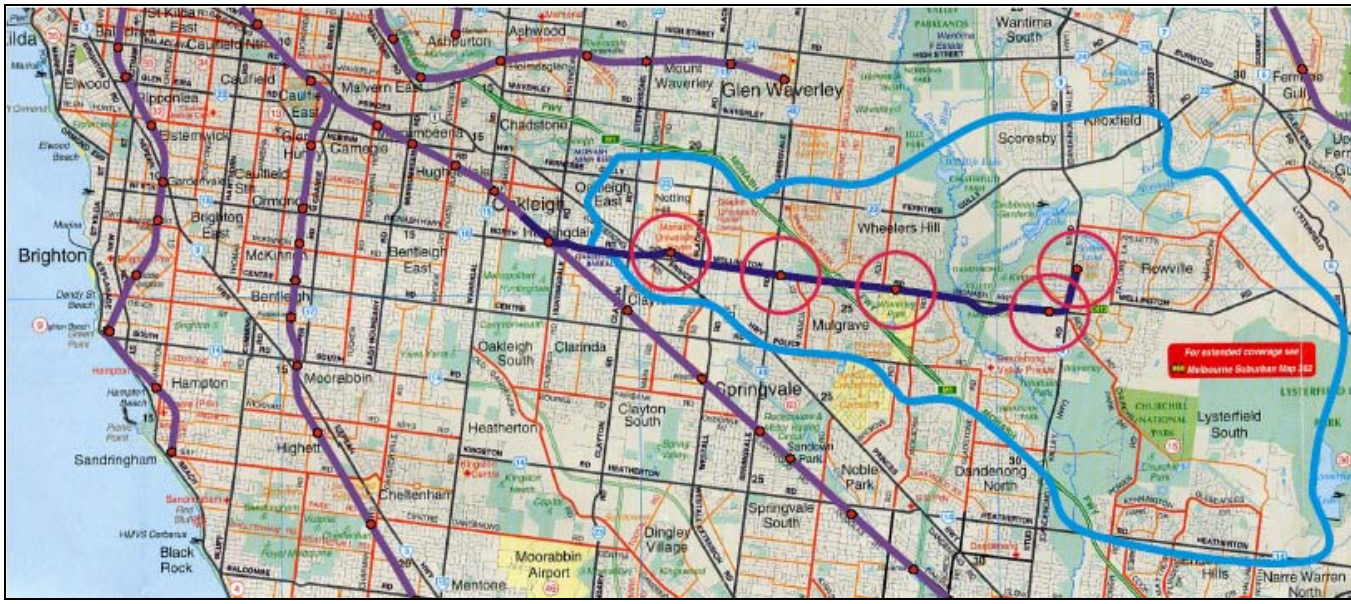
Stud Road, Springvale Road and the Monash Freeway significantly increase the ***driving catchment*** of the Rowville rail corridor. For the catchment to be effectively increased by car access from these roads, viable park and ride facilities need to be constructed where these roads meet the rail corridor.

The overall catchment of the Rowville Rail Corridor can therefore be defined as follows:

Walking Catchment: 1 kilometre either side of Wellington Road from the Princes Highway to Rowville and 1 kilometre around Stud Park Shopping Centre.

Driving Catchment: (including cycling and bus feeders) The driving catchment extends to about 2 to 2.5 kilometres from Wellington Road between the Princes Highway and Jell's Road. This catchment could be functionally wider than this area, however, if patrons from the Dandenong and Glen Waverley line rail catchments choose to travel via the Rowville line for reasons of convenience, access, etc. Also within the driving catchment are all of the suburbs of Rowville, Scoresby, Lysterfield and Mulgrave, and half of Dandenong North. Suburbs such as Endeavour Hills, Doveton and Narre Warren North may also be included via access to future Park and Ride facilities. that may be seen as necessary and be funded by government as freeway congestion worsens.

The Walking and Driving Catchment of the Rowville Railway:



The total estimated population for this catchment is around 100,000 residents. This catchment is expected to continue to grow in population due to ongoing housing development and limited infill-medium density redevelopment. Ultimately this catchment could be expected to house up to 150,000 people.

Trip Purposes

Trip purposes to and from a catchment area like the Rowville Rail corridor consist of journeys to and from work, education and shopping. Some trips for recreational purposes will also occur but these are more likely outside peak periods and do not contribute significantly to the overall demand for a rail service in this corridor. Journeys to Work are likely to represent the dominant share of trips. However, with the Monash University Clayton Campus located on the route, total trips for educational purposes are also likely to be higher than might normally be expected.

Due to the two primary trip purposes being Journeys to Work and Education, both of which tend to occur during the morning peak, this will place ongoing additional demand on the transport networks of the area and will help to justify a rail link to ease congestion overall on the transport systems of the area. Both Journeys to Work and Educational trip purposes should be used as primary justification demands supporting the need for a Rowville Railway. Most of the educational trips are likely to be counter-peak or "back loading" on this line, providing a useful balance of patronage.

Trip Generators

A number of significant trip generators currently exist along the proposed Rowville rail corridor route. These can be analysed in the following 5 categories:

Residential development,
Employment developments (non retail),
Retail developments,
Educational institutions, and
Other community attractors such as hospitals and sporting facilities.

Each of the above categories is here further examined.

Residential development is dominant all along the corridor, and is the primary land use in the eastern sections or the corridor. Residential development is also significant in the western sections of the corridor but in this area there is also considerable light industry and warehousing. The new Waverley Park residential redevelopment provides a substantial new trip generator for the middle section of the corridor.

Employment developments (non-retail) tend to be predominantly located in western parts of the corridor, west of Springvale Road and with older industrial workshops near Huntingdale. A small warehousing area is located on the western side of Rowville. There are a number of industrial areas in Scoresby to the north west of Rowville but these are located outside the 1 km walking catchment of the Wellington Road alignment and are hence not likely to generate many Journey to Work trips. The new Scoresby-Rowville employment precinct will in coming years provide a significant employment focus near the terminus of the line, providing 8000 jobs. Many of these employees will be future users of the Rowville Railway.

Retail developments are predominantly located at Stud Park Shopping Centre and also at Huntingdale (in an older shopping strip suffering from neglect and decline). These two locations would generate the majority of retail related public transport journeys in the corridor. There are also some "drive in" style retail outlets near the intersection of Wellington Road and Springvale Road, but these are car-orientated developments and are unlikely to generate much public transport patronage.

Educational institutions are a prominent land use along the corridor. The Monash University Clayton Campus is the largest single trip generator along the corridor and generates at least 10,000 daily student trips at the peak of semester. Importantly, there are also many colleges and schools within the 1 km walking catchment of the corridor. There are at least six colleges and ten schools within walking distance of the proposed railway, all of which would generate a substantial number of student trips

each day. The University has a wider and longer distance catchment than local colleges and schools and will therefore generate more trips by rail per student enrolled. The University's second largest campus, located near Caulfield station, is also on the proposed rail route. Connecting the two campuses by a frequent and quick train link will both develop rail patronage and provide university authorities with new flexibility in the planning of their programs. It will also relieve the University of some of the cost of providing student and staff car parking, which has absorbed many millions of dollars of university funds in recent years. Such funds could be better spent on educational objectives rather than additional car parking.

Major Trip Generators in the Rowville Corridor:

Key: Yellow = Educational, Orange = Employment, Dark Pink = Retail and Light Pink = Medical

Other community attractors such as hospitals and sporting facilities are dispersed along the corridor from Huntingdale to Rowville. A number of retirement villages are located at the Rowville end of the corridor. The Monash Medical Centre is the primary medical facility within the corridor. Other hospital and medical facilities within the corridor are mostly outside the walking catchment and are not likely to attract many public transport trips by rail with long walk included.

Sporting facilities are located at Monash University, ovals and sports fields within reserves along the route and also a golf course. The sporting fields associated with the University and colleges are most likely to generate some recreational trips, but these would only be additional to educational trips if occurring on the weekends.

Mode Share

The mode share following the construction of the Rowville Railway for the primary journey purpose, being journeys to work, for rail trips has been assumed to be 7%. This has been based on census figures for similarly structured regional corridors in south eastern Melbourne that already have a rail service (e.g. Glen Waverley line

catchment). The majority of trips to work by rail would be heading toward the CBD and office employment during the peaks. A significant proportion of these trips (up to 20%) would also be seeking to access working locations outside the CBD, via other rail lines or other modes. These trips would also be occurring during the peak periods.

Finally a smaller proportion of trips would be occurring outside the peaks, made up predominantly of shift workers and industrial workers with slightly earlier start and finish times than the white collar workforce. These trips usually occur outside the peak period are can be accommodated on most transport networks' surplus off peak capacity without difficulty.

Integration with other transport modes

Integration with other modes is an integral part of any transport system (including road networks). No single transport mode can be expected to satisfy the travel requirements of every individual's journey needs. Although this ability to satisfy individual needs can vary from mode to mode, and some modes can alone satisfy many individuals' needs on a case by case, trip by trip, basis, no one mode can actually satisfy all journey needs alone. This is why integration with and between modes is not only important, but is essential to ensuring that the transport network is flexible, effectively satisfying all users' needs, and hence, is complete.

The key to flexibility within a transport network is not based on the flexibility of any one mode but on the flexibility with which people can easily use a network of integrated modes to reach their destinations as quickly and efficiently as possible.

As the user is infinitely more flexible than any one mode could ever be, it is more efficient to allow the user to provide this component of the system. The less flexible modes are better at providing speed, capacity and reliability. By building on the strengths of each mode, tailoring the right mode to the capacity of the task required, and relying on the ultimate element of flexibility, (that provided by the user), a balanced and efficient transport network will ensue.

Without an integrated and balanced network that consists of a variety of modes, each selected to best fit the task that they are expected to deliver, the network would be strained and one mode after another would be over-burdened leading to inefficiency and ultimately failure (congestion!)

The proposed Rowville Railway would be the centre piece of a fully integrated package of transport improvements consisting of new railway stations, bus interchanges and park and ride facilities. The services operating along the new line would be integrated with these modes and also with the rest of the rail system through which the Rowville rail services would run towards the city. Integration with the remainder of Melbourne and its suburbs would occur at existing rail stations between Oakleigh and the CBD, where passengers could change to other train, tram or bus services.

Estimated Journey time to CBD

The existing journey time by rail from Huntingdale to the CBD is 21 Minutes, covering a distance of 17 km with four stops on the way. The distance from Huntingdale to Rowville is about 11 km with four stations enroute. With an average operating speed of 40km (including stopping time) the trip from Huntingdale to Rowville will take 9 minutes. The complete journey time from Rowville to the CBD will therefore take about 30 minutes.

Patronage Estimates

The estimate for peak hour patronage on the proposed Rowville rail line has been calculated using the following method:

Total catchment population x 60% = workforce participation rate (average for suburbs)
Workforce x 80% = proportion of workforce working during day (i.e. 20% shift workers)
Day time workforce x 7% = proportion of Journey to Work trips by rail (average for outer suburbs)
Total Journey to Work trips x 70% = proportion of Journeys to Work during peak 1 hour (from observation)
Result is the Journey to Work patronage towards the Central Business District during the peak one hour

Then for other trips (mostly education purposes)
Peak one hour Journey to Work trips x 1.7 = expansion for total of all trips during peak one hour

Using the above method, and assuming a catchment population of about 100,000, we get the following:

100,000 x 0.6 = 60,000 = workforce
60,000 x 0.8 = 48,000 = day time workforce
48,000 x 0.07 = 3360 = Journeys to Work by rail
3360 x 0.7 = 2352 = peak 1 hour Journey to Work trips

About 2350 passengers per hour would be on board trains that entered the rail network at Huntingdale. As trains have 600 seats this would require 4 trains per hour to ensure that all passengers from the new rail line were sure of getting a seat.

Expanding the above figure to take account of all journey purposes we get:

2350 x 1.7 = 3998 = trips for all purposes.

However, of the 1646 extra trips, most of these would be heading on short journeys and would not occupy seats for long. Additionally many of these trips would also be heading counter peak. Most of the counter peak flow would be students traveling from

the rest of the rail network to Monash University Clayton. In fact it is estimated that if the university generates 10,000 student trips by all modes a day, that as many as 2000 of these trips would be by rail if the new rail line was to be built.

In light of the above patronage calculation and the large counter peak flow for non Journey to Work trips it is considered that a service level of four trains per hour, running at 15 minute intervals, would be sufficient to satisfy demand for trips by rail along the corridor.

Although it could be argued that this level of service should be reduced to a half hourly service during the off peaks it is important to remember that the University has a constant flow of students, staff and visitors at all times of the day and early evenings. For this reason, to facilitate passenger convenience (and safety) it is also recommended that the four trains per hour level of service be maintained from 7:00am through to 9:00pm. Half hour services would suffice before 7:00am and after 9:00pm, and all day on weekends.

Patronage Impact of Route Options

A number of route options are examined from a patronage impact point of view in this part of the study. Elsewhere in this study these options are assessed from an engineering standpoint. Each has been assessed here on the basis of its ability to satisfy the community's travel needs.

Alignment Options

Junction Options

Four alignment options have been identified for patronage analysis and comparison. The first option involves leaving the Dandenong line at grade immediately south of Huntingdale station and involves provision of an extra single sided platform at Huntingdale.

The alternative option at Huntingdale is to pass through Huntingdale on an elevated structure north of North Road. This option would provide a grade-separated junction that would need to be located north of Huntingdale and south of Oakleigh. This option would not serve platforms at Huntingdale.

The railway would run down the centre of Wellington Road to Rowville. It would be located in either a slot or on an elevated structure. Both configurations facilitate grade separation of the rail line except where a transition from one configuration to the other occurs. Each has differing cost implications for both the permanent way (the tracks themselves) and for the stations. As the impacts of these configurations have little impact on service provision or the likely patronage, neither the elevated nor slotted options have been considered further in this part of the report and a "generic" alignment has been used for patronage analysis.

Two options at the terminal end of the Rowville rail corridor were considered. The first option is to terminate on the southern side of Wellington Road near the

intersection with Stud Road, near land currently used by Powernet Victoria. ("Rowville Parkway")

The second alternative considered was the extension of this option further into Rowville to terminate at to Stud Park Shopping Centre. .

The following analysis summarised the patronage implications of each option.

Huntingdale at grade option is likely to generate slightly higher patronage than elevated options; such patronage would be related to the two following purposes:

The first would be a small number of shopping trips heading to Huntingdale from the east. This is considered almost insignificant at this time with Huntingdale being somewhat depressed as a retail destination. It is unlikely that the addition of an extra platform in itself would constitute sufficient stimulation to initiate a turn around in the retail market at Huntingdale.

The second would be a small number of students changing from trains that have been heading north from the Dandenong line wishing to change to Rowville services to gain access to Monash University Clayton. However, this interchange would be better facilitated at Oakleigh, a premium, fully staffed station where all suburban services on the line currently stop. A platform at Huntingdale would only replace the need to change at Oakleigh. As most passengers changing to the Rowville services would find Oakleigh the more convenient location to change from their service the additional stop at Huntingdale would be an inconvenience for the majority of passengers.

In light of the above, the *Elevated Option at Huntingdale* would be better suited to the majority of passengers' needs, effectively bypassing Huntingdale and resulting in an easier grade separation with the Dandenong line than the at-grade junction option. The elevated option is therefore recommended at Huntingdale from a passenger perspective.

Terminus Options

At the Rowville end of the line, the first option is for a *Terminus at Rowville Parkway* that is, near the junction of Stud and Wellington Roads. The line would terminate at a station adjacent to the electricity substation. This option has been named the Rowville Parkway option due to the desirability of it serving as a Park and Ride facility for rail users arriving at the line by car. Although this option is the cheaper option to construct, being the shortest and least physically intrusive on the existing built form, it may not stimulate the same urban development opportunities around Stud Park Shopping Centre that might be desired as a flow on from this rail project. A large Park and Ride facility should be located near this location, whether or not the line is extended further. This would be the primary Park and Ride facility for the entire line so parking for at least 500 cars should be considered. The site is large enough to accommodate the proposed terminal station, car park and bus interchange that would be required.

The second option is for a *Terminus at Stud Park Shopping Centre*. Although considerably more expensive to construct, this station location is much better suited to

the needs of the overall Rowville catchment. This station should have minimal commuter parking, as it would primarily intended to be a "walk in" station. A bus interchange would be required, but not of the same scale as the bus interchange envisaged at Rowville Parkway. The primary advantage of the Stud Park Shopping Centre terminus is the longer term opportunity to redevelop the shopping centre (which is on the top of a gently slopping hill) into an urban village with mixed uses, whereby the residential components could command views of the Dandenongs and surrounding areas.

In comparing the opportunities afforded by both options it is considered that a terminus at Stud Park Shopping Centre would provide the better long term option and support the development of a vibrant activity centre in this area. This area has been identified in *Melbourne 2030* as an activity centre and also is identified as a future development focus in the draft *Knox City Council Housing Statement*.

Journey Time Estimates

Journey times on each of the above options will be discussed in this section.

A line terminating at Rowville Parkway (the substation option) is expected to have a 7 minute journey time to Huntingdale (assuming a 40km/h average journey speed including three stops enroute).

A line terminating at Stud Park Shopping Centre is expected to have a journey time to Huntingdale of 9 minutes.

Station Options

A number of options for stations exist along the line that have potential to generate different patronage outcomes. The possible locations for stations are many, however not all would be considered desirable as too many stops would make the journey time unnecessarily long. The following locations have been considered as possible station locations:

An interchange station at Huntingdale,
West of Clayton Road,
At Monash University, ("**Monash**")
East of Blackburn Road,
Near Springvale Road, ("**Mulgrave**")
Near the Monash Freeway (for Park and Ride)
East of Springvale Road (A station between the two above to facilitate the needs of both)
Near Waverley Park redevelopment, ("**Waverley Park**")
East of the proposed Mitcham to Frankston Freeway for Park and Ride. .
Near the intersection of Wellington and Stud Roads for Park and Ride, ("**Rowville Parkway**")
Stud Park Shopping Centre, ("**Stud Park**")

Of the above options, the stations at Monash University Clayton and Rowville Parkway are considered to be mandatory due to their location beside significant trip generators or Park and Ride potential. Following from this, stations at Clayton Road and Blackburn Road would be too close to Monash and should be discarded from the list. The station just east of the Mitcham to Frankston Freeway would not be required as it is too close to the Rowville Parkway Park and Ride station.

Springvale Road (Mulgrave) is a desirable station location that would provide interchange opportunities with north-south Smart Buses on Route 888. A station, located east of Springvale Road could service both the employment developments near Springvale Road and also provide a possible future Park and Ride location.

A station immediately east of Jell's Road (Waverley Park), would service the local residential area, including the Waverley Park redevelopment, as well as the areas accessed from Jell's Road and Jackson's Road just to the east.

This results in the following station locations: :

Monash University ("Monash")
Springvale Road, offering Park and Ride for Monash Freeway. ("Mulgrave")
Jell's Road ("Waverley Park")
Stud Road ("Rowville Parkway"), and
Rowville ("Stud Park")

The average distance between these proposed stations is about 2km.

Park and Ride Considerations

A number of options for Park and Ride facilities have been identified in this review of patronage generating factors. All stations will attract some demand for Park and Ride but it is important to consider the location of larger facilities, which of themselves attract more patronage to their specific stations. Locating large Park and Ride facilities near local shopping centres can result in unacceptable congestion in the local streets and any overflow demand for parking not catered for in the facility will spill over into the streets occupying the spaces otherwise used by shoppers and necessitating local parking schemes to be implemented.

Locating larger Park and Ride facilities away from local shopping precincts can be beneficial for the both the shopping precinct (especially if it has its own station) but allows easier access by car drivers who do not need to approach the Park and Ride station through otherwise congested and narrow streets. This also leaves the shopping precinct free of commuter pedestrians, but detracts from patronage benefits to local traders.

Park and Ride stations should not be located where it is intended to promote future residential or mixed uses or urban village redevelopment, as the higher numbers of cars that they attract will congest the urban environment, detracting from that style of redevelopment. Stations located in urban villages or existing residential areas with

little or no Park and Ride should ideally be identified as separate locations from those chosen for Park and Ride stations.

If no option to separate the two exists, then the location of the Park and Ride should be focused on one side or the other, with road access only from that side from the arterial road network, ensuring that the other side can be a more pedestrian friendly environment. This will ensure that the benefits of a new railway station on new residential developments can be maximized and the negative impacts of traffic associated with the Park and Ride are minimised for pedestrians.

The features of the Park and Ride would be similar to those provided on the Doncaster Park and Ride opened by the Minister for Transport in January 2003. Those features are:

- free parking for 400 cars
- bicycle lockers
- taxi rank
- climate controlled waiting lounge and under-cover waiting areas
- toilets and showers
- Closed Circuit Television security cameras
- staffed from 6am until 12.30am on weekdays, and 12.00 am on weekends.

The State Government announced in 2003 that it would consider providing facilities of this kind in a variety of locations in Melbourne as part of its strategy of achieving a 20% modal shift to public transport by 2020. In this context the costs of providing this facility at Rowville could be attributed to wider government policies including the need to offset freeway congestion rather than the Rowville project.

Rail Networking Issues and Constraints

Joining the proposed Rowville Railway into the rest of the Melbourne Metropolitan rail network cannot be achieved without planning both Physical Integration and Service Integration. Physical Integration refers to issues such as integration with the existing physical rail network, e.g. the design of the junction with the main Dandenong line, while Service Integration involves planning how Rowville services would mesh with the current or required pattern of operations, integration with the timetable, and integration with other modes at interchanges (i.e. buses etc.) Each of these issues will be discussed below.

Network Physical Integration

Integration with the rest of the Melbourne Metropolitan rail network must first occur in the form of a junction with the main Dandenong line. It has been proposed that this junction should occur north of Huntingdale and before Oakleigh. Two options were considered, one being a flat (at grade) junction and the other involving a flying (or grade separated) junction north of Huntingdale. It is unlikely that the at-grade junction

will be capable of delivering the desired service reliability that is expected of modern rail networks and a grade separated junction is recommended in this instance.

Other options involve approaching the Dandenong line on an elevated structure. This design would not require as much approach distance as designs that have to ramp up then down. The elevated approach design, with its lesser space requirement, would allow for more stabling to be incorporated on the southern side of Oakleigh.

GLOSSARY NOTE
In this Section:
The "Up Dandenong line" refers to the line taking trains towards Melbourne
The "Down Dandenong line" refers to the line taking trains away from Melbourne

The configuration of the junction will require clear standing room for a full length train both before entering the single track section of the Rowville Railway (possibly commencing at the flyover) and also in the opposite direction before joining the Up Dandenong line. It may be necessary to at least triple track the section of line between Caulfield and Oakleigh to carry the additional trains that the Rowville service will place on to the main line. In the triple track arrangement the centre track will be the bi-directional peak flow track. It is understood that such triplication is an existing priority for the State Government.

Service Integration

Integration with other rail services will be essential for the Rowville Railway as its services would need to flow on to the Dandenong line to head towards the city. This new line will form part of the Caulfield Group of lines. Some minor changes in the patterns of operations along the group would be required to facilitate the flow of additional trains towards the city.

Currently a variety of services from both the Dandenong line and Frankston line stop at the stations between Caulfield and South Yarra. After the integration of the Rowville service on to the line it is likely that no Frankston service would stop at the stations between Caulfield and South Yarra and that more Dandenong services would be fed on to the Through Caulfield lines and then on to the through Suburban lines via Flinders Street Station during the morning peak period. The remaining services on the Caulfield local lines would need to provide a mix of fast and all stopping services between South Yarra and Caulfield and Caulfield and Oakleigh.

Trains running from the Rowville line would not be expected to provide the all stops services to South Yarra during the peak periods however during the off peak periods some Rowville services may be required to make additional stops enroute to ensure service frequency for the lesser stops along the main line. During the peak periods it has been determined that the Rowville to CBD service would take 30 minutes.

Timetable Integration

Integration with the timetable of the other services operating on the Caulfield group of lines will be essential for the reliable operation of the proposed Rowville rail line. The four services per hour from the line would need to "slot" into the remainder of the timetable, run towards the city and around the loop in the peak direction then back out to Rowville. Ideally the Rowville fleet would be a self contained fleet of trains, i.e. the trains on the Rowville daily roster would only do Rowville runs all day, however this would be subject to further detailed analysis as party of a more detailed review of timetable integration that is beyond the scope of this study.

The timetable required to operate the Rowville services will require six train sets during the peak period if a 15 minute frequency of service is to be provided. Six train sets are required to launch the peak services before any have returned from the city to recommence the city-bound journey. This could be reduced to five train sets if a half hourly off peak service was all that was required.

A passing loop at Monash station would be required to allow opposing trains to pass. The Down train would arrive first and wait for the Up train to pass in the opposite platform.

Two platforms would be required at the terminal of the line. This is because two trains would be at the terminal station simultaneously. If initially the terminal station was Rowville Parkway then this station would need to be built with two platforms. The turn around time (or layover) at Stud Park would be 16 minutes. If the terminal point of the line was at Rowville Parkway, the turn around time would be 20 minutes.

In the event of a train arriving from the city at Oakleigh up to 2 minutes late, then the Monash passing loop should facilitate the passing move as intended. However, if a train arriving from the city presents itself at Oakleigh anywhere between 3 and 8 minutes late then this will necessitate the construction of an "emergency" passing loop at Waverley Park station that would only see trains passing when they were running late.

A train arriving 9 to 12 minutes late would have to wait on the approach to the single line section or pass the opposing train on the double track south of Oakleigh before the beginning of the single tracks. However, this service will then encounter the next Up service from Rowville before reaching the emergency passing loop at Waverley Park and would have to be held in the platform at Monash. By the time the line ahead was clear of the approaching Up service, the following Down service would have caught up to the back of the delayed Down being held at Monash (assuming it too was not already running late also). In this scenario, both Down trains would then need to proceed down the line, one behind the other and the first service would have almost no time to turn around at the terminus, being only one minute. (This would be slightly less of a problem for a terminus at Rowville Parkway as the turn around time there would be 20 minutes instead of 16 minutes.)

Integration with Other Transport Modes

A number of opportunities exist for the proposed Rowville rail line to integrate with other modes of transport. Apart from Park and Ride, which has been discussed earlier, there is also a considerable number of existing bus routes that cross the proposed corridor. Many of these routes are likely to be affected by the imminent introduction of the "Smart Bus" initiative and would also be affected by the introduction of the proposed new rail line.

Smart Bus routes involve the introduction of new-limited stops bus services, most likely running in a north south orientation and integrating with the existing rail network. The introduction of the Rowville line would add additional interchange points for the Smart Bus routes, helping to complement the comprehensive nature of the transport network for the region. The Government has also recently announced the introduction of a Wellington Road Smart Bus. This service will have a useful transitional role in developing the market for public transport services along this corridor, but it would ultimately be replaced by the Rowville Railway.

Smart Bus routes could hub at Monash University (as many bus routes currently do) and could also hub at Rowville Parkway interchange station near the corner of Wellington Road and Stud Road. Other Smart Bus routes could cross the rail corridor at Springvale Road and Jackson's/Jell's Road. Each of these other crossing points would provide interchange with the other two railway stations proposed for the line, being just east of Springvale Road and also just east of Jell's Road.

Conventional bus routes could also integrate with the proposed Rowville Railway, whist others could be rerouted to better complement the new network opportunities that the new rail line facilitates. It is interesting to note that currently no bus route operates along the length of Wellington Road from Rowville to Huntingdale or Oakleigh. Integration to the rail system from Rowville is provided by route 665 which runs to Dandenong some 8 km to the south, and route 754 which indirectly heads to Glen Waverley Station to the west.

The new Smart Bus announced recently should be implemented without delay to remedy this important service gap, to commence the development of the public transport market in the corridor and to provide residents with more transport choice.

The following bus routes would be made redundant by the introduction of the new rail line:

Route 804 from Oakleigh to Jell's Road. (Route 754 would now be on the route of a north south Smart Bus that would replace route 804 between Wellington Road and Wheelers Hill Shops.)

Route 754 from Jell's Road to Rowville Shops.

Routes that would be rerouted would be the following:

Route 802 and 862 that would be re-routed via Blackburn Road, Princes Highway and Police Road.

Route 630 that would be rerouted to Oakleigh rather than terminating at Monash.

Route 691 and 664 that would be run to Rowville Parkway rather than Waverley Gardens Shops.

Other routes that would remain unchanged and that integrate with the following stations would be as follows:

At Monash, routes 631, 703, 733, and 737.

At Springvale Road routes 888, 889, and a new Smart Bus.

At Waverley Park (Jell's Road) routes 754 and 804 would now commence here, routes 850 and 848 would also integrate here.

At Rowville Parkway routes 665, 667 and a new Smart Bus would integrate here, and this would be the new western end of routes 691 and 664.

At Stud Park Shopping Centre shops routes 665, 691 and 664 would all integrate.

All bus routes integrating with the rail service should operate at at least 15 minute frequencies during the peak periods and at half hour frequencies in the off peak (unless certain routes warrant more frequent off peak services). This level of service will enable the bus timetables to coincide with the rail timetables at the stations where the service integration occurs, facilitating customer interchange between rail and bus services.

An additional benefit to bus operations is the reduced length of route needing to be serviced, and the additional patronage attracted by the rail service. These two factors taken together will improve bus efficiency in terms of patronage per km traveled.

Service Provisioning Issues

A number of service provisioning issues need to be considered before the full implications of the requirement of the proposed rail service can be determined. These service provisioning issues are the requirements for additional train sets to operate the new service, the need to stable these new train sets somewhere near the new line, and other ancillary infrastructure requirements needed to operate the service efficiently. Each of these will here in turn be discussed.

Fleet Requirements

The fleet requirements for the line have been determined in the previous section. It has been estimated that at least six trains would be required to operate the proposed 15 minute peak hour frequency for one and a half hours. If this level of service was

only required for the peak one hour, and service levels were reduced to half hourly out side of this time, then only five train sets would be required.

This fleet of up to 6 trains would be additional to the existing fleet requirements for the Caulfield group and would need to be purchased as part of the rail infrastructure project. They would also require additional stabling facilities, preferably close by the line on which they are intended to operate.

Stabling Locations

A number of possible stabling locations could be considered to house the fleet of six additional train sets needed to operate the new Rowville line. Ideally the new stabling facility would be located at the end of the line. However a suitable location for stabling trains in the middle of the existing Rowville residential area is not likely to be found.

Options for stabling include along the new line, or in a purpose built new facility near the junction with the rest of the rail network.

New stabling locations along the proposed line, even if located in existing industrial areas, are not likely to be considered favorably by their surrounding communities. Land acquisition costs are also likely to be prohibitive for this option and it is not recommended.

The recommended option is to reconfigure and enlarge the existing but unused Oakleigh stabling yard. This yard currently has space for two to three trains but could be extended and reconfigured to join the new line, which would have its junction just south of the Oakleigh yard. The new Oakleigh yard would have space to house all 6 train sets required to operate the new line.

A yard in this location would feed trains out on to the Rowville line early in the morning to build up the flow of trains in readiness for the morning peak. Late at night, the last services returning from the city would terminate at Oakleigh and then proceed straight into the yard. Alternatively, these services could operate all the way to Rowville and return as empty sets to the Oakleigh yard.

Other Servicing Infrastructure Requirements

Additional infrastructure required to ensure the smooth operation of the rail service is also required and space for their provision will need to be considered as part of the project. Apart from the need for a grade separated junction north of Huntingdale and the proposed stabling yard south of Oakleigh, both of which will consume most of the available width of the existing Dandenong line rail corridor the following additional items will also need to be considered:

Transmission lines and substations, engineering depots, temporary construction sites and stockpile areas, staff car parks at stations, noise barriers and drainage requirements of the corridor, and vehicular access to the new rail corridor for maintenance and in case of emergency.

As development of this rail project is currently only preliminary it is too early to discuss the above considerations in any detailed way, however, it is important to note that the requirements for each of the above elements are important to facilitate as without any of them, the new rail line will be unable to operate or would only do so in a substandard and unreliable fashion.

Summary Specifications of Rail Service Model

This section of the report summarises the outcomes of the analysis of the determining factors for the recommended Rail Service Model.

Proposed route: From Oakleigh/Huntingdale to Stud Park Shopping Centre via Monash University Clayton.

Number of stations on route: 5

Names and locations of stations for preferred option: Monash, Mulgrave, Waverley Park, Rowville Parkway and Stud Park.

Location of Park and Ride facilities: Rowville Parkway

Possible additional future Park and Ride: Mulgrave

Location of primary bus interchanges: Rowville Parkway and Monash.

Location of lesser bus interchanges: Oakleigh, Mulgrave, Waverley Park and Stud Park Shopping Centre.

Journey time to the city from Rowville: 30 minutes

Number of mainline stops enroute to city: 4, Oakleigh, Caulfield, South Yarra and Richmond.

Service frequency during the peaks: every 15 minutes

Service frequency during the off peaks: 15 minutes preferred, half hour minimum.

Estimated Journey to work patronage in the peak one hour: 2350

Number of pax total all journey purposes during the morning peak: up to 4000

Total number of daily trips: 8,000 up to 10,000

Number of 6 car trains per hour required to move forecast demand: 4 per hour

Number of 6 car train sets required to provision the timetable: 6 train sets

Location of recommended stabling location: 6 trains to be located south of Oakleigh

Proposed integration with bus services: Buses should have timetables that integrate with the 15 minute frequency rail service.

Recommended hours of service provision: 4:30am through to 12:30 am

5. *Engineering Issues*

Geometric Considerations

Vertical clearances

Vertical clearances for rail over road structures have been based on clearances provided by the existing structures over the South Eastern Freeway. A minimum vertical clearance of 5.5m has been adopted.

The North Road overpass at Huntingdale has been used as a guide to an acceptable vertical clearance over electrified tracks. A structural vertical clearance above top of rail of 6m has been adopted.

The depth from top of rail to finished formation level has been taken as 600mm. This is based on 50AS rail 154mm deep, concrete sleepers with a rail seat depth of 200mm and 250mm of ballast below the sleepers.

Horizontal clearances

For simplicity this feasibility study has been based on a 5m wide envelope for each track and, accordingly, double tracks are at 5m centres. There may be scope at a detailed design stage to reduce these values over the greater proportion of the route and it may be necessary to slightly increase them in regions of track curvature.

Vertical alignment

A ruling gradient of 1 in 50 has been adopted but where necessary steeper grades have been used, including one location with 1 in 33 for almost a kilometre. Grades of this magnitude occur on the existing urban network and are considered acceptable for modern electric traction.

Vertical curves at changes of grade have not been shown on the grade lines. They will be necessary at most changes of grade but will generally be of dimensions achievable through minor adjustments in the ballast depth.

Large scale drawings of the vertical and horizontal alignment of the proposed Rowville Railway have been prepared as part of this study and provided to Knox City Council in hard copy and electronic formats.

Horizontal alignment

The majority of the route is straight or near-straight. Curvature becomes necessary where the North Road-Wellington Road alignment is joined or left and in the vicinity of the station proposed for Monash University. In investigating feasibility, a minimum radius of 200 metres has been adopted. It will be necessary to restrict speed on 200 metre radius curves to about 45 km/hr but because the curves are few and generally located near stations or near crests in the grade line the operational penalties should not be severe.

At the detailed design stage, larger radii may prove possible in some locations. Rail-wheel contact noise is curve radius dependent but the problem will not be significantly worse for 200 metre radius as opposed to, say, 300 metres. Greater than 300 metres is unlikely to be achieved due to constraints of property boundaries.

Major road crossings

Major road crossings severely constrain the type of construction available. Multiple straight-ahead lanes with the addition of multiple right-turn turn lanes result in the loss of much of the width of the central median.

If the line is in cut as it approaches such an intersection, then a considerable length of tunnel is required. For example, the Princes Highway intersection would require at least 460 metres of tunnel if the rail alignment were to follow the North Road, Wellington Road alignment. Tunnel lengths greater than 300 metres are likely to be required at other major road crossings. The depth of cover to the tunnels under major roads may have to be increased to accommodate utilities. If the line is elevated over these intersections then there will generally be a need for a minimum span length of 60 metres and usually three such spans will be required.

A significant advantage of elevating the rail is that there is much less disruption to the roads during construction. Pier foundation construction works will encroach on some traffic lanes but placing a below-ground railway will cause disruption over longer distances and for a longer period

Minor road crossings

Crossings at minor intersections will generally be capable of being spanned with one 30 metre span. A similar length of tunnel would be adequate.

Track Form

Generally it has been assumed that the track will be conventional ballasted track with 50AS rail on concrete sleepers. In a few locations, to achieve greater attenuation of noise generated at the wheel-rail interface, it may be necessary to adopt a more sophisticated track form such as Cologne eggs on concrete slabs but these locations are expected to be few and not extensive.

Structural Considerations

Elevated sections of the Route

Structural materials

On the bases of aesthetics and noise attenuation concrete has been assumed to be the preferred structural material. It also has some constructional advantages in the case of the larger spans, enabling individual longer spans to be assembled close to their final locations from pre-cast segments stressed together.

Structural forms

It is assumed that the spans will be box girders with the top slab forming a ballast trough for conventional ballasted track. The cross-sectional shape would be determined at the detailed design stage based on structural, aesthetic and noise attenuation considerations.

Spans and depths

A span length of 30 metres has been adopted generally. This suits most minor road crossings and is considered to offer a reasonable compromise between minimum structural depth and minimum number of support piers. Based on preliminary design calculations the depth from underside of girder to the track formation level has been taken as 1.3 metres for the purposes of establishing a grade line.

At a number of locations it has been found necessary to adopt a span length of 60 metres. Preliminary calculations suggest that the depth from underside of girder to the track formation level should be taken as 3.2 metres. Where the topography dictates a grade line significantly higher than the usual minimum level of elevation, this span length may be nearer to optimum than the generally adopted 30 metre span length but no attempt has been made to optimise these designs.

Pier size

Piers are likely to be of cylindrical cross-section (nominally 1.2m diameter) with some form of cross-head to meet stability requirements of the spans. Each pier is likely to be supported on a group of piles with a pile cap length of about 8 metres. Pile caps would be constructed beneath the surface of road ways and median strips would need to accommodate only the diameter of the pylon supporting the railway. There will be no requirement to sacrifice road lanes to support elevated sections of the railway. Within that length of pile cap there is some scope for eccentric placement of the visible part of the pier to suit the alignment and available width of the road median strip at intersections.

Earth fill approaches

Limited lengths of earth fill approach ramps will occur. These are likely to be reinforced earth structures where space limitations restrict the footprint of the elevated sections.

Below-ground sections of the Route

Open slots will generally need cantilevered retaining walls to enable construction to proceed without excessive disruption of adjoining infrastructure. Other solutions such as reinforced earth are not practicable due to their need for major over-excavation and compacted selected backfill.

Tunnel sections are assumed to be of reinforced concrete box form. Precast units are feasible but the choice of precast or insitu would be based on detailed design and costing data.

Alignment Options Examined

Junction at Huntingdale

Options based on proposed line passing under the Huntingdale flyover

Passing under the westbound carriageway

This is achievable using 200m radius curves but with the following shortcomings:

- The initial gradient from the junction with the main lines needs to be 1 in 40 (acceptable for relatively short zones).
- Huntingdale Road connections to the westbound carriageway of North Road require major realignments involving reverse curves of about 90 metres radius and grades in excess of 6%. (Emerging from under the overpass Huntingdale Road needs to turn sharp left then sharp right whilst climbing at an average grade of 5.75% to pass over the new rail lines. Provision of vertical curves will increase the maximum grade to more than 6% and sight distances may be a problem)
- The Huntingdale Road realignments will eliminate the car parking in the semicircular zone south east of the overpass.

Once the proposed railway is established in a slot in the North Road central reservation it needs to climb at 1 in 46 continuously for 1.6 km in order to pass over the Princes Highway. Implementation of this option would result in the loss of road crossings of the central reservation except for Clayton Road and Beleura Grove including:

- Fenton Street – Milgate Street
- Franklin Street
- Lerina Street
- Flora Road
- Greta Street

(Clayton Road width cannot exceed about 27 metres.)

Alternatively, the climb can be delayed to a point 100 metres east of Fenton and Milgate Streets then climbing at 1 in 33. This permits retention of the

Fenton Street-Milgate Street crossing and, with some regrading of North Road, Franklin Street could also be retained.

Passing over the westbound carriageway

This would require a gradient of 1 in 17 and is therefore not a workable option.

Options based on a junction with the main lines between Oakleigh and Huntingdale.

Passing over the North Road eastbound carriageway

This is achievable with relatively easy grades because of the available length over which the necessary levels can be achieved. The alignment is quite constrained as it runs over the Huntingdale Road approach to the Huntingdale overpass. Here it runs over the Huntingdale Road access to the North Road eastbound carriageway but rail level is sufficiently high that access can be maintained with suitable placement of piers. There would also be minimal impact on the car parking space at Huntingdale station.

Passing under the North Road eastbound carriageway

Passage under rather than over is also achievable. The approach grade from a junction between Oakleigh and Huntingdale will be easier due to the grade on the main line between Huntingdale and the proposed junction. Passage under the North Road brings the same limitations described above where entry to the central reservation was below the westbound carriageway.

Crossing at Princes Highway

The only feasible solution was considered to be an elevated crossing displaced northwards from the North Road-Wellington Road alignment. This enables 60 metre spans to be used. This solution, apart from limiting the span length required to cross the Princes Highway, also provides the opportunity to provide a station adjacent to Wellington Road within the University campus.

Alignment at Monash University

Above-ground options

Two options were examined within the university campus. Both are technically feasible but result in some loss of facilities adjoining buildings close to the alignment.

The first of the options brings the alignment as close to Wellington Road as possible and passing in front of the Monash International building. A walled enclosure at the front of the building would be affected. The railway would remain elevated through the adjoining car parking areas until after the Main Entrance / East Ring Road was

crossed and would re-join the Wellington Road central reservation immediately east of the main entrance.

The other option is to run parallel with the South Ring Road, passing between it and the Japanese Studies Centre. This would affect the Japanese garden adjoining the Japanese Studies Centre.

This alignment would entail re-joining the Wellington Road central reservation in a similar location to that of the first option.

Below ground option

Using an alignment similar to the one passing near the Japanese Studies Centre and using a grade of 1 in 40, it is possible to pass below the surface levels of the Japanese Garden, the adjoining Ring Road South and the bus terminal. This would permit a Monash station in cut at the northern end of the bus terminal.

East of the station another 1 in 40 grade would permit the railway to pass under the main entrance roadway. Due to existing road and natural surface levels it is not feasible to remain below the surface but a 1 in 50 rising grade will permit the Wellington Road central reservation to be re-joined by means of a flyover.

Crossing at South Eastern Freeway

The selected grade line at the crossing of the South Eastern Freeway is close to that of Wellington Road. Bridge spans and their locations will be dictated by those of the adjacent road bridges. Bridge soffit levels will be based on maintaining the clearances provided by the road bridges and this will result in the grade line being approximately 1.5 metres higher than the northern road bridges.

Crossing at Dandenong Creek

The road bridges at the Dandenong Creek crossing are too close together to enable the railway to use the central reservation. The rapid fall of the natural ground levels east of Waverley Park dictates that the railway must leave its slot approximately 250 metres west of Jackson’s Road. From Jackson’s Road the selected grade is 1 in 36 in order to minimise the visual impact of this elevated section of the line. This provides the opportunity to leave the central reservation immediately west of the Dandenong Creek and to run south of Wellington Road.

Crossing of Proposed Mitcham to Frankston Freeway Alignment

The available information on the proposed freeway indicates that it will have to be crossed about 200 metres south of Wellington Road in order to clear ramps from Wellington Road. It must then return to about 30 metres from Wellington Road approaching Myer Place. A grade of 1 in 40 enables the railway to re-enter the slot and pass under Myer Place.

Alignment at proposed Rowville Parkway station

The alignment will occupy a strip of the SPI Powernet Victoria Terminal Station land close to the westbound carriageway of Wellington Road.

Entry to Stud Road from Rowville Parkway

Leaving Rowville Parkway Station, the alignment needs to swing away from Wellington Road to about 80 metres south of Wellington Road centreline in order to achieve a satisfactory passage over or under the Wellington Road – Stud Road intersection. If passing under, the alignment can pass through the slip road taking northbound traffic from Wellington Road into Stud Road. If passing over, the alignment would be better encroaching on the car parking of the Stamford Hotel.

Passage under the intersection is not preferred because of drainage problems which would be encountered in the north-eastern corner of the substation land and because of the steep gradients then required to proceed north along Stud Road.

Adopting the preferred passage over the intersection, the alignment crosses Wellington Road west of the intersection and both carriageways of Stud Road north of the intersection. This requires a gradient of 1 in 30. Thereafter it runs parallel with Stud Road approximately 30 metres east of its centreline.

Alignment to Stud Park Station

Two options have been presented. One continues to climb at 1 in 48 to cross above Turramurra Drive and the first road entrance to Stud Park Shopping Centre and terminates in the region immediately north of Safeway at a height above car park level varying from 7 metres to 10 metres. There is no opportunity to reduce this height significantly.

The other falls at 1 in 34 to pass under Turramurra drive and then climbs at 1 in 33 to terminate in the car parking area at depths ranging from 6 metres to 4 metres measured to the top of the rails.

Miscellaneous considerations

Stations at crests in the grade line

It is recognised that there are operational benefits in having stations located on crests rather than in sags. Other considerations have dictated the grade line over most of the route however; each of the stations meets the objective fairly well. Monash University is approached by a falling grade from the west and a rising grade from the east. Mulgrave (Springvale Road) station is approached by a rising grade from the west apart from the last 200 metres. The approach from the east is rising. Waverley Park is ideally placed with grades falling immediately in both directions and Rowville Parkway, although approached by a long down grade from the west has the last 200

metres rising at 1 in 33. The approach from Stud Road is adverse, falling at 1 in 30. Stud Park station is approached under both above and below-ground options by rising grades.

Protection of electrical equipment in below ground sections

Where the railway is in open slot, special provision will need to be made to protect trespassers from coming into contact with the overhead electrical equipment.

6. Cost Estimates

Methodology

The methodology used to establish cost estimates in this study has several elements. In relation to Light Rail options, there are several recent contracts that have been completed in Melbourne for the cost of Light Rail extensions in roadways. These projects have predictable costs per kilometre.

Cost estimation for the Huntingdale to Rowville Heavy Rail option began with careful consideration of the topography of the ground, the engineering problems associated with avoiding at grade crossings with the north-south arterial roads that cross the route, and analysing options, where they seemed to exist, for different approaches to the junction with the Dandenong line and other necessary structures.

Accommodation of grade separation and a typical grade of 1 in 50 made it clear that in the section of the line between Huntingdale and Springvale Road, it is not feasible for the line to be alternately on the surface and then elevated. This section will require elevated construction throughout.

Once the vertical and horizontal alignment of the line had been determined, a description of the line was then prepared, and benchmarking similar rail projects was employed to establish cost estimates.

In recent years, rail construction expertise has advanced rapidly, and several recent rail construction projects have been tendered and/or completed at extremely competitive rates. The final construction cost of this project will not be determined by the estimates, but by the extent to which strong competition exists when the project is tendered.

It has been beyond the scope of this project to recommend a tendering philosophy. We note however that several recent rail projects have included design and construct elements. Alliance contracting has also been used on new rail construction projects, and has delivered benefits in terms of cost and timely completion of works. Such forms of contracting encourage tenderers to suggest innovative solutions to design problems, and could result in design options that are more cost-effective than the approaches that form the basis of this report. However, we are confident that the estimates we have provided meet the objective of providing Council with an indication of the likely costs of a project of this nature, based on the limited level of engineering analysis commensurate with the scope and scale of the current study.

Estimated Construction Costs

Summary of Estimated Construction Costs

Item	**Option 1A**	**Option 1B**
Direct railway construction costs:		
Elevated double track flyover junction, Huntingdale	50	50
Track construction including:		
civil works, track, bridges		
electrical works	338.1	282.9
4 stations		20
5 stations	25	
Total construction cost	**413.1**	**352.9**
Related civil construction costs:		
Train stabling facility at Oakleigh	4	4
Park and Ride Rowville - acquisition of land	10	10
Park and Ride Rowville - construction	4	4
Guardrails within median strip - 3.0km	2	2
Roadworks -North, Wellington & Stud Rds	15	15
Compensation	10	10
Acquisition of 6 train sets		
Purchase of 6 x Xtrapolis sets @ $12m	72	72

7. Findings and Recommendations

The team submits the following findings and recommendations to Council in relation to the matters it has investigated:

Technical Feasibility

7.1 Feasibility of a Heavy Rail Link from Huntingdale to Rowville. The team finds that a feasible alignment can be identified mainly on public land between Huntingdale Station on the Dandenong line, and Stud Park in Rowville, on which a Heavy Rail link could be constructed, as a single line with passing loops.

7.2 Ruling Grade and Maximum Curvature. A Heavy Rail link can be constructed from Huntingdale to Rowville with a typical grade of 1 in 50, and with a minimum curve radius of 200 metres. These parameters are comparable with those on similar existing suburban railways in Melbourne, including the Glen Waverley line, and are consistent with the desired journey time from Rowville to the CBD of 30 minutes being achieved. Alternatively, a more inexpensive construction can be achieved by adopting a typical grade of 1 in 33. The latter choice has a small cost in terms of additional journey time and operating cost.

7.3 Service Levels. Four trains per hour can be provided to Rowville and fitted within the service patterns of the suburban train system, providing some re-organisation of services, which the team has investigated, are implemented, particularly the re-routing of some trains from the Dandenong and Frankston lines to Flinders St Direct instead of City Loop.

Benefits

7.4 Journey Times. The project can achieve a Peak Period Journey Time of 30 minutes from Rowville to the Central Business District, greatly improving the typical 80 minute journey currently offered through bus- train connections, and somewhat better than a 50 minute journey by car

7.5 Smart Bus offers no alternative. The journey times available by Heavy Rail are significantly better than those likely to be achieved by the provision of a Smart Bus from Rowville to Huntingdale on North/Wellington Roads. A Smart Bus can provide a transitional option to help develop the public transport market in the area but provides no real alternative ion terms of capacity and speed to the provision of a Heavy Rail service.

7.6 Economic and employment benefits. The project will generate significant employment during construction and subsequently as Rowville and its catchment becomes a more feasible place for businesses to locate and for workers to reside. International experience supports the link between investment in Heavy Rail and economic success for regions and neighbourhoods, due to a variety of links that come into place once a railway is provided.

7.7 Reduced Traffic Congestion. The expected level of patronage is capable of removing 2350 vehicles from the road system in the catchment and is equivalent to the provision of an extra freeway lane. In relation to Monash University Clayton campus, up to 1000 cars are likely to be replaced by rail journeys easing traffic and parking congestion in the campus and releasing university land for higher uses than parking.

7.8 Environmental benefits. Transfer of many thousands of car journeys per day to rail in the Rowville area will significantly decrease environmental pollution and greenhouse gases. These environmental benefits will also translate to health benefits for Rowville citizens in relation to the impact of ailments associated with environmental pollution, such as asthma.

7.9 Social benefits. Residents of outer suburbs such as Rowville with high car dependence are especially vulnerable as world oil price rises in future years. The provision of a transport alternative reduces this vulnerability in general, and in particular assists families for whom car maintenance and petrol absorbs an increasing share of disposable income. The Railway would also provide access to Melbourne and reduce isolation for those citizens of Rowville who cannot or do not wish to drive. This group includes the young, the disabled, and senior citizens who no longer wish to drive in city traffic.

Costs and Issues of Concern

7.10 Cost affected by many crossroads. The route from Huntingdale to Rowville is relatively costly since seven main roads and three freeway routes must be crossed on a grade separated basis.

7.11 Elevated Construction. Since government policy excludes the construction of grade crossings, and in the interests of public safety and access to local streets, the proposal is for elevated construction on circular pylons, placed at 30 and sometimes 60 metre intervals. This will permit the retention of planted median strips.

7.12 Urban Design. A modern railway with elevated structures can be constructed with an attractive appearance that enhances urban design and provides a “high technology” theme that is consistent with the role

of the areas surrounding Monash University. However the team notes that urban design has subjective elements and some stakeholders may not find these structures attractive.

7.13 Direct Costs. The study estimates that construction of the line would cost between $350 and $420 million, depending on the precise option adopted. This cost would be exclusive of rolling stock and stabling costs that could be attributed to the project. These amount to some $66 to $116m depending on whether rolling stock is leased or purchased. Operating costs would also have to be funded in future years. It is to be anticipated that the State Government would conduct benefit/cost analysis of this project in comparison to other Heavy Rail projects in order to determine the priority that it might attach to such a project.

7.14 Further studies and processes needed. The team considers the following further studies and processes (which were not part of the current brief) would be appropriate for Council to consider:

7.16.1 **Community consultation**, to engage with the relevant communities (including Rowville residents, catchment residents, and traders, regarding this project and the community's preferences;

7.16.2 **Consultation with Monash City Council** to determine whether an approach can be developed that can accommodate issues raised by MCC regarding urban design and the role of buses;

7.16.3. **Further development of engineering cost estimates.**

7.16.4. **Preparation of a Business Case** and a formal benefit/cost analysis.

7.16.5 **Urban Design Studies** in conjunction with Monash City Council to establish design principles for the project acceptable to both councils